UNDERSTANDING STUDENTS' TECHNOLOGY APPROPRIATION AND LEARNING PERCEPTIONS IN ONLINE LEARNING ENVIRONMENTS

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by

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DEDICATION

With a grateful heart I dedicate this dissertation to my parents, Jen-Chih Lin and Kuei-Lan Shao, and my younger brother, Ming-Hsien Lin. Without their unconditional love, support, and encouragement, I could never have achieved the many accomplishments I have attained in my academic and professional career.

Dad and Mom, I am blessed to be your daughter.
Ming-Hsien, I am blessed to be your sister.
I love you!

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UNDERSTANDING STUDENTS' TECHNOLOGY APPROPRIATION AND LEARNING PERCEPTIONS IN ONLINE LEARNING ENVIRONMENTS

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ABSTRACT

Distance education has the unique characteristic of using technologies as the primary means of delivery of instruction and interaction. The present study contributes to research dedicated to explaining or predicting phenomena related to distance education, and has four objectives: (1) to identify specific social and technological factors affecting online students' behavior of using technology, (2) to conceptualize a theoretical model to better represent the relationships among the salient factors, (3) to examine how the elements in the theoretical model influence students' learning perceptions and satisfaction in the distance education program, and (4) to compare the proposed model with prior work to model and explain online behavior and satisfaction.

For the purpose of advancing understanding of the roles of social and technological factors in a distance learning environment, this study proposed a unified theoretical model based upon four attitude-behavior models, the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and the decomposed TPB. By reviewing and identifying salient factors in each model, this study attempts to construct a measurable Unified Model of Technology Appropriation (UMTA) integrating the identified factors so as to best overcome the limitations of each model.

The study investigated a distance education program providing both a physical and virtual place to support enrolled students in a Midwest state university to learn knowledge and skills by doing. Instructional materials and supports were delivered through a network-based learning system as well as other communication tools. Data collection included self-report questionnaires and computer-recorded system usage data.

Among the statistically significant paths found in UMTA, subjective norm (instructor/mentor/peer influence) had the strongest relationship to students' technology appropriation behavior, while perceived behavioral control (self-efficacy and technology/resource facilitating conditions) had the strongest impact on students' satisfaction. These findings have important implications for system designers, online educators, and distance education program managers. In order to reduce students' frustration, not only online instructors but also program managers need to provide and assure the availability of external supports including mentoring and technical supports. System designers, on the other hand, have to enhance the system's ease of use through good design and by providing clear instructions. Results of the present study should help to better manage online courses by focusing attention on social influences and control factors in a distance education program.

CHAPTER I

Introduction

Overview

According to the National Center for Education Statistics (NCES, 2003) Postsecondary Education Quick Information System (PEQIS), 55 percent (2,280) of all 2-year and 4-year Title IV-eligible, degree-granting institutions offered credit-granting distance education at either the undergraduate or graduate/first-professional level during the 12-month 2000-2001 academic year. Among these 4,130 institutions offering distance education courses for any level of audiences, 90 percent reported that they use asynchronous instruction. Of the institutions that offered distance education courses in 2000-2001 (2,320) or that planned to offer distance education courses in the next 3 years (490), 88 percent indicated plans to start using or increase the use of asynchronous computer-based instruction as a primary mode of instructional delivery for distance education courses.

The rise of distance education programs has prompted research into the effects on students (Wheeler, 2002; Lim; 2002) such as their satisfaction, appreciation and engagement toward learning, and into the acceptance and continuing implementation of technical systems (e.g., Pumareja & Sikkel, 2002; Brown, 2002). Distance education has the unique characteristic of using technologies as the primary means of delivery of instruction and interaction (Miltiadou & Savenye, 2003). Technology implementation within a social context brings challenges including that it is hard to anticipate or predict in advance how the technology will be accepted and used (Norman, 1993; Pumareja & Klaas, 2002). The Socio-Technical System Theory provides a framework for

understanding the implementation of technologies as a dynamic process of adaptation and acceptance between two systems, the technology and the group of people using this technology. Pumareja & Klaas (2002) proposed a socio-technical dynamics model (Figure 1.1) to depict the inter-relationships among 3 variable groups: technical variables, social variables, and interaction outcome variables. These 3 sets of variables constitute the primary analytical framework for this empirical study. In the context of distance learning, information technology (i.e., groupware, courseware) is the primary technological tool that delivers courses and mediates interactions. Other technical tools may include email, real-time communication tools, etc. The social elements in the environment include individual students, supports, course structures and assignments, and interactions among those elements. These social elements and technical tools are highly interdependent. For instance, if the majority of students dislike the courseware, they will seek other technical tools to fulfill their needs. Similarly, the characteristics of the courseware also shape the way students interact and come to know each other.

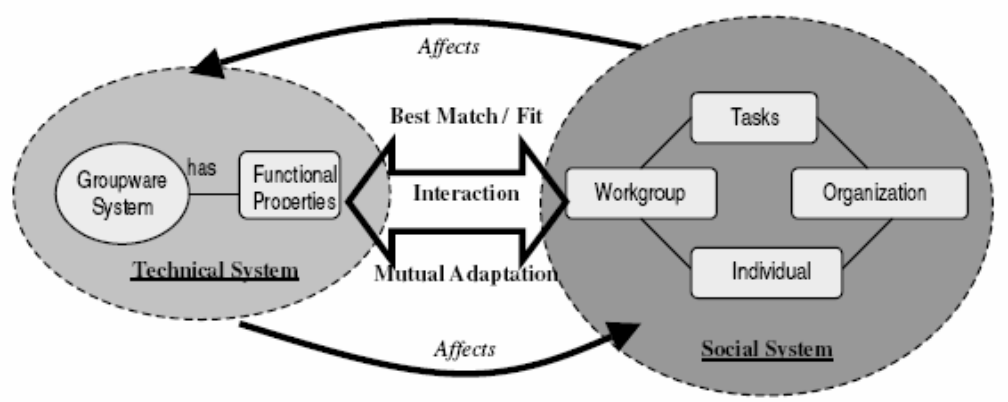

Figure 1.1. Socio-technical dynamics model (reproduced from Pumareja & Sikkel, 2002, p. 16)

Although STST provides a theoretical perspective for systematically understanding the complexity of socio-technical systems for academic users, it does not offer "a ready made set of alternative methods of involvement or of measurement" (Dillon, 2000, p. 124). In addition, most STST research is narrative, which makes it hard to confirm theoretical postulations about relationships among the factors. As a result, for the purpose of advancing understanding of the roles of social and technological factors in a distance learning environment, this study proposes a unified theoretical model based upon four attitude-behavior models, the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and the decomposed TPB. By reviewing and identifying salient factors in each model, this study attempts to construct a measurable path model integrating the identified factors so as to best overcome the limitations of each model. This study will advance and test theory for representing and understanding the social and technical aspects of distance education.

TRA was proposed by Fishbein and Ajzen (1975) to predict and explain consciously intended behavior. TRA posits that an individual's behavioral intention is a function of his/her attitude and social norms. Behavioral intention, in turn affects a person's behavior. TRA has been shown to have good explanatory power across a variety of domains; however, it should be recognized that TRA is designed explicitly to explain volitional behaviors (Ajzen, 1988). To overcome this limitation, Ajzen (1985) modified TRA by including a third determinant of an individual's behavioral control, perceived behavioral control, and termed it TPB. Perceived behavioral control refers to an individual's perceptions and assessment of one's own capabilities and resources required to perform a behavior (Ajzen, 1991). TRA and TPB have been examined in various

domains such as exercise and diet (Bagozzi & Kimmel, 1995), online shopping (Park, 2003), and organizations (Hartwick & Barki, 1994). Hypothetically, these two models can be used to explain any human behavior.

TAM, proposed by Davis (1989), on the other hand, is a model that specifically applies to technology usage behavior. According to TAM, one's intention of using a technological tool is determined by one's attitude toward using the tool to perform a certain behavior and perceptions of the usefulness of the tool. Perceived usefulness and perceived ease of use are two antecedents that determine one's attitude. Social norms as well as other control beliefs are considered to be external factors that are mediated through one's perceptions of usefulness and ease of use. Mathieson (1991) compared both TAM and TPB in predicting students' intention of using spreadsheets and computers; she found that although TAM only explained somewhat more variance (69%) of intention than TPB did (62%), it explained students' attitudes much better (72% vs. 41%). Her findings support decomposing the attitudinal beliefs into two construct, perceived ease of use and perceived usefulness. Thus, the decomposed model (i.e. TAM) is hypothesized to have better explanatory power than TPB. Taylor and Todd (1995) further explained that TPB was limited by its' unidimensional view toward the beliefs structures and the determinants of intention. Therefore, they decomposed the 3 determinants of behavioral intention; subjective norms, perceived behavioral control, and attitude, and termed it the decomposed TPB (DTPB). Their results indicate that the DTPB explains more variance as well as provides a more complete understanding of technology usage behavior.

While empirical IT research has explicitly examined and supported TRA, TPB, and TAM, scholars such as Bagozzi and Kimmel (1995) and Perugini and Conner (2000)

argue that constructs like subjective norms, perceived behavioral controls, and attitudes cannot fully explain behavioral intentions and technology usage behavior if the target behavior is instrumental to larger goal achievement. For example, in the context of self-paced online learning, if a student's goal of taking an online course is to get a good grade, (s)he will be more likely to use the primary technological tool, the courseware, regardless of others' expectations (i.e., subjective norms) and one's own attitude and competency. Thus, for the purpose of constructing a theoretical model to better understand the dynamic relationships among social and technical systems in distance education, the present study not only decomposes the salient factors identified from the four models but also incorporates the motivational perspective in the model.

Purpose of the Study

Starting in the Summer of 2003, the School of Information Science and Learning Technologies at the University of Missouri-Columbia began offering credit-granting courses including the Digital Media Certificate and a masters degree in educational technology primarily through the Zone. The Zone is both a physical and virtual place that supports enrolled students learning knowledge and skills by doing. Unlike conventional courses, there are no regular class meetings for Zone courses. Instructional materials are delivered through the Shadow netWorkspace™ (SNS) as well as other communication tools. SNS is a web application system that allows a learning community to establish an intranet with network workspaces and communication tools for all members and groups. Different from most other distance education programs, enrolled students in the Zone having physical access to the campus can go to the Zone computer lab and use the hardware, software, books, and other supplements there. In its efforts of narrowing what

Moore and Kearsley (1996) called the "transactional distance" with the enrolled students, the Zone provides help and supports through diverse technologies including the telephone, real-time chat, message boards, email, and video conferencing. Moreover, the Zone is experimenting with *ZONE Live!* , a live Internet radio call-in show, where students can call in with questions or send questions prior to the show and listen to discussions regarding topics in Zone courses.

This study examines the ways students participate in the online courses and how they perceive both social and technical systems during their coursework. The objectives of this study are fourfold: (1) to identify specific social and technological factors affecting students' behavior of using technology, (2) to conceptualize a theoretical structural model based upon the reviewed literature so as to best represent the relationships in socio-technical online learning environments, (3) to examine how the elements in the proposed model influence students' learning and satisfaction in distance learning, and (4) to compare the power of the four models, TRA, TPB, TAM, and the proposed model for understanding and explaining students' behavior and satisfaction.

Research Questions

1. What are the factors that significantly influence students' intention of using the technology, technology appropriation behavior, and satisfaction in online learning environments?
2. How does the proposed model, United Model of Technology Appropriation (UMTA), compare with TRA, TPB, and TAM for explaining the variances of students' behavioral intention, technology appropriation behavior, and satisfaction?

Based upon the findings of empirical TAM and DTPB studies, it is anticipated that the decomposed constructs of subjective norms, perceived behavioral control, and attitude and one's motivational perceptions in UMTA will best explain and predict students' technology appropriation and utilization in the online learning environments.

Assumptions

The researcher made the following assumptions while conducting the study:

1. All participants responded to the questionnaires honestly.
2. Participants' responses were independent of each other.
3. Participants' learning experiences were the outcomes of participation in the physical and virtual Zone environments.
4. All participants had sufficient opportunities of using needed resources and supports provided through the Zone regardless of the constraint of geography.

Professional Significance of This Study

The methodology and findings of this study have implications for theory building, research methodology, and practical implementations of technology mediated distance learning. First of all, unlike most STST research which uses a narrative methodology, this study constructs a measurable structural model as an attempt to wholistically understand why and how the social and technological elements in distance education programs relate to each other and affect students' technology appropriation behavior, learning and satisfaction. Second, this study identifies salient social and technological factors based upon a series of social psychological models that have been widely examined in the IT area and develops a more comprehensive model to better explain students' technology behavior. In addition, findings of this study should help broaden the scope and overcome

some common limitations of the existing related research. Furthermore, since the path between students' behavior and satisfaction was found significant after the data analysis, the instrumentation supports further research in the area of connecting technology usage and distance learning effectiveness studies.

By operationalizing the specific constructs depicted in UMTA, this study provides a measurable and shareable understanding of the individual, social, and technological characteristics that affect students' behavior and perceptions in educational settings similar to the Zone. Moreover, the findings of this study have potential to contribute to improvements in technological tools, learning supports, and pedagogical strategies.

Chapter Summary

Chapter I describes the purposes and research questions of this study. The rationale of the proposed unified model is explained. Chapter II reviews the underlying theoretical perspectives and research of the proposed model. It also depicts the proposed UMTA model based on reviewed literature. Chapter III outlines the research design and procedure, data collection, and data analyses.

Abbreviations

STST

The social-technical systems theory seeks to describe the dynamic nature of technical systems, social systems, and interaction outcomes.

TAM

The technology acceptance model explains individuals' intention to use technology through two beliefs, perceived ease of use and perceived usefulness. This is the most widely cited model to explicate technology acceptance.

TRA

The theory of reasoned action postulates that individuals' behavior is determined by their intention to perform a specified behavior. Their intention is, in turn, a function of their attitudes toward the behavior and subjective norms.

TPB

The theory of planned behavior is an extension of the theory of reasoned action to account for non-volitional control conditions.

DTPB

The decomposed theory of planned behavior seeks to use a multidimensional view to understand the antecedents of behavioral intention.

MGDB

The model of goal directed behavior is proposed by Bagozzi (1992), which incorporates the motivational state of mind into TPB.

UMTA

The unified model of technology appropriation integrates critical antecedents across TAM, TRA, TPB, and DTPB, and adds a fourth dimension, motivation, to fuller understand individual's intention to use, use behavior, and satisfaction in online learning environments.

SNS

Shadow netWorkspace™ is a web-based collaborative system designed and developed at the University of Missouri-Columbia to support online learning community.

Definition of Terms

The following terms are defined within the confines of this study.

1. Attitude: a student's positive or negative feelings about performing a target behavior (Fishbein & Ajzen, 1975).
2. Perceived ease of use: the degree to which students believe that using SNS would be free of effort (Davis, 1989).
3. Perceived usefulness: the degree to which students believe that using SNS would enhance their performance (Davis, 1989).
4. Subjective norms: students' perceived social pressures or expectations from salient referents including instructors, mentors, and peers in the Zone.
5. Perceived behavioral control: students' assessment of own ability and the availability of external supports required to perform a behavior in their online courses.
6. Self-efficacy: students' judgments of their capabilities to execute a behavior (Bandura, 1997) in their online courses.
7. Resource facilitating conditions: students' assessment of the level of resources available to them. Resources include mentoring, technical supports, additional references, etc.
8. Technology facilitating conditions: students' assessment of the compatibility of technological tools including connection speed, web browsers, operation systems, etc.
9. Task value: students' evaluation of how meaningful, important, and interesting a learning task appears.
10. Behavioral intention: the strength of a student's intention to engage in a specific behavior (Ajzen & Fishbein, 1980) in the online learning environment. It is the

cognitive representation of a student's readiness to perform a given behavior (Ajzen, 2002).

11. Technology appropriation: students' self-report usage of SNS.
12. Technology utilization: students' actual usage of SNS recorded in the SNS server.
13. Satisfaction: a positive emotional and cognitive state resulting from students' learning experience in the online learning environment.

CHAPTER II

Review of Literature

Overview

With the rapid advance of information technology and the increasing use of information technology (IT), a variety of theoretical perspectives have been advanced to explain the use and value of IT to users and organizations. In particular, because of the unique characteristic of using technologies as the primary means of delivery of instruction and interaction in the context of online education (Miltiadou, 2000), understanding the determinants of IT usage should help to ensure effective and efficient teaching and learning as well as improve the deployment of resources (Taylor & Todd, 1995) in an online education program. Among these theoretical perspectives employing attitude-behavioral based models to explain technology acceptance and utilization is of increasing research interest (Taylor & Todd, 1995; Park, 2003). This attitude-behavioral research ties in well to a socio-technical systemic perspective which highlights the importance of examining and understanding "underlying drives and motivations to use tools that supersede concerns with effectiveness and efficiency alone" (Dillon, 2000). Using the tenets of socio-technical systems theory (STST) the objectives of this study are fourfold: (1) to identify specific social and technological factors affecting students' technology use behavior, (2) to conceptualize a theoretical model to better represent the relationships in socio-technical online learning environments, (3) to examine how the elements in the proposed model influence online students' behavior and satisfaction, and (4) to compare the power of the four models, TRA, TPB, TAM, and the proposed UMTA model, for explaining students' behavior and satisfaction.

This chapter begins by reviewing the concept of STST. It then elaborates the theoretical models (TRA, TAM, TPB, and decomposed TPB) and presents empirical studies to identify core elements that can be used to explain students' technology-usage behavior during their learning in online learning environments. A unified model, UMTA, is proposed to integrate the core elements.

Socio-Technical Systems Theory of Technology Acceptance

IT researchers have been searching for an appropriate theoretical perspective to determine critical incidents of individual behavior and technology usage and acceptance:

> *"The field of information systems continues the search for appropriate approaches to information system research that would marry the social and technological aspects in information systems…However, the search for a unifying theoretical foundation for IS research seems to be far from over" (Ditsa, 2003, P. 193).*

STST has been widely applied in the domain of information systems implementation (Dillon, 2000, 2002; Friedrich, Hron, & Hesse, 2001; Joshi, Bostrom, & Perkins, 1986; Kleinman, 2003; Lamb & Kling, 2003; Orlikowski & Lacono, 2001). First introduced by the Tavistock Institute of Human Relations in London, STST tries to provide a guiding framework to describe and explain technology generally (Ropohl, 1999). The STST framework considers a work system to be made up of social and technical subsystems:

> *"The technical system is concerned with processes, tasks and technology to transform inputs to outputs. The social system is concerned with such things as the attributes of people (e.g., attitudes, skills and values), the roles they enact, reward systems and authority structures. The outputs of the work system are the result of joint interactions between these two systems" (Bostrom, 1980, p. 7, as cited in Joshi, Bostrom, & Perkins, 1986).*

In Dillon and Morris' (1996) review of theories and models of users' technology acceptance, they noted that the term 'socio-technical' has been widely applied to any

analysis of a configuration of technology and users (Dillon, 2000). From a socio-technical perspective, researchers should link technical and social issues to explain technological change processes and social behavior (Sawyer et al., 2003). In an attempt to combine socio-technical concepts and usability engineering to the development of information systems, Dillon (2000) asserts that STST "has long emphasized the psychodynamic forces shaping our behavior and the search for control and enhancement of one's position are considered natural phenomena of existence. Such forces are far deeper and more difficult to measure than efficiency etc. yet they are ultimately more powerful in determining our behavior" (p. 121). Control and enhancement are two competing forces in studying technology usage behavior (Eason, 1988). Dillon and Morris (1996) further explain that control factors are those that impose rules or structures on the users, while enhancement factors include mastery, knowledge growth, discretion, ability to act informally, requirement for certain skills, and enabling of worker cooperation.

Although STST provides a wholistic framework to view technology acceptance from both the social and technical attributes of any organization, it does not offer "a ready made set of alternative methods of involvement or of measurement" (Dillon, 2000, p. 124). While control and enhancement forces are intuitively considered as theoretical constructs and used for plausible explanations of acceptance and resistance to new technology, they are "difficult to clearly measure" (Dillon, 2000, p. 125). Hence, borrowing from four theoretical models- TRA, TAM, TPB, and decomposed TPB, grounded in social psychology (Davis, Bagozzi, & Warshaw, 1989), this study attempts to construct a measurable path model to understand and explain both the social and

technical aspects of students' technology appropriation, and the relationships between these aspects and learning and satisfaction outcomes.

Theoretical Models to Understand the Psychology of Technology Acceptance

The Theory of Reasoned Action

The theory of reasoned action (TRA) proposed by social psychologists, Fishbein and Ajzen (1975), is a widely studied model to predict and understand consciously intended behaviors (Chau, 1996; Davis et al., 1989; Karahanna, Straub, & Chervany, 1999; Venkatesh & Smith, 1999). According to TRA, an individual's behavior is determined by his or her behavioral intention which is a function of the person's attitudes and subjective norm (Figure 2.1). Behavioral intention is the strength of one's intention to perform a specified behavior (Davis et al., 1989; Dillon & Morris, 1996). Attitude is defined as "an individual's positive or negative feelings (evaluative affect) about performing the target behavior " (Davis et al., 1989), whereas subjective norm refers to "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 302).

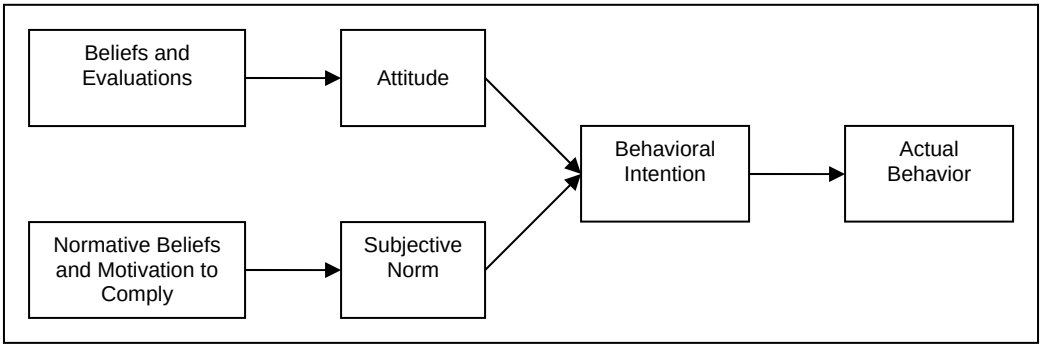

Figure 2.1. Theory of reasoned action (TRA)

Attitudinal beliefs are defined as an individual's subjective probability that performing a given behavior will result in a specific consequence. The evaluations refer to "an implicit evaluative response" (Fishbein & Ajzen, 1975, p. 216). Using a mathematical function to depict the relationship between attitudinal beliefs and one's attitude, Karahanna et al. (1999) described that "attitude is derived by the strength of the person's beliefs that adopting the IT will lead to certain consequences, each weighted by the evaluation of each belief's behavioral consequences" (p. 187). An individual's subjective norm, on the other hand, is determined by "a multiplicative function of his or her normative beliefs, i.e., perceived expectations of specific referent individuals or groups, and his or her motivation to comply with these expectations" (Davis et al., 1989). TRA asserts that any other factors (e.g., user characteristics, personality variables, system characteristics, task characteristics, organizational structure, etc.), which Fishbein and Ajzen (1975) refer to as 'external variables', only indirectly influence behavior through mediators, attitude and subjective norm. In other words, "TRA mediates the impact of uncontrollable environmental variables and controllable interventions on user behavior" (Davis et al., 1989).

This model has been proven to have good prediction power across a variety of domains. For example, Davis et al. (1989) used TRA to explain 107 full-time MBA students' usage of WriteOne, a word processing program, and found that TRA accounted for 32% of the variance at the beginning of their investigation period and 26% of the variance 14 weeks later. In their meta-analysis of 86 TRA studies, Sheppard et al. (1988) concluded that TRA has a strong predictive utility across a variety of situations and activities. On average, behavioral intentions and actual behavior has a significant

correlation of .53, and significant correlation of .66 for the prediction of behavioral intentions from attitude and subjective norm. However, TRA is designed "to explain virtually any human behavior" (Ajzen & Fishbein, 1980, p. 4), and explicitly "to deal with purely volitional behaviors" (Ajzen, 1988, p. 127). As a result, TRA may only usefully predict behaviors under volitional control (Armitage & Conner, 1999; Davis et al., 1989; Park, 2003). The model fails to account for external constraints, for example, if a student forms a positive attitude toward tablet PCs after seeing his friend's demonstration, he may still not be able to use a tablet PC if he does not have money to buy one.

In summary, TRA is a model that postulates the causal relationships among a set of beliefs, attitude, subjective norms, and behavioral intention. An individual's behavior is determined by the person's behavioral intention, which is, in turn, determined by his or her attitude toward performing the behavior and subjective norms (social influence) regarding the certain behavior. If people as well as their important others perceive the outcome of performing the behavior as positive, people will be more likely to perform the behavior. The primary constructs of one's behavior intention are volitional in this model. Thus, TRA has limitations for explaining behavior that is not completely under volitional control. Even though one is highly motivated by positive attitudes and norms, the person may not actually perform the behavior because of intervening environmental conditions (Hubbard & Davis, 2002).

The Technology Acceptance Model

While TRA is a general model that is applicable to various domains related to human behavior, Davis (1989) posits the technology acceptance model (TAM) which is

the most widely cited MIS-specific model (Adams, Nelson, & Todd, 1992; Arbaugh, 2000, 2002; Dillon, 2002; Dillon & Morris, 1996; Goodhue, 1995; Hubona & Whisenand, 1995; Hwang & Yi, 2002) to explicate technology acceptance. TAM is a powerful and parsimonious model using two belief factors, perceived usefulness and perceived ease of use, to represent and predict technology usage behavior. Technology acceptance is defined as "the demonstrable willingness within a user group to employ IT for the tasks it is designed to support" (Dillon & Morris, 1996). According to Compeau, Higgins, and Huff (1999), technology use behavior is "viewed as the result of a set of beliefs about technology and a set of affective responses to the behavior" (p. 146).

Davis (1989) defines perceived usefulness as the extent to which "people believe that the technology will help them perform their job better" (p. 320), while perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (p. 320). A user's attitude toward technology usage is defined as feelings of favorableness or unfavorableness toward the technology. Behavioral intention is defined as the extent to which an individual intends to use the technology to perform a specific behavior. According to TAM, the easier and more useful the technology is perceived, the more positive one's attitude and intention toward using the technology (Taylor & Todd, 1995). The Technology Acceptance Model (Davis, 1989), as presented in Figure 2.2, is an adaptation of the Theory of Reasoned Action (Fishbein & Ajzen, 1975), with only two belief factors as determinants of attitude toward behavior intention and technology usage. According to TAM, attitude is determined jointly by perceived usefulness and perceived ease of use. Additionally, ease of use is modeled as a direct determinant of perceived usefulness. The impact of 'external factors' mentioned in TAM

(Davis et al., 1989) is mediated through perceived usefulness, perceived ease of use, attitude, and behavioral intention to an actual behavior.

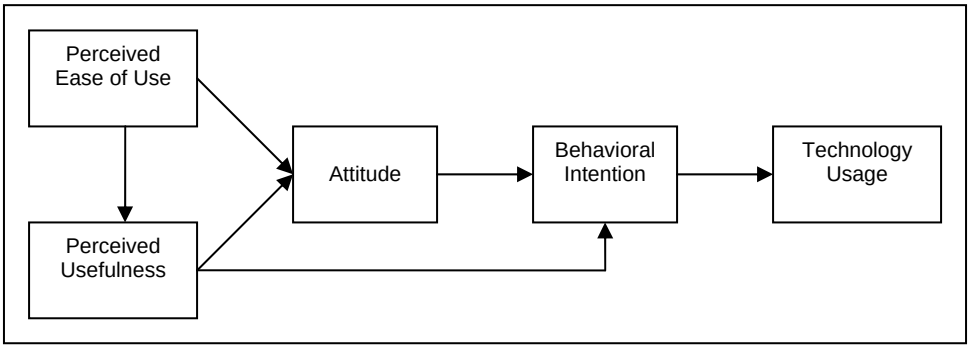

Figure 2.2. Technology acceptance model (TAM)

Similar to TRA, TAM contends that the behavior of using technology is directly influenced through one's behavioral intention. However, different from TRA, behavioral intention is a weighted function of attitudes and perceived usefulness of a certain technology. TAM doesn't include TRA's subjective norm to predict an individual's intention of using the IT because of concerns for its "uncertain theoretical and psychometric status" (Davis et al., 1989). Rather, it adds a direct linkage from perceived usefulness to intention. This assertion of TAM violates the basic assumption of TRA that the relationship between beliefs and behavioral intention is completely mediated by one's attitude (Taylor & Todd, 1995). According to Davis et al. (1989), the reason for this violation is that in organizations, people's intention of using IT may be based on their perceived usefulness of using the IT to increase their job performance regardless of their overall attitude.

Use of TAM has been replicated and validated within different computer settings and has been found to be a robust model for technology usage prediction (e.g., Adams et

al., 1992; Taylor & Todd, 1995; Szajna, 1996; Venkatesh & Davis, 1996; Lee et al., 2003). For example, in Davis' (1989) study of evaluating two IBM PC-based graphics systems, 40 volunteer MBA students were given one hour of hands-on experience with these two systems. He found that when the data were pooled across two systems, usage significantly correlated .85 with perceived usefulness and .59 with perceived ease of use. In addition, one of the most significant findings was that perceived usefulness was significantly more strongly correlated to user acceptance than was perceived ease of use. Adams et al. (1992) used TAM to investigate both usage of voice-mail and e-mail. Usage was measured through users' self-reported reflection on the number of messages they sent and received on the previous working day and on a typical day. The results of the studies also support that perceived usefulness and perceived ease of use are determinants of users' technology usage. Similar to Davis' (1989) findings, they found that perceived usefulness (R^2=.41) had more impact on usage than perceived ease of use (R^2=.33).

While Davis (1989) concluded that perceived ease of use "may be an antecedent to usefulness, rather than a parallel, direct determinant of usage" (p.319), in a later study conducted by Venkatesh and Davis (1996) and some recent studies on web-based technologies, perceived ease of use becomes a more important component on usage of and intentions to use technologies (e.g., Liu and Arnett, 2000; Wang, et al., 2001; Brown, 2002; Lim, 2002). According to Brown (2002), "web-based technologies are designed to facilitate the learning process, and therefore, their perceived ease of use is a definite necessity, especially where the learners have only recently been introduced to computer and Internet" (p. 3). Moreover, more effect of the perceived ease of use on the technology

usage may emphasize the importance of the user-friendly nature of information systems that are used in academic institutions (Lim, 2002).

To sum up, according to TAM, perceived usefulness and perceived ease of use are the primary constructs that affect one's feelings (attitude) toward an IT which directly impacts the person's intention of using the IT and actual use. In addition, perceived usefulness is positively related to one's intention and mediates the effect of perceived ease of use on behavioral intention to use (Lee, Cho, Gay, Davidson, & Ingraffea, 2003). In this case, if people perceive positive consequence of using an IT to perform tasks whether or not they like it, they will be more likely to use the IT. Also, if they perceive the IT to be easier to use, they will be more likely to accept the IT. Recent findings on the relationship among the antecedents in TAM suggest that not only perceived usefulness but also perceived ease of use have direct impacts on attitude and behavioral intention. Arbaugh (2000) contends that TAM is particularly helpful for predicting whether and why learning takes place in an Internet based course. Applying TAM to the context of learning in the Zone, it is believed that higher levels of perceived usefulness and the ease of use of the courseware will enhance students' attitudes toward their course experience.

The Theory of Planned Behavior

As discussed in the aforementioned review, TRA shows good prediction when applied to behaviors that are under an individual's volitional control. To account for non-volitional conditions, Ajzen (1985) modified TRA by including a third construct, perceived behavioral control, as a determinant of behavioral intention. This extended model of TRA is termed as the theory of planned behavior (TPB). Perceived behavioral control refers to an individual's perceptions and assessment of one's own capabilities and

resources required to perform a behavior (Ajzen, 1991). In other words, perceived behavioral control is determined by "the availability of skills, resources, and opportunities as well as their perceived importance to achieve outcomes" (Dillon & Morris, 1996). In its second version of TPB, Ajzen and Madden (1986) proposed that perceived behavioral control may have a direct impact on performed behavior. They argued that perceived behavioral control can directly relate to actual behavior when it accurately reflects actual control.

As depicted in Figure 2.3, actual behavior is a weighted function of behavioral intention and perceived behavioral control (Taylor & Todd, 1995), and behavioral intention is determined by attitude, subjective norm, and perceive behavioral control. Similar to attitude and subjective norm that are influenced by behavioral and normative beliefs respectively, control beliefs has a direct relation to one's perceived behavioral control. Control beliefs are "the individual's perception of the extent to which s/he possesses internal and external factors that may increase or decrease the perceived difficulty of performing the behavior" (Armitage & Conner, 1999; Park, 2003). According to Ajzen (1985), internal factors may include variables such as individual differences, skills, abilities, power of will, emotions, and compulsions, while external factors may include time, opportunity, and dependence on others.

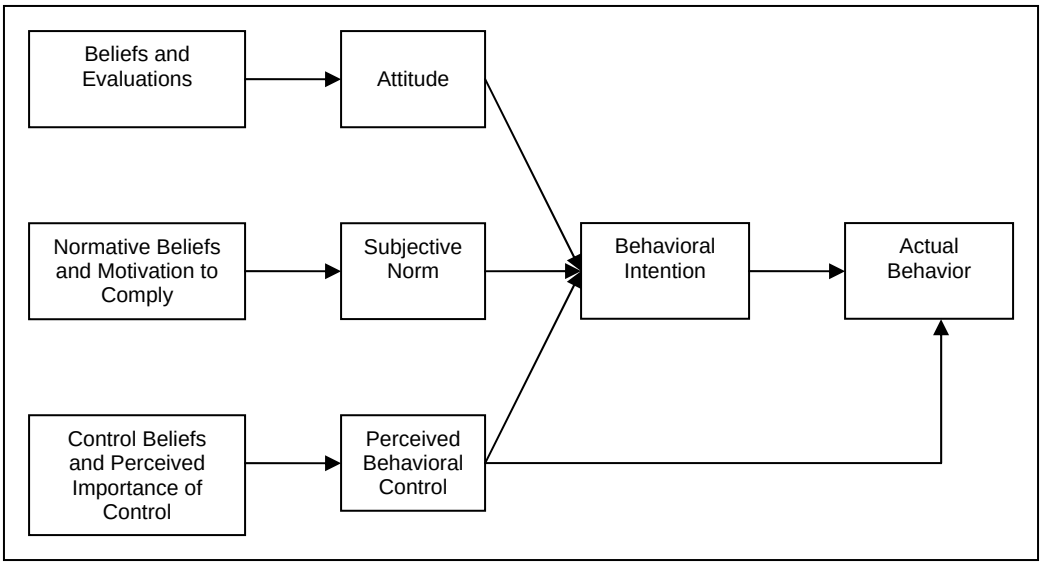

Figure 2.3. Theory of planned behavior (TPB)

Since Ajzen's introduction of TPB in 1985, a series of narrative and quantitative reviews (e.g., Ajzen, 1991; Ajzen & Madden, 1986; Godin & Kok, 1996; Mathieson, 1991; Conner & Sparks, 1996; Armitage & Connor, 2001; Taylor & Todd, 1995; Hubbard & Davis, 2002) have provided support for the efficacy of TPB applied in a variety of domains. Findings show that TPB has considerable power in predicting intentions and behaviors. For instance, Goldin and Kok (1996) reported that attitudes, subjective norm, and perceived behavior control explained 41 percent of the variance in behavioral intention, while intention and perceived behavioral control accounted for 34 percent of the variance in actual behaviors. In addition, after assessing the predictive validity and causal ordering of TPB constructs over a 3-month period, Armitage and Conner (1999) concluded that their findings were congruent with other meta-analyses of TPB, and therefore support its predictive utility. Ajzen and Madden (1986) conducted two experimental tests of TPB, involving both students' class attendance and getting an

"A" in a class. They found that perceived behavioral control consistently influenced intentions for the two outcomes, but it only enhanced prediction of actual grades attained. Moreover, Ajzen (1991) assumed that one's beliefs or confidence to successfully perform a behavior may strongly influence the person's actual technology usage behavior. Park (2003) further elaborated Ajzen's proposition through the example of inexperienced and experienced users shopping online. He posited that an inexperienced user who has more confidence in his/her ability to use the Internet is more likely to succeed in shopping online than an unconfident inexperienced person.

However, the results of reviewing TPB in different situations are somewhat mixed. In her study of comparing TAM and TPB, Mathieson (1991) found that although TPB provided more complete explanations of behavioral intention toward using an IS, its predictive power was not better than TAM. In addition, she commented that TAM was easier to apply. To explain why the result is mixed, Davis et al. (1989) indicated that the role of subjective norm as a determinant of IT usage is uncertain. For example, Davis et al. (1989) did not find a significant subjective norm-behavioral intention effect, although they explained that it resulted from the lack of sophisticated methods of developing the subjective norm scale and that the application of the IT itself was fairly personal and individual. They posited that a more multi-person application such as email and group decision support systems will increase the social influence on individuals' behavior. Taylor & Todd (1995) further support this assertion by indicating that "in a setting where actual behavior with real consequences is studied, subjective norm would be expected to be an important determinant of intention and usage" (p. 150).

The Decomposed Theory of Planned Behavior

Taylor and Todd (1995) asserted that because of TPB's unidimensional view toward the belief structures and the determinants of intention (i.e., attitude, subjective norm, and perceived behavioral control), which makes it difficult to operationalize TPB, its meta-analyses show mixed findings for predictive power. In attempting to make TPB consistent and generalizable across different settings, they used a decomposed TPB to examine the specific antecedents to attitude, subjective norm, and perceived behavioral control (Dillon & Morris, 1996). Taylor and Todd summarized the advantages of the decomposed TPB as follows (p. 151):

1. Belief structures, representing a variety of dimensions, will be consistently related to the antecedents of intention.
2. The decomposition can provide a stable set of beliefs which can be applied across a variety of settings.
3. By focusing on specific beliefs, the model becomes more managerially relevant, pointing to specific factors that may influence adoption and usage.
4. The decomposed model introduces a larger number of factors, and this will provide a more complete understanding of IT usage relative to the more parsimonious TAM.

Taylor and Todd's (1995) decomposed TPB is represented in Figure 2.4. In their model, normative beliefs, which refer to the product of multiplying an individual's perceived social pressure from salient referents with the person's motivation to comply with these expectations, were decomposed into peer influence and superior's influence. Behavioral beliefs, that represent the product of multiplying an individual's perceived

probability of a certain behavior with the person's evaluation of its consequences, were decomposed into perceived usefulness, perceived ease of use, and compatibility. Finally, control beliefs, which refer to an individual's perceived internal and external factors of controlling the difficulty of performing a certain behavior, were decomposed into self-efficacy, resource facilitating conditions, and technology facilitating conditions. After sampling 786 potential users of a computer resource center over a 12-week period, the results indicate that the decomposed TPB provides better predictive power than the TAM and TPB models (Table 2.1). In addition, they found that attitude, subjective norm, and perceived behavioral control were significant determinants of behavioral intention. The paths from perceived usefulness to attitude, peer and superior's influence to subjective norms, and self efficacy and resource facilitating conditions were significant. The significant path coefficients are denoted in Figure 2.4 using bolder dark lines.

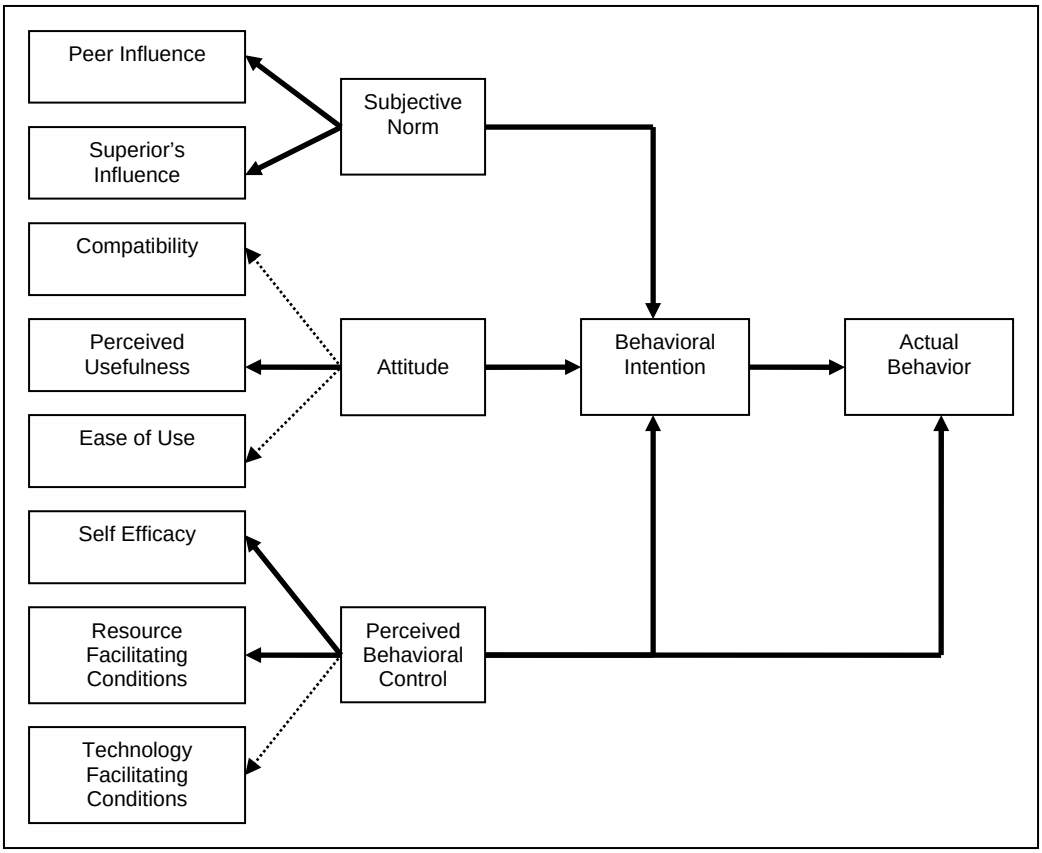

Figure 2.4. The decomposed TPB (Taylor & Todd, 1995).

TABLE 2.1

Fit Indices and Explanatory Power for Each of the Models

	df	χ^2	AGFI	RMSEA	R^2_B	R^2_{BI}	R^2_A	R^2_{SN}	R^2_{PBC}
TAM	12	98.14*	0.85	0.096	0.34	0.52	0.73	-	-
TPB	31	208.17*	0.84	0.085	0.34	0.57	0.58	0.50	0.84
Decomposed TPB	61	431.45*	0.82	0.088	0.36	0.60	0.76	0.57	0.69

Similarly, Park (2003) examined TRA, TAM, TPB, and decomposed TPB in the context of online shopping. In his model, normative beliefs were decomposed into friend, family, and media influence. Control beliefs were decomposed into self-efficacy and technology facilitating conditions. Behavioral beliefs were decomposed into usefulness,

ease of use, playfulness, and trust (Figure 2.5). A total of 733 online shopping consumers were surveyed in this study, and path analysis showed that besides TRA, the other three models provided adequate model fits and explained the same amount of variance in intention to shop online. Moreover, in terms of the decomposed beliefs, the antecedents of intention in TPB, this study found that the four attitudinal components including usefulness, ease of use, playfulness, and trust and the two control components including self-efficacy and technology facilitating conditions had significant effects on consumers' intention toward online shopping. Bolder dark lines in Figure 2.5 indicate the paths with significant coefficients, while dashed lines indicate non-significant path coefficients.

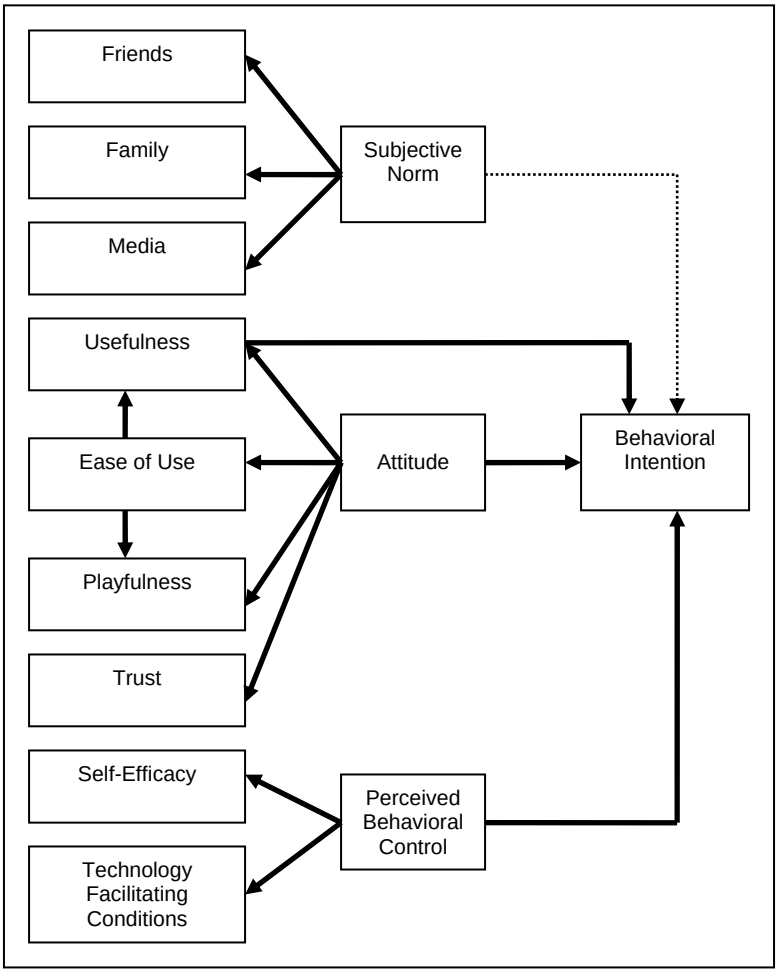

Figure 2.5. The decomposed TPB (Park, 2003)

Since Taylor and Todd (1995) proposed a decomposed TPB to better understand information technology usage, a stream of research has emerged (e.g., Taylor & Todd, 1995; Park, 2003, Lee-Partridge & Ho, 2003; Venkatesh & Brown, 2001; Pederson, 2001; Venkatesh et al., 2003) to unify theoretical models with roots in information systems, psychology, and sociology and understand the drivers of technology acceptance (Venkatesh et al., 2003). Venkatesh et al.'s (2003) contention best depicts the needs of conducting more studies in this line of research:

> *"Researchers are confronted with a choice among a multitude of models and find that they must 'pick and choose' constructs across the models, or choose a 'favored model' and largely ignore the contributions from alternative models. Thus, there is a need for a review and synthesis in order to progress toward a unified view of user acceptance*" (p. 426).

As a consequence, in attempting to capture the essential antecedents that predict and explain students' behavior and technology usage, this present study integrates the motivational dimension (Pintrich et al., 1993), which is another significant body of research in terms for explaining human behavior, into UMTA. The proposed theoretical model (Figure 2.6) will be elaborated in the next section.

The Proposed Unified Model of Technology Appropriation

> *"There is a clear stream of research that has examined the influence of individual psychological variables on user performance or acceptance of technology, lending support to the idea that user-situational variables are the most important determinants… Clearly, both individual and tool-specific characteristics are important; however, there is a dearth of theoretical models that link both perspectives to further an understanding of the nature of technology acceptance" (Dillon & Morris, 1996).*

The proposed study adapts the term, "unified model", from Venkatesh et al.'s (2003) meta-analysis of user acceptance of IT models. In their study, they reviewed eight representative models of technology acceptance (i.e., TRA, TPB, TAM, decomposed TPB, the model of PC utilization, innovation diffusion theory, and social cognitive

theory), and then proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) integrating critical elements across the eight models and empirically compared the UTAUT with the eight models. Essentially, the primary purpose of their constructing this model is the same as Taylor and Todd's (1995) and Park's constructing (2003) the decomposed TPB models, that is, they all seek to find a better way to explain why and how users appropriate IT in various situations. Decomposing a model, in a way, is intended to integrate more powerful antecedents that have been supported in other studies into a structural model so as to increase its predictive power.

Furthermore, this proposed unified model UMTA alters the term "technology usage" or "actual behavior" used in previous studies into "technology appropriation". Among the studies reviewed in this chapter, although they focus on different aspects of the individual's reactions to IT, they all seem to share one premise. That is, individuals have goals, either tangible or intangible, when they enter into a system or organization. These goals will translate to different individual outcomes such as performance, satisfaction, and acceptance through the mediation of tools. Wertsch (1998) used "appropriation" to refer "the process of taking something that belongs to others and make it one's own" (p. 53). Drawing upon sociocultural theory, Wertsch argues that human action is mediated by cultural tools. Changes in the tools we use force changes in human action. Tierney (1996) also argued that appropriation is more than simple "proficiency in the mechanics of computer use" (p. 169). Rather, it is "a repertoire of abilities with which they could explore possibilities that would be too cumbersome or difficult to attain without technology" (p. 169). By using the term "technology appropriation", the study endeavors to represent the nature of transformation embedded in each user's behavior.

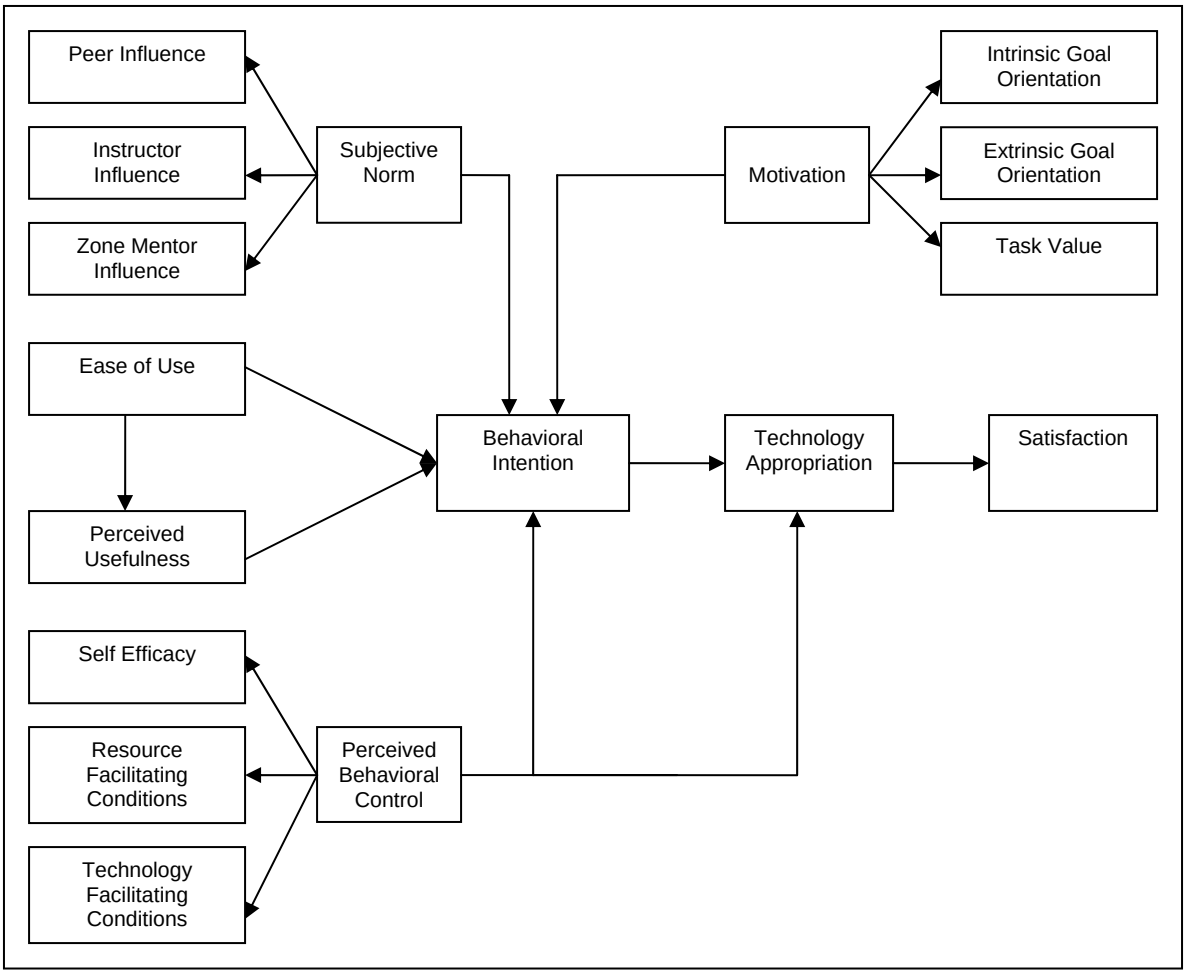

Figure 2.6. Proposed unified model of technology appropriation (UMTA)

Significant Determinants Emerged from the Reviewed Models

Normative Determinants

The research results related to the impact of subjective norms are mixed. Mathieson (1991) found no significant effect of subjective norms on users' technology adoption, neither did Davis et al. (1989) support the construct after controlling for perceived ease of use and perceived usefulness. Venkatesh and Davis (2000) found that subjective norms were more salient to users only when the technology was mandatory. Other studies like Hartwick and Barki (1994) also have similar conclusion that normative influences only

matter in mandated-use situations. Davis et al. (1989) explained that it was due to its uncertain theoretical and psychometric status. Likewise, Wolfe et al. (2003) suggested that it is because of its lack of content validity of the scale measurement. “Given these equivocal results, there is clearly a need for additional research that clarifies the precise role of social pressure in technology acceptance” (Agarwal, 2000, p. 98).

Subjective norms are generated by individuals’ perceiving the normative beliefs, opinions, and behaviors of salient others. Although it is usually ignored in IT and diffusion research (Rogers, 1976), CMC studies and social influence studies have widely supported the influence of subjective norms. Having become aware of the issue, several scholars in the field of IT usage research (e.g., Ajzen, 1991; Davis et al., 1989; Taylor & Todd, 1995; Fishbein & Azjen, 1975; Mathieson, 1991) suggest that normative beliefs should be multidimensional. For example, in virtual group work, student A wants to follow the instructor’s suggestion of using the discussion board as the primary tool for group work consensus. However, students B and C prefer to use a word processing tool to work collaboratively because of its built-in tracking function. As a result, this group uses MS Word instead of the discussion board. In this situation, this group’s decision for choosing a tool to collaborate is related to both the instructor’s expectation and the peer’s tool preference. Using “a monolithic normative structure” to predict students’ technology appropriation “may show no influence of subjective norm or intention because the effects of the referent groups may cancel each other out” (Taylor & Todd, 1995, p. 152). Therefore, the proposed unified model posits that ‘peer influence’, ‘instructor influence’, and ‘Zone mentor influence’ based on students’ interactions with other participants in the distance education program (i.e., peer-peer, peer-mentor, and student-instructor) are three

antecedents that relate to normative beliefs, and in turn, influence students' intention of using the courseware.

Attitudinal Determinants

Given that Shadow netWorkspace™ (SNS) was the primary means for interaction and learning in the Zone, TAM seems especially appropriate for explaining and predicting the participants' appropriation of the courseware. Because the measures of perceived ease of use and perceived usefulness in TAM have been validated by extensive IT studies, the proposed model includes these two belief constructs- perceived usefulness and perceived ease of use. In the context of the Zone, 'perceived usefulness' can be defined as the degree to which students believe that using the courseware would enhance their performance (Davis, 1989), while 'perceived ease of use' can be defined as the degree to which students believe that using the courseware would be free of effort (Davis, 1989). 'Behavioral intention', on the other hand, specifically represents a students' intention of using the courseware to perform a target behavior.

Control Determinants

To take volitional or nonvolitional control into account, the present study follows the approach of both Taylor & Todd's (1995) and Park's (2003) decomposed constructs of the perceived behavioral control: self-efficacy, resource facilitating conditions, and technology facilitating conditions.

Self-efficacy. Some recent models for IT usage prediction incorporate self-efficacy as a critical antecedent of behavior (i.e., Compeau, Higgins, & Huff, 1999; Yi & Hwang, 2003; Venkatesh, 2000; Henry & Stone, 1995; Maller, 2000). Self-efficacy, as defined by Bandura (1986), is "people's judgments of their capabilities to organize and execute

courses of action required to attain designated types of performances. It is concerned not with the skills one has but with the judgments of what one can do with whatever skills one possesses" (p. 391). Bandura (1997) states that self-efficacy influences "the courses of action people choose to pursue, how much effort they put forth in given endeavors, how long they will persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishments they realize" (p. 3). In short, self-efficacy is another strong component that comes from students' beliefs about themselves in relation to their capability of performance in a specific context (Driscoll, 2000). Perceived self-efficacy is strongly correlated to decision making (Wood & Bandura, 1989) and technology acceptance (Agarwal, 2000; Venkatesh, 2000; Yi & Hwang, 2003; Maller, 2000). For example, students may know that using a computer helps complete homework effectively and efficiently. However, they will hesitate to use a computer if they believe that they personally cannot master the tools.

Resource and technology facilitating conditions. In the model proposed by Venkatesh (2000), he included internal and external control as one anchor that determined perceived ease of use in technology acceptance. Internal control relates to self efficacy, while external control relates to the environment (Venkatesh, 2000; Azjen, 1991). In the context of workplace technology use, Venkatesh (2000) and Harrison et al. (1997) found that consultant support has impacts on users' perceptions of control. Therefore, in the context of the Zone learning environment, it is conceivable that when students have good perceptions toward the Zone support, they are likely to form positive

perceptions of behavioral control. External control exerts its influence through Triandis's notion of "facilitating conditions" (Taylor & Todd, 1995, p. 152). There are two dimensions constructing the facilitating conditions: the resource facilitating conditions (i.e., money, technical staff) and technology facilitating conditions. Studies that have examined both facilitating conditions, such as Taylor and Todd (1995), Gragg and King (1993), Venkatesh (2000), and Torkzadeh and Dwyer (1994), have found positive associations with the successful implementation of computerized systems. According to Venkatesh (2000),

> *"In the context of workplace technology use, specific issues related to external control include the availability of support staff, which is an organizational response to help users overcome barriers and hurdles to technology use, especially during the early stages of learning and use. In fact, consultant support has been conceptually and empirically shown to influence perceptions of control" (p. 347).*

Motivational Dimension

TRA, TAM, TPB, and decomposed TPB all focus on cognitive determinants of technology usage. Technology use is mediated through behavioral intention which in turn is determined by subjective norms, attitudes toward using the technology, and perceived behavioral control. Although these models have been explicitly examined and supported by empirical IT studies, some scholars (e.g., Bagozzi, 1992; Perugini & Bagozzi, 2001; Perugini & Conner, 2000; Bagozzi & Kimmel, 1995; Perugini & Bagozzi, 2004) argue that these constructs are not sufficient to explain behavioral intentions as well as technology use behavior if the target behavior is instrumental to larger goal achievement.

Bagozzi (1992) proposed the Model of Goal Directed Behavior (MGB) as an extension of TPB to address the issue. He added an independent variable, desire, as a parallel predictor of the behavioral intention. "Desires have a particular kind of

relationship to intentions in the sense that, once one is aware of and accepts his or her desire to act, this will motivate him or her to form an intention…Thus, desires represent the motivational state of mind wherein appraisals and reasons to act are transformed into a motivation to do so" (Perugini & Bagozzi, 2001, p. 83). For example, in the context of the Zone environment, if a student's motivation is to get an "A" in the course (extrinsic goal orientation), he will be more likely to use the courseware to check new discussions or announcement to see if the instructor has something new posted regardless of his favorableness toward the courseware (attitude).

In the educational field, it is well known that motivations play crucial roles in determining educational outcomes including affect, strategy, use, and performance (e.g., Pintrich, 2000; Pintrich & Schunk, 1996; Dweck & Leggett, 1988; Ames, 1992; Lee, 2003). Davis (1989) also pointed out that "although intrinsic motivation has been studied in the design of computer games, it is just beginning to be recognized as a potential mechanism underlying user acceptance of end-user systems" (p. 334). According to Pintrich et al. (1993) and Pintrich (2000), motivational beliefs include intrinsic and extrinsic goal orientations, task value, and test anxiety. Because the Zone courses are primarily project-based, test anxiety is not salient in this online environment.

Achievement goal orientation. Over the course of the past two decades, the value (goal-oriented) aspect of learning has driven several researchers (e.g., Ames & Archer, 1988; Dweck, 1986; Dweck & Leggett, 1988; Weiner, 1979; Pintrich, 2000, Anderman & Midgley, 2002; Miltiadou, 2000; Longo, 1999) toward achievement motivation. According to Achievement Goal Theory, which has emerged as a preeminent approach to motivation, there are two major types of goal orientation: (a) learning goal (Dweck,

1986), mastery goal (Ames & Archer, 1988; Elliot & Harackiewicz, 1996), or task involvement (Nicholls, 1984), and (b) performance goal (Ames & Archer, 1988; Dweck, 1986) or ego involvement (Nicholls, 1984). Students who are learning, mastery, or task-involved goal oriented are motivated to learn because they want to develop their competence for their own sense of improvement. On the contrary, students with performance or ego-involved goal orientation seek to demonstrate superior performance and competence compared to others.

Yi and Hwang (2003) extended TAM by incorporating the motivation variables of self-efficacy, enjoyment, and learning goal orientation to predict the usage of Blackboard, a web-based information system. The results highlighted the important roles of these three motivation variables in determining the actual technology usage measured through computer-recorded objective data. In addition, Hubbard and Davis (2002) added the Model of Goal-Directed Behavior to TPB to investigate the psychological antecedents of behavior and how decision-making processed differ for homeowners and renters. They found that by integrating the goal dimension into TPB, the predictive power of the model was substantially increased relative to the original TPB.

Task value. Different from goal orientations, task value refers to the student's "evaluation of how interesting, how important, and how useful the task is" (Pintrich et al, 1993, p. 11). Eccles (1983) indicated that while measuring an individual's task value, there are three aspects we should account for: the person's perception of the importance of the task, the intrinsic value or interest of the task, and the utility value of the task for future goals.

In summary, although the construct of motivation has been recognized as being important in understanding individual differences in behavior, it has not received much attention with regard to technology acceptance in the IT and HCI domains (Yi & Hwang, 2003). By adding the motivational dimension to TPB, this study expects that the predictive power of the proposed extended model will increase.

Satisfaction

Students' satisfaction with their learning experience has been included as an important dependent variable in many studies of distance education and CMC (e.g., Alavi, 1994; Alavi, et al., 1995; Strauss, 1996; Arbaugh, 2000; Arbaugh, 2002; Lee, et al., 2003). It has been supported that this dependant variable will likely determine students' actions of taking subsequent courses with the same educational program. Arbaugh (2000) argues that students' satisfaction has significant impacts on the continued viability of an Internet-based course as well as the educational medium. In addition, Etezadi-Amoli and Farhoomand (1991) imply that users' computing satisfaction is an important theoretical construct because of its potential for discovering both forward and backward links in a causal chain. Doll and Torkzadeh (1991) assert that "satisfaction is potentially both a dependent variable (when the domain of one's research interest is upstream activities or factors that cause end-user satisfaction) or an independent variable (when the domain of one's research interest is downstream behaviors affected by end-user satisfaction)" (p. 5). Therefore, unlike most of the IT studies that only measure users' technology use (Lee et al., 2003), the present study will measure students' satisfaction as an attempt to examine and evaluate the influence of the social and technological factors that have been identified in the literature review.

Chapter Summary

In conclusion, this study is grounded in socio-technical systems theory (STST) as a wholistic analytical framework to investigate factors that may influence students' participation and learning in distance education programs. However, given that STST does not offer ready made methods of measurement, this study reviews user acceptance literature and four IT usage models (i.e., TRA, TAM, TPB, and decomposed TPB) in order to construct a measurable path model to understand and explain both social and technical aspects of students' technology appropriation.

The review of the aforementioned IT usage studies indicated that students' technology appropriation can be explained through four dimensions: subjective norm, attitude, perceived behavioral control, and motivation. A unified model of technology appropriation was then constructed based on the findings and assertions of literature related to users' technology acceptance. Table 2.2 summarizes the empirical findings of technology-acceptance studies. Chapter III presents the data collection and analysis methodology that will be used in this study.

TABLE 2.2

Summary of Selected Technology-Acceptance Studies

Authors	Models	Constructs	Applications	Participants	Method	Findings
Arbaugh (2000)	ETAM	Ease of use, Usefulness, Usage, Course flexibility, Program flexibility, Ease of interaction, Instructor emphasis, Classroom dynamics, Learning	LearningSpace (web-based system)	97 MBA students	Survey, System log	Ease of interaction, instructor emphasis, and classroom dynamics were found to directly influence students' learning.
Arbaugh (2002)	TAM	Learning, Satisfaction, Perceived flexibility, Ease of use, Usefulness, Media variety, Instructor experience, Immediacy behavior, Interaction emphasis, Control	LearningSpace or Blackboard	222 MBA students	Survey	Ease of use and usefulness were not significantly associated with learning. Perceived usefulness was not significantly associated with satisfaction either. However, students' emphasis of interaction was strongly associated with learning and satisfaction.
Bagozzi & Kimmel (1995)	TRA, TPB, MGB	Attitude, Subjective norms, Perceived behavioral control, Desire, Past behavior, Intention, Behavior	Exercise & Diet	142 students	Survey	Attitude significantly impacted one's intention. In addition, desire was the strongest direct predicator of intention compared to attitude and subjective norms. Furthermore, past behavior was found to have significant influence on intention and subsequent behavior.
Brown (2002)	TAM	Usefulness, Ease of use, Usage, Ease of Finding, Ease of Understanding, Self-efficacy, Anxiety	WebCT	78 students	Survey	Ease of finding and ease of understanding significantly impacted perceived ease of use. In addition, perceived ease of use had influence on both perceived usefulness and usage.
Chau (1996)	Modified TAM	Ease of use, Near term usefulness, Long term usefulness, Intention	MS Word, MS Excel	285 users	Survey	Perceived near term usefulness had the strongest impact on staff's intention of using an IT system

Chen (1999)	ETAM	Usefulness, Ease of use, Intention, Interactivity, Experience, Peer influence, Enjoyment	Online shopping	228 users	Survey, System log	Usefulness had significant impacts on ease of use, intention, and interactivity. In addition, peer influence, enjoyment, and experience were influenced by both perceived ease of use and usefulness.
Davis (1989)	TAM	Usefulness, Ease of use, Usage	E-Mail, XEDIT, Chart-Master, Pendraw	264 MBA students	Survey	Both perceived usefulness and ease of use were significantly correlated with usage. Regression analyses suggested that perceived ease of use might have direct influence on perceived usefulness. Usefulness, in turn, was a direct determinant of system usage.
Davis et al. (1989)	TRA, TAM	Usefulness, Ease of use, Attitude, Subjective norms, Intention, Usage	WriteOne	107 MBA students	Survey, Telephone interviews	Perceived usefulness strongly influenced intention and explained more than half of the variance in intention. Perceived ease of use had a significant but small effect on intention. Subject norms had no influence on intention. TAM explained more variance in intention (R^2=.47 at Time 1 and .51 at Time 2) than TRA (R^2=.32 at Time 1 and .26 at Tame 2)
Gefen & Straub (1997)	ETAM	Social presence, Ease of use, Usefulness, Usage, Gender	Email	392 workers	Survey	Perceived usefulness mediated the relationship between social presence and usage. In addition, gender differences were found in terms of perceptions toward social presence, ease of use, and usefulness, but not the use of email.
Hartwick & Barki (1994)	TRA	Attitude, Subjective norms, Intention, Usage, User participation, User involvement	Industry's target system	127 members of the Canadian Information Processing Society	Survey	Participation led to involvement. Involvement mediated the relationship between participation and usage. In addition, the effect of participation on intention and usage was mediated by attitude and subjective norms. Usage was strongly influenced by one's intention to use a system.

Karahanna, Staub, & Chervany (1999)	ETRA	Attitude, Subjective norms, Intention, Usefulness, Ease of use, Visibility, Image, Demo, Trialability, Voluntariness, Top management, Supervisor, Peer, Department, Computer specialist, Friend.	MS Windows	268 employees	Survey, Interviews	For potential adopters, intention was solely determined by subjective norms. In contrary, for current users, only their attitude toward continuing to use significantly impacted their intention.
Lederer et al. (2000)	TAM	Usefulness, Ease of use, Attitude, Intention, Usage	WWW	163 users	Survey	Usage was determined by ease of use and usefulness.
Lee (2003)	ETAM	Usefulness, Ease of use, Attitude, Intention, Usage, Distance learning expectation, Social presence, Perceived behavioral control, Interface design, Subjective norms	AIDE (web-based collaboration technology system)	31 students	Survey	Distance learning expectation, social presence, and perceived ease of use had direct impacts on perceived usefulness. Attitude and subjective norms were the two determinants impacting intention. Usage was solely determined by intention to use.
Lee et al. (2003)	ETAM	Usefulness, Ease of use, Attitude, Usage, Performance expectation, Social expectation, Satisfaction	AIDE (web-based collaboration technology system)	31 students	Survey	Both perceived ease of use and performance expectation had direct impacts on perceived usefulness. In addition, students' usage behavior was determined by their attitude and perceived usefulness. However, only attitude had impacts on students' satisfaction.
Mathieson (1991)	TPB, TAM	Usefulness, Ease of use, Attitude, Intention, Usage	Spreadsheet, Calculator	262 students	Survey	The results supported the relationships postulated in TAM and TPB. Even though TAM explained more variance than TPB, the difference was not large enough to conclude that TAM was a better model.

Park (2003)	TRA TAM TPB DTPB	Ease of use, Usefulness, Subjective norms, Perceived behavioral control, Intention, Playfulness, Trust, Usefulness, Friends, Family, Media, Self-efficacy, Technology facilitating	Online shopping	733 consumers	Survey	Usefulness, ease of use, playfulness, trust, self-efficacy, and technology facilitating conditions had significant indirect effects on intention to shop online. However, social influences (i.e., friends, family, and media) did not build intention to shop online. TPB, TAM, and DTPB revealed adequate model fits and explained approximately the same amount of variance (43%) in intention.
Perugini & Bagozzi (2001)	TPB MGDB	Attitude, Anticipated emotions, Subjective norms, Desire, Perceived behavioral control, Intention, Past behavior (frequency & Recency), Behavior	Bodyweight regulation & Effort expended in studying	108 and 122 college-level students respectively	Survey	Desire was found mediating the effects of the antecedents (subjective norms, attitude, perceived behavioral control, and anticipated emotions) on intentions in both studies. MGDB explained more variance in intention and behavior than TPB.
Shaffer (1990)	TRA TPB	Attitude, Subjective norms, Perceived behavioral control, Intention, Behavior	Grade point average	113 students	Survey	Perceived behavioral control, attitude, and subjective norms were determinants of intention at the end of the semester. Behavior was solely determined by intention.
Straub, et al. (1995)	TAM	Ease of use, Usefulness, Usage	V-Mail	458 employees	Survey, System log	Usefulness had a direct impact on self-report usage
Szajna (1996)	TAM	Usefulness, Ease of use, Intention, Self-report usage, System log usage	Email	61 MBA students	Survey, System log	Ease of use directly impacted usefulness, and usefulness, in turn, affected intention. Intention was the sole determinant of both self-report and system-log usage.

Taylor and Todd (1995)	TPB, TAM, DTPB	Usefulness, Ease of use, Attitude, Subjective norms, Perceived behavioral control, Intention, Usage	Computing resource center	786 students	Survey	Attitude, subjective norms, and perceived behavioral control had direct influence on intention to use the computing resource center. In addition, students' usage behavior was directly affected by their intention and perceived behavioral control. All three models exhibited a reasonable fit to the data and explained similar amounts of the target behavior (ranging from .52 to .60). However, DTPB provided a fuller understanding of students' behavior.
Yuen & Ma (2002)	TAM	Ease of use, Usefulness, Intention, Usage	Computer	186 preservice teachers	Survey, System log	Perceived ease of use and usefulness had direct impacts on intention to use computers. Also, perceived ease of use had a direct impact on perceived usefulness. Usage was determined by both intention and perceived usefulness.
Venkatesh & Davis (2000)	ETAM	Usefulness, Ease of use, Intention, Usage, Voluntariness, Experience, Subjective norms, Image, Job Relevance, Output quality, Demo	Industry's target system	156 employees	Survey	Subjective norm, image, job relevance, output quality, demo, and perceived ease of use all had significantly impacts on perceived usefulness. In addition, subjective norms affected one's intention to use. Both perceived ease of use and usefulness had significant impacts on intention, but perceived usefulness had a stronger relationship. Lastly, usage was solely determined by intention.
Venkatesh (2000)	ETAM	Ease of use, Usefulness, Intention, Self-efficacy, External control, Anxiety, Playfulness, Enjoyment, Usability	Industry's target system	246 employees	Survey	Control, self-efficacy, anxiety, playfulness, enjoyment, and usability were important factors influencing one's perceived ease of use. Ease of use and usefulness together impacted one's intention to use a system.

Venkatesh et al. (2003)	TRA TAM TPB DTPB MM SCT UTAUT	Ease of use, Usefulness, Attitude, Subjective norms, Perceived behavioral control, Intention, Usage, Self-efficacy, Performance expectation, Effort expectation, Facilitating conditions, Anxiety.	Industry's target system	645 employees	Survey	Performance expectation, effort expectation, and subjective norms had impacts on workers' intention. Facilitating conditions had a direct impact on usage but no impact on intention. In addition, intention had direct effects on usage. UTAUT was found to outperform the eight examined models.

CHAPTER III

Research Methodology

Introduction

The primary purpose of this study was to examine the social and technical factors affecting students' technology use behavior and satisfaction in distance learning. To achieve this goal, the research examines and tests a unified model of technology appropriation that integrates significant constructs across various attitude-behavior and social influence models. A set of self-report questionnaires measuring students' goal orientation, self-efficacy, task value, tool and resource usage, technology acceptance, and overall satisfaction were administered during the time period of the course. In addition, computer-recorded courseware usage data including the frequencies of login, the time each student spent in the courseware, the number of messages each student authored, and the percentage of available messages read provided an objective measure of technology utilization.

This chapter describes the data collection procedures, subjects, and instrumentation used in this study as well as describing approaches to the data analyses. Multiple methods of data analysis including descriptive statistics (frequencies and percentages, means, and standard deviations), Pearson's correlation, and Structure Equation Modeling (SEM) techniques, were used to represent the data and test socio-technical models of students' participation in the Zone. Table 3.1 shows the time period for the data collection.

Table 3.1

The Timeframe of the Research

Wk4 2/09	Wk5 2/16	Wk6 2/23	Wk7 3/01	Wk8 3/08	Wk9 3/15	Wk10 3/22	Wk11 3/29	Wk12 4/05	Wk13 4/12	Wk14 4/19	Wk15 4/26	Wk16 5/03	Wk17 5/10	Wk18 5/17
Computer Recorded System Usage Logs														
The 1st Survey Administration - Demographic Survey (Appendix B) - Motivated Strategies for Learning Questionnaire (MSLQ)											The 2nd Survey Administration (Appendix C) - Part A: Attitude - Part B: Facilitation and Appropriation - Part C: Learning Satisfaction			

Research Questions

This study addressed the following research questions:

1. What are the factors that significantly influence students' intention of using the technology, technology appropriation behavior, and satisfaction in online learning environments?
2. How does the proposed model, UMTA, compare with TRA, TPB, and TAM for explaining the variances of students' behavioral intention, technology appropriation behavior, and satisfaction?

Participants and Sampling Method

The population of this study included all students (N=187) enrolling in 18 credit-granting Zone courses in Winter 2004. The potential sample included all 187 students for whom email addresses could be obtained through course registration lists. All students were given the option of participating in this research project. Over the course of the investigation 2 surveys were conducted, and students who voluntarily completed the consent form became the sample of this study. The response rates of the first and second survey were 62.03% (116 of 187) and 83.62%, (97 of 116) respectively.

Data Collection

Research Procedures

The participants completed multiple instruments described in the next section during the Winter 2004 semester. The first set of instruments was administered between the fourth and eighth week, and the second set of instruments was administered near the end of the semester. One week prior to the first scheduled questionnaire administration, instructors received a pre-written message attached with an electronic consent form (Please see Appendix A for the consent form used in this study) from the researcher and were asked to forward it to students. Instructors then presented the information about the study and informed consent to the students in their courses and encouraged them to participate. After reviewing the consent form, students could consent by entering their name and contact information through a web-based consent form, or print the consent form out, sign it, and return it to the researcher. Participants would then receive directions to the web-based surveys via emails and class discussion boards. The data collection continued through the Winter semester.

Early in the semester (week 4-8). Following the first three weeks of the semester students received instructions for completing a set of questionnaires including the Demographic Survey (DS) (Appendix B) and the Motivated Strategies for Learning Questionnaire (MSLQ). The first set of surveys measured students' motivational orientations and learning strategies (students' goals and value beliefs and their self-efficacy) as well as obtained their demographic information. At the end of the initial questionnaires, students were told to expect another set of questionnaires to be distributed to them near the end of the semester. One and two weeks later, after the survey

administration, the first and second reminders were sent to those students who had not taken the survey to encourage their participation and to emphasize the importance of having their participation in this study.

Near the end of the semester (week 15-18). At the fourteenth week of course work, participating students received a second set of questionnaires (Appendix C) measuring attitudes toward technology (Part A in Appendix C) and facilitating resources (Part B in Appendix C), technology appropriation (Part B in Appendix C), and satisfaction (Part C in Appendix C) with instructions. Participants had approximately 4 weeks to complete and submit them electronically. Similar to the first survey administration, two reminders were sent to the students for the purpose of increasing the response rate.

Over the 18-week period. Actual technology usage was collected from computer-record usage logs including each participant's number of minutes spent in the courseware, frequency of accessing the courseware, total number of messages authored, and percentage of available messages read.

Operational Measures of Variables

Demographic Variables

Gender (Appendix B). Participants were asked their gender, and the responses were coded as male=1, and female=0.

Age. Participants were asked to select their age from the following choices: 1) under 20, 2) 21-25, 3) 26-30, 4) 31-35, 5) 36-40, 6) 41-45, 7) 46-50, and 8) over 51.

Academic status (Appendix B). Participants were asked to select their current academic status from the following five choices: 1) undergraduate, 2) master, 3) specialist, 4) PhD, and 5) other.

Prior online learning experience (Appendix B). Participants were asked, "How many online courses have you taken prior to this semester?" and "How many Zone courses have you taken prior to this semester?" The actual number of courses was used as the value.

Access location (Appendix B). Participants were asked, "Where did you access the Internet for your Zone coursework primarily?" The answers were coded to 1=home, 2=work, 3=Zone (top level of the Reflector), 4=IAT computer labs, and 5=other.

Independent Variables

Subjective norm beliefs (Part A in Appendix C). According to the Theory of Reasoned Action (Ajzen, 1985), others' behavior and perceptions have impact on individual's behavioral intention toward using a certain technology. In an attempt to develop a model with better predictive power, Taylor and Todd (1995) decomposed the TRA's subjective norm beliefs into two different referent groups, peers (coefficient alpha= .92) and supervisors (coefficient alpha= .80) in an organizational setting and found that the decomposed constructs have significant association with IT usage. Similarly, the current study decomposed the referent groups in the Zone learning environment into "peers", "the instructor", and "Zone mentors", and modified the items from Taylor and Todd's (1995) instrument. In addition, 3 questions were generated from the focus group interview in the pilot study to better understand the impacts of subjective norm beliefs. They were 1) My classmates want me to use the courseware frequently, 2) My instructors want me to use the courseware frequently, and 3) The Zone mentors want me to use the courseware frequently. Students were asked to rate the level of agreement on a 7-point Likert scale where 1 indicated strongly disagree and 7 indicated strongly

agree with 9 statements represented in the following table. Table 3.2 lists the items measuring students' subjective norm beliefs.

Table 3.2

Items Measuring Participants' Subjective Norm Beliefs (Part A in Appendix C)

Scale and measures	Source	Scheduled Administration
Peer Influence • My classmates expect me to use the courseware • My classmates want me to use the courseware frequently • Generally speaking I try to do what classmates think I should do	Taylor and Todd (1995) & Pilot Study (2003)	The 2nd Survey Administration
Instructor Influence • My instructors expect me to use the courseware • My instructors want me to use the courseware frequently • Generally speaking I try to do what instructors think I should do	Taylor and Todd (1995) & Pilot Study (2003)	The 2nd Survey Administration
Zone Mentor Influence • The Zone mentors expect me to use the courseware • The Zone mentors want me to use the courseware frequently • Generally speaking I try to do what the Zone mentors think I should do	Taylor and Todd (1995) & Pilot Study (2003)	The 2nd Survey Administration

Attitudinal beliefs toward the technology (Part A in Appendix C). As has been discussed in Chapter II, the Technology Acceptance Model (TAM) is used to explain and predict students' appropriation and utilization of the courseware. According to the TAM, perceived ease of use and perceived usefulness are two specific determinants of users' attitude toward usage intentions and technology usage (Davis, et al., 1989; Taylor & Todd, 1995). In this study, students' perception of usefulness and ease of use of the courseware were measured through the Technology Acceptance instrument developed and validated by Davis (1989). Any description including "electronic mail" in the

original instrument was altered to “the courseware” for the purpose of investigating students’ courseware adoption in this study. Each variable consists of six 7-point Likert scale items with 1 indicated strongly disagree and 7 indicated strongly agree. Table 3.3 lists the items measuring students’ attitudinal beliefs toward SNS.

Table 3.3

Items Measuring Participants’ Attitudinal Beliefs toward the Technology (Part A in Appendix C)

Scale and measures	Source	Scheduled Administration
Perceive Usefulness • Using the courseware helps me learn about & accomplish the course requirements quickly • Using the courseware helps me to be a productive student • Using the courseware enhances my effectiveness on the course coursework • Using the courseware makes it easy to do the course coursework • Using the courseware improves my academic performance • I find the courseware a useful tool for my learning in this course	Davis (1989)	The 2nd Survey Administration
Perceived Ease of Use • Learning to use the courseware is easy for me • The courseware is flexible to interact with • I find it's easy to get the courseware to do what I want to do • It's easy for me to become skillful at using the courseware • My interaction with the courseware is clear and understandable • The courseware is easy to use	Davis (1989)	The 2nd Survey Administration

Perceived behavioral control beliefs. The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action (Ajzen, 1985). TPB adds behavioral control into its conceptual model to account for the influence of an internal notion of self efficacy

and external resource constraints (Taylor & Todd, 1995) on individual's behavioral intention and actual technology appropriation and utilization. According to Taylor and Todd's (1995) assumptions,

1. higher levels of self efficacy will lead to higher levels of behavioral intention and IT usage, and
2. the absence of facilitating conditions may reduce users' intention and actual technology usage.

To explore these constructs, this study employed the "self efficacy" scale from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, et al., 1993) and designed 10 new questions specifically focused on both "resource" and "technology" facilitating conditions that were seen in the Zone learning environment to measure the three belief constructs of behavioral control. To ensure content validity, two instructors and three students reviewed the ten questions.

Students were asked to rate the level of trueness of eight statements that measured "self-efficacy" and the level of agreement with ten statements that measured facilitating conditions. For the measurement of "self-efficacy", the answer was rated on a 7-point Likert scale with 1 indicated "not true at all", 2 indicated "not true", 3 indicated "not so true", 4 indicated "neutral", 5 indicated "somewhat true", 6 indicated "true", and 7 indicated "very true". For the scales of measuring both technology and resource facilitating conditions, students selected their answers on a 7-point Likert scale with 1 indicated strongly disagree and 7 indicated strongly agree. Table 3.4 lists the items measuring resource and technology facilitating conditions in the distance education program.

Table 3.4

Items Measuring Resource and Technology Facilitating Conditions (Part B in Appendix C)

Scale and measures	Source	Scheduled Administration
Resource Facilitating Conditions • The mentors are available when I need help with any software issues • The information needed to do well in the course is easily accessible • I am able to learn what I need to succeed in this course • I have the time it takes to succeed in this course • For me it is important to get support/help from the Zone mentors & instructor to succeed in this course • For me it is important to get support/help from other fellow students to succeed in this course	ZES (2004)	The 2nd Survey Administration
Technology Facilitating Conditions • The computer I use to access the course and Zone meets my needs • The network connection I use to access the course and Zone meets my needs • For me it is important to use the software and other media development tools of the Zone to succeed in this course • For me it is important to use the communication tools (messaging, discussion boards, email) provided by the Zone to succeed in this course	ZES (2004)	The 2nd Survey Administration

Motivational beliefs. Hubbard and Davis (2002) argue that while many studies using the TPB model support that users' behavioral intentions are determined by subjective norms, attitude toward a specific technology, and perceived behavioral control, there are doubts about its "sufficiency in explaining behavioral intentions and behavior in cases where they are instrumental to the achievement of larger goals" (p. 14). Borrowing from the Model of Goal-Directed Behavior (MCB), they added the dimension of motivation as a fourth determinant of behavioral intentions to the TPB model. As a result,

their model explained 75 percent of the variation in behavioral intentions, compared to Perugini and Conner's (2000) TPB model (30%). Consequently, in an attempt to increase the predictive power of the UMTA proposed in this study, the motivational dimension was added to the decomposed TPB. The three scales, intrinsic goal orientation, extrinsic goal orientation, and task value, in the MSLQ (Pintrich, et al., 1993) were utilized to measure the motivation constructs.

Mediating Variable

Behavioral intention toward the technology use (Part B in Appendix C). Students' "intention to use the courseware" (behavioral intention) was measured through an 8-item 7-point Likert scale modified from Taylor and Todd's (1995) 3-item behavioral intention scale. This original scale measured a student's behavioral intention to use a computing resource center, and its reliability coefficient was .91. Table 3.5 lists the items measuring students' behavioral intention toward SNS use.

Table 3.5

Items Measuring Participants' Behavioral Intention toward the Technology Use (Part B in Appendix C)

Scale and measures	Source	Scheduled Administration
Behavioral Intention • When I need to communicate with my instructor and Zone mentors, I use SNS tools such as Shadow Express and discussion board • When I need to communicate with my instructors and Zone mentors, I use tools such as Email, instant messenger, and telephone • When I need to interact with fellow students, I use SNS tools such as Shadow Express and discussion board • When I need to interact with fellow students, I use tools such as Email, instant messenger, and telephone • I frequently find myself using SNS tools to meet the requirements of the course • I frequently find myself using tools other than SNS to meet the requirements of the course • When I need to complete and submit assignments, I use SNS tools such as Shadowdoc and discussion board • When I need to complete and submit assignments, I use tools other than SNS	Taylor and Todd (1995)	The 2nd Survey Administration

Dependent Variables

Technology Appropriation and Utilization (Part B in Appendix C). The variable, technology usage, has been a focus in a great deal of MIS and IT studies. However, "despite the number of studies targeted at explaining technology usage, there are crucial differences in the way the variable has been conceptualized and operationalized. This wide variation of system usage measures hinders the efforts of MIS researchers to compare findings across studies, thus impeding the accumulation of knowledge and

theory in this area. Moreover, the literature falls short of providing guidance on which measures are appropriate under which circumstances" (Straub, et al., 1995, p. 1328).

In order to address methodological issues related to measuring IT usage, Straub, et al. (1995) compared both subjective and objective measures of technology usage with Davis' (1995) TAM, and found that while subjective self-report technology usage was related to perceived usefulness and perceived ease of use, objective computer recorded technology usage showed distinctly weaker links. Moreover, in his study of validating measurement scales for predicting technology usage, Davis (1989) further suggests that:

> *"Not enough is currently known about how accurately self-reports reflect actual behavior. Also, since usage was reported on the same questionnaire used to measure usefulness and ease of use, the possibility of a halo effect should not be overlooked. Future research addressing the relationship between these concepts and objectively measured use is needed before claims about the behavioral predictiveness can be made conclusively" (p. 334).*

Accordingly, this present research examined both subjective self-report measures of technology usage, namely "technology appropriation", and objective computer recorded usage, namely "technology utilization" to address the issues raised by Davis (1989) and Straub et al. (1995). The scale of self-report technology appropriation was revised from Lee's (2003) study of understanding social influences and technology acceptance in a distance learning environment. The description of "AIDE" in the original scale was altered to "the courseware". Table 3.6 lists the items measuring students' technology appropriation and technology utilization.

Table 3.6

Items Measuring Technology Appropriation and Technology Utilization (Part B in Appendix C & the computer-record usage logs)

Scale and measures	Source	Scheduled Administration
Technology Appropriation (Self-report) • Can you estimate how often you login the courseware for this course in an average week? • Can you estimate how many hours a week on average you use the courseware for this Zone course? • Please indicate the extent to which you did the following course-related activities (7-point Likert Scale where 1 indicated never used and 7 indicated a great extent): o Posted messages on the discussion board o Read messages on the discussion board	Lee (2003)	The 2nd Survey Administration
Technology Utilization (Computer-record) • Computer-record frequencies of login in an average week • Computer-record time using the courseware in an average week • Computer-record usage of the course applications: o Discussion Board ▪ Messages Authored ▪ Messages Read	ZES (2004)	Through the 18-Week Observation

Satisfaction (Part C in Appendix C). There are few attitude-behavioral studies that explicitly considered user satisfaction. According to Lee et al. (2003), "most studies simply assume that user satisfaction could be manifested by acceptance and use of technology, neglecting satisfaction as an outcome variable" (p. 53). However, Etezadi-Amoli and Farhoomand (1991) state that users' satisfaction is an important theoretical construct because of its potential for discovering both forward and backward links in a causal chain. In addition, a few studies of distance education, CMC, and Internet-based courses (e.g., Alavi et al., 1994; Alavi, et al., 1995; Strauss, 1996; Arbaugh, 2000;

Arbaugh, 2002; Lee, et al., 2003) included satisfaction and perceptions as dependent variables and found that these variables predict students' actions of taking subsequent courses with the same institution. If they are not satisfied with their experiences, they will seek alternative choices or stop taking courses, "which would have serious implications for their [online courses'] continued viability as an educational medium" (Arbaugh, 2000, p. 42). As a consequence, for the present study the researcher decided to measure students' satisfaction as a dependent variable that supports upstream research. In the context of learning in the Zone, technological tools are largely used for the purpose of interaction and communication. Therefore, it is conceivable that when students have good perceptions about the social, psychological factors, and technology use, they are more likely satisfied with their learning and the environment.

Student satisfaction was measured by a 21-item Likert scale in this study. This scale was modified from the original scale administered in the pilot study last Fall semester. A pilot study was conducted with 27 students from four Zone courses one semester (Fall 2003) prior to the actual investigation. The purpose of the pilot study was to refine and improve the measurement of students' overall satisfaction about the distance education program. The original measurement of satisfaction included 12 questions and was developed based upon components drawn from various satisfaction related studies. The reliability coefficient was .88. The pilot sample consisted of eighteen female and nine male students. Approximately 25% of the participants were under 25 years old and 26% were over age 40. Among the 27 participants only two were undergraduate students. After the pilot study, the instrument was revised according to the results of the pilot study

as well as Hiltz's (1998) and Alavi's (1994) learning and evaluation scales and suggestions. Table 3.7 lists the items measuring students' satisfaction.

Table 3.7

Items Measuring Participants' Satisfaction (Part C in Appendix C)

Scale and measures	Source	Scheduled Administration
Learning Interest • If I had a chance to take another course similar to the one I am taking now I would be happy if it used the courseware • If I had a chance to take another course similar to the one I am taking now I would be happy if was being taught in the Zone • If I had a chance to take another course similar to the one I am taking now and it used the courseware I would be confident that I could do well • If I had a chance to take another course similar to the one I am taking now and it was taught in the Zone I would be confident that I could do well • If I had the chance to teach a course I would like to use software similar to the courseware • If I had the chance to teach a course I would like an environment similar to the Zone	Hiltz (198) & Alavi (1994)	The 2nd Survey Administration
Course Evaluation • Course learning objectives were clear • I usually have a clear idea of where I am going and what is expected of me in this course • The teaching materials for this course are extremely good at explaining things • The course really tries to get the best out of all the students	Hiltz (198) & Alavi (1994)	The 2nd Survey Administration
Learning Satisfaction • I developed knowledge and competencies in this course • The course activities were a good fit for the way I like to learn • The course activities met my expectations for what I had hoped to learn • The knowledge and competencies taught through the course activities are personally meaningful and important to me	Pilot Study & Interviews (2003)	The 2nd Survey Administration

Courseware Effectiveness • The courseware effectively helped me know what to do and easily access course materials • The courseware effectively helped me communicate with others in the course • The courseware effectively helped me present my work to others in the course and complete assignments • I am satisfied with using The courseware in this course	Pilot Study & Interviews (2003)	The 2nd Survey Administration
Zone Satisfaction • The mentors helped me solve problems and met my needs for assistance • I am satisfied with the physical space of the Zone • I am satisfied with the web-based supports from the Zone	Pilot Study & Interviews (2003)	The 2nd Survey Administration

Data Analyses

The analyses of data include descriptive statistics, Pearson's correlation, and Structural Equation Modeling (SEM). Responses from the questionnaires were gathered and entered into SPSS 12.0.1. The significance level chosen for this study was .05.

Descriptive statistics on all the data provided frequencies, percentages, means, and standard deviations on the demographic information of the participants. The data screening was performed to identify data entry errors and to examine how appropriately the data meet the statistical assumptions. Frequencies tables were used to find mis-coded entries and missing data. Scatter plots and Mahalanobis distance in SPSS were used to detect univariate and multivariate outliers, respectively. Structural equation modeling was performed to test the psychometric properties of the measures and to express the strength of relationships between independent and dependent variables.

The following section explains the methods of analysis for each research questions.

Research Question 1: What are the factors that significantly influence students' intention of using the technology, technology appropriation behavior, and satisfaction in online learning environments?

Structural equation modeling (SEM) techniques with AMOS 5.0 were used to examine the hypothesized models and paths in the models. SEM is often viewed as a confirmatory procedure on theoretical constructs, thus, it not only obtains estimates of the parameters of a model (i.e., factor loadings, variances and covariances of a factor, and residual error variances of observed variables), but also evaluates how well a hypothesized conceptual model fits its associated data. SEM can be seen as an extension of regression and factor analysis, which simultaneously "examine relationships between and among one or more dependent variables and two or more predictor or independent variables" (Grapentine, 2000, p. 14). The relationships between the theoretical constructs are represented by regression or path coefficients between factors.

An SEM diagram consists of rectangular and circles/ellipses, which are connected by arrowed lines. In Wright's notation (Wright, 1921), a measured/observed variable is represented as a rectangle box, and a latent factor is depicted as a circle or ellipse. Single headed arrows are used to define causal relationships in the model, where the variable at the tail of the arrow causes the variable at the point. Double-headed arrow linkages indicate covariances or correlations between factors, without a causal interpretation. Statistically, the single headed arrows or paths represent regression coefficients, and double-headed arrowed links indicate covariances (Hox & Bechger, 1998). Associated with each observed variable is an error term, which represents measurement error that reflects on its adequacy in measuring the related underlying factor. Additionally,

associated with each latent variable is a residual term. It represents error in the prediction of endogenous factors from exogenous factors. Since both error terms and residual terms represent other variables that are not articulated in the model, they too are denoted as circles.

In general, a structural equation model can be decomposed into two sub-models: a measurement model and a structure model. The measurement model defines relationships between the latent and manifest/indicator variables. It provides the links between item questions on an instrument and the underlying constructs they are designed to measure. Therefore, the measurement model is a confirmatory factor analysis (CFA) model that specifies the pattern by which each measure (i.e., item question) loads on a particular factor. It should first be assessed and fixed before the structural equation model is examined (Byrne, 2001).The structure model, in contrast, defines causal relationships among the latent variables. By “causal” is meant the assumption that, everything else being constant, a change in the variable at the tail of the arrow will result in a change in the variable at the head of the arrow (Loehlin, 1987). Therefore in a structural equation model each equation represents a causal link rather than a mere empirical association.

As a result, SEM has the advantages of helping researchers (1) to check the overall goodness of fit of a hypothesized model; (2) to define and investigate relationships among latent variables; (3) to estimate the variance accounted for in each latent construct by other variables in a model; and (4) to compare the relative goodness of fit of competing models by assessing the strength of different model paths.

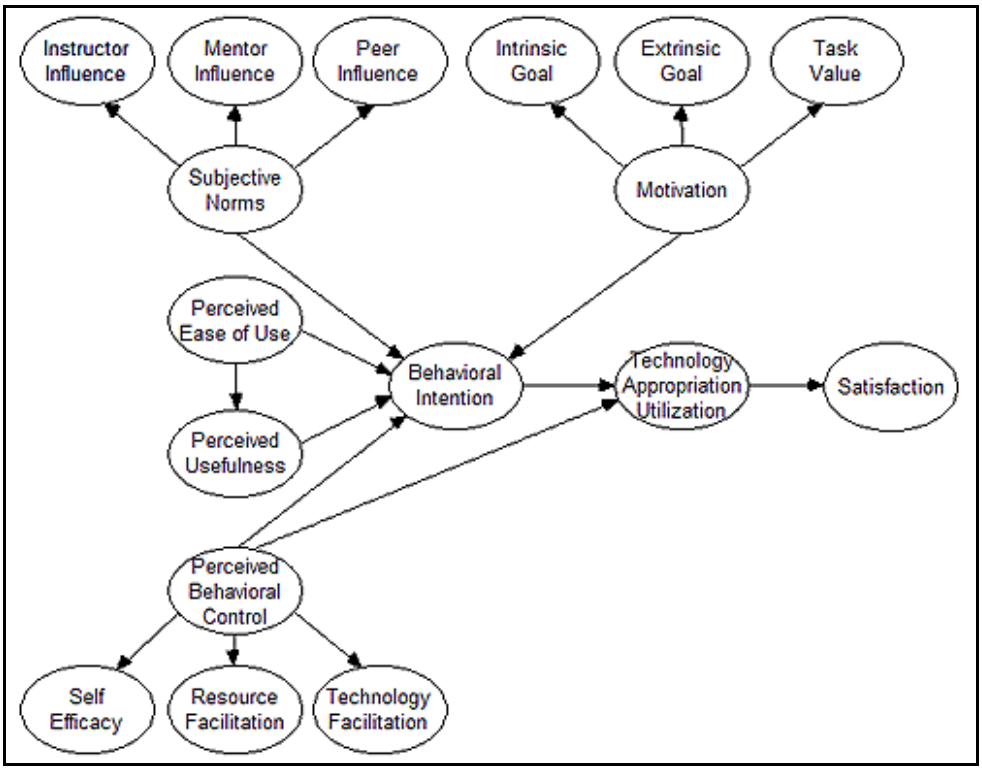

Figure 3.1. The initial structure model of the unified model of technology appropriation (UMTA)

Research Question 2: How does the proposed model, UMTA, compare with TRA, TPB, and TAM for explaining the variances of students' behavioral intention, technology appropriation behavior, and satisfaction?

To compare the four models, this present study adopted a four-step approach. TRA, TPB, and TAM were tested and adjusted for goodness-of-fit by turns. For each model, overall fit, predictive power, and the significance of paths were considered. R^2 for each dependent construct was examined to assess explanatory power, and the significance of individual paths was assessed. The fit statistics and R^2 values for each of the four models as well as the path coefficients for each model and their significance will be described in Chapter IV.

Protection of Human Subjects

The study was approved by the University of Missouri Institutional Review Board (IRB) for human subjects protection. Participation in this study was completely voluntary. Subjects were informed that they could withdraw from participation at any time without any negative consequences, and that all data pertaining to the student would be destroyed. There was no treatment. Subjects participated in their courses as they would if the study was not underway. Subjects were only asked to provide responses to written questions about their attitudes, preferences, and responses to activities in the Zone. To induce more participation, the information about an extra incentive was included into the announcement of the second survey administration. All survey respondents were eligible to be entered into a drawing from which two winners were randomly selected at the end of the investigation. The winners received a $100 check. There were no substantial risks or discomforts that might occur as a result of subjects' participation. All records and information collected in this study are confidential.

Chapter Summary

The primary purpose of this study is to investigate how students perceived both social and technical systems in online learning environments during their coursework. As discussed in Chapter II, a unified model is proposed to integrate significant elements and relationships in the context of the Zone learning environment. Consequently, an initial measurement model including 4 independent latent constructs, 1 mediating measured variable, and 2 dependent measured variables is depicted in Figure 3.1 to statistically test the proposed unified model in Chapter II.

This chapter described the research design, sample used in this study, research procedure, data collection methods, instrumentation, and data analysis techniques. Table 3.8 is a summary of studies using similar research design and instrumentation although in different contexts. Chapter IV describes the results of the data analysis.

Table 3.8

Summary of Methodologically Relevant Studies

	Studies		
	Taylor & Todd (1995)	Park (2003)	ZES (2005)
Theories/Models Compared	TAM TPB DTPB	TRA TAM TPB DTPB	TRA TAM TPB DTPB UMTA
Applications	Model comparison of users' intention to use and usage of a computing resource center (CRC)	Model comparison of consumers' intention to shop online	Model comparison of students' intention/usage/satisfaction to an online learning program
Methodology	786 users • Survey • CRC usage card	733 consumers • Survey • No usage measurement	97 students • Survey • Self-report usage • Computer-record usage
Instrumentation			
Subjective Norm Antecedent 1	Peer Influence • My friends would think that I should use the CRC • Generally speaking, I want to do what my friends think I should do • My classmates would think that I should use the CRC • Generally speaking, I want to do what my classmates think I should do	Friends • My friends would/do oppose/support my shopping online • My friends would/do disapprove/approve of my shopping online	Classmates • My classmates expect me to use SNS • My classmates want me to use SNS frequently • Generally speaking I try to do what classmates think I should do

Subjective Norm Antecedent 2	Superior Influence • My professors would think that I should use the CRC • Generally speaking, I want to do what my professors think I should do • I will have to use the CRC because my professor require it Generally speaking, I want to do what my professors think I should do	Family • The members of my family (e.g., parents, spouse, and children) would/do oppose/support my shopping online • My family would/does disapprove/approve of my shopping online	Instructor • My instructors expect me to use SNS • My instructors want me to use SNS frequently • Generally speaking I try to do what instructors think I should do
Subjective Norm Antecedent 3	N/A	Media • Media recommend people shop online • Media frequently encourage people to shop online	Zone Mentor • The mentors expect me to use SNS • The mentors want me to use SNS frequently • Generally speaking I try to do what the mentors think I should do
Attitude Antecedent 1	Perceived Ease of Use • Instructions for using equipment in the CRC will be hard to follow • Instructions that are hard to follow are bad/good • It will be difficult to learn how to use the CRC • A service that is difficult learn is bad/good • It will be easy to operate the equipment in the CRC • A service with equipment that is easy to operate is bad/good	Perceived Ease of Use • Learning to use the Internet for shopping would be/is easy for me • It would be/is easy for me to become skillful at using the Internet for shopping • The process of interacting with the Internet for shopping would be/is clear and understandable • I would/do find the Internet easy to use for shopping	Perceived Ease of Use • Learning to use SNS is easy for me • SNS is flexible to interact with • I find it's easy to get SNS to do what I want to do • It's easy for me to become skillful at using SNS • My interaction with SNS is clear and understandable • SNS is easy to use

Attitude Antecedent 2	Perceived Usefulness • The CRC will be of no benefit to me • A service that is of no benefit to me is bad/good • Using the CRC will improve my grades • A service that will improve my grades is bad/good • The advantages of the CRC will outweigh the disadvantages • A service with more advantages than disadvantages is bad/good • Overall, using the CRC will be advantageous • A service that is advantageous is bad/good	Perceived Usefulness • I would/do find online shopping useful • Online shopping would/does improve my shopping productivity • Online shopping would be/is more convenient than traditional shopping • Online shopping would/does enable me to save time • Online shopping would/does let me easily compare products based upon several attributes • Online shopping would/does allow me to save money	Perceived Usefulness • Using SNS helps me learn about and accomplish the course requirements quickly • Using SNS helps me to be a productive students • Using SNS enhances my effectiveness on the course coursework • Using SNS makes it easy to do the course coursework • Using SNS improves my academic performance • I find SNS a useful tool for my learning in this course
Attitude Antecedent 3	Compatibility • Using the CRC will fit well with the way I work • A service that fits well with the way I work is bad/good • Using the CRC will fit into my workstyle • A service that fits into my workstyle is bad/good • The setup of the CRC will be compatible with the way I work • A service that is compatible with the way I work is bad/good	Playfulness • I would/do find it fun to use the Internet for shopping • I would/do find it exciting to use the Internet for shopping • I would/do find it enjoyable to use the Internet for shopping • I would/do find it interesting to use the Internet for shopping • Interacting with the Internet to shop would/does spark my imagination • Using the Internet to shop would/does make me curious	N/A

Attitude Antecedent 4	N/A	Trust • The process of online shopping would/does result in personal harm form the theft of my credit card number • The process of online shopping would/does put my privacy in jeopardy • Products purchased on the Internet would/do meet my expectations	N/A
Perceived Behavioral Control Antecedent 1	Self-Efficacy • I would feel comfortable using the CRC on my own • For me, feeling comfortable using a service on my own is unimportant/important • If I wanted to, I could easily operate any of the equipment in the CRC on my own • For me, being able to easily operate equipment on my own is unimportant/important	Self-Efficacy • It would be/is possible for me to shop online at the level I would like • I could/can shop online as well as I would like • I would be/am confident in my abilities to use the Internet for shopping • I think my performance in shopping online would improve/has improved substantially	Self-Efficacy • I believe I will receive an excellent grade in this course • I'm certain I can understand the most difficult material presented in the readings for this course • I'm confident I can learn the basic concepts taught in this course • I'm confident I can understand the most complex material presented by the instructor in this course • I'm confident I can do an excellent job on the assignments and tests in this course • I expect to do well in this course • I'm certain I can master the skills being taught in this course • Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this course

Perceived Behavioral Control Antecedent 2	Technology Facilitating Conditions • The equipment (printers, computers, etc) in the CRC are not compatible with the other computers I use • For me, a service having equipment that is compatible with the other equipment I use is unimportant/important • The software in the CRC is not compatible with the software I use • For me, a serviced having software that is compatible with the software I use is unimportant/important • I will have trouble reading my disks in the CRC • For me, whether or not I have trouble reading my disks is unimportant/important	Technology Facilitating Conditions • Online stores would be/are easily accessible (e.g., through search engines, cyber malls, and Web ads) • Products of online stores would be/are well described • Transaction processing in online stores would be/is efficient (e.g., fast retrieval of information and payment processing and delivery) • The loading speed of online stores would be/is appropriate	Technology Facilitating Conditions • The computer I use to access the course and Zone meets my needs • The network connection I use to access the course and Zone meets my needs • For me it is important to use the software and other media development tools of the Zone to succeed in this course • For me it is important to use the communication tools (messaging, discussion boards, email) provided by the Zone to succeed in this course
Perceived Behavioral Control Antecedent 3	Resource Facilitating Conditions • There will not be enough computers for everyone to use in the CRC • For me, having enough computers for everyone to use is unimportant/important • Printing in the CRC will be too expensive • For me, being able to print for a low price is unimportant/important • I won't be able to use a computer in the CRC when I need it • For me, being able to use a computer when I need it is unimportant/important	N/A	Resource Facilitating Conditions • The mentors are available when I need help with any software issues • The information needed to do well in the course is easily accessible • I am able to learn what I need to succeed in this course • I have the time it takes to succeed in this course • For me it is important to get support/help from the Zone mentors & instructor to succeed in this course • For me it is important to get support/help from other fellow students to succeed this course

Behavioral Intention (BI)	• I intend to use the CRC this term • I intent to use the CRC to print projects, papers or assignments this term • I intend to use the CRC frequently this term	• It is likely that I will shop online n next six months • I expect to shop online in next six months • I intent to shop online in next six months	• When I need to communicate with my instructor and Zone mentors, I use SNS tools such as Shadow Express and discussion board • When I need to communicate with my instructors and Zone mentors, I use tools such as Email, instant messenger, and telephone • When I need to interact with fellow students, I use SNS tools such as Shadow Express and discussion board • When I need to interact with fellow students, I use tools such as Email, instant messenger, and telephone • I frequently find myself using SNS tools to meet the requirements of the course • I frequently find myself using tools other than SNS to meet the requirements of the course • When I need to complete and submit assignments, I use SNS tools such as Shadowdoc and discussion board • When I need to complete and submit assignments, I use tools other than SNS.

Technology Appropriation & Utilization (U)	Users' filled out the CRC usage card every time they left the CRC: • Visiting Date • Arrival/Departure Time • Purpose of Visiting • Computer Station # • # of pages printed • Software used • Did the CRC attendant assist you? How?	N/A, he didn't measure usage.	Self-Report Usage Survey • Can you estimate how many hours you use SNS for this course in an average week? • How often do you access SNS site? • The extend to which you posted messages on the discussion board • The extend to which you read messages on the discussion board Computer-Record System Usage • Computer-record frequencies of login in an average week • Computer-record time using the courseware in an average week • Computer-record message authored • Computer-record message read
Satisfaction (S)	N/A	N/A	Learning Interest Course Evaluation Learning Satisfaction Courseware Effectiveness Zone Satisfaction

CHAPTER IV

Results of Data Analysis

Overview

This chapter describes the demographics of the subjects who participated in the research, presents the procedures used to examine the psychometric properties of the measures, and reports the results of the data analyses to answer the research questions. Data were collected on student demographic characteristics, motivational beliefs, subjective norm beliefs, attitudinal beliefs toward the technology, perceived facilitating conditions, technology appropriation behaviors, and satisfaction. The research questions are:

1. What are the factors that significantly influence students' intention of using the technology, technology appropriation behavior, and satisfaction in online learning environments?
2. How does the proposed model, UMTA, compare with the TRA, TPB, and TAM for explaining the variances of students' behavioral intention, technology appropriation behavior, and satisfaction?

Procedures to analyze the data included descriptive statistics and structural equation modeling techniques.

Demographic Description of the Participants

This study included all students (N=187) enrolling in 18 credit-granting Zone courses in Winter 2004. The response rates of the first and second survey were 62.03% (116 of 187) and 83.62%, (97 of 116) respectively. Univariate outliers were examined

through computing standardized scores. Cases with standardized scores in excess of 3.29 ($p < .001$, two-tailed test) may be potential outliers. Multivariate outliers, which are cases with an unusual combination of scores on two or more variables, were further examined through calculating Mahalanobis distance. "Mahalanobis distance is the distance of a case from the centroid of the remaining cases where the centroid is the point created at the intersection of the means of all the variables" (Tabachnick & Fidell, 2001, p. 68). Cases with Mahalanobis distance in excess of 39.252 (df =16. $p < .001$) may be potential multivariate outliers. Following these guidelines no univariate nor multivariate outliers were detected in the present study. Analyses for this study were performed using data from 97 respondents.

The sample included 52 female students (53.6%) and 45 male students (46.4%). Ages varied from "under 20" to "over 51" with 22.7% below age 25, 48.5% were 26-40 years old, and 28.8% were over age 40. Approximately half of the participants (53.6%) were master's degree students, and 26.8% were undergraduate students (N=26). A description of the subjects including gender, age, and academic status is presented in Table 4.1.

Table 4.1

Description of the Subjects for the ZES study

Demographic variable	N	%
Gender		
Female	52	53.6
Male	45	46.4
Age		
Under 20	2	2.1
21-25	20	20.6
26-30	32	33.0
31-35	10	10.3
36-40	54	5.2
41-45	7	7.2
46-50	14	14.4
Over 51	7	7.2
Academic Status		
Undergraduate	26	26.8
Master	52	53.6
Specialist	9	9.3
PhD	6	6.2
Other	4	4.1
Total	*97*	

Additionally, 77.3% of the participants accessed their Zone course at home (N=75). Over 85% of the participants reported that they accessed their course at least two or three times a week. Half (50.5%) of the participants estimated they spent about one to five hours for their Zone course in an average week. About 12% spent over eleven hours for their course per week; however, there were also 16.5% indicated that they spent less than one hour in an average week. Table 4.2 presents detailed information of where and how often the participants accessed their course on average.

Table 4.2

Frequencies of Accessing the Course

Variable	N	%
Location		
Home	75	77.3
Work	10	10.3
IAT Labs	12	12.4
Accessing the courseware		
Several times a day	22	22.7
Once a day	24	24.7
2-3 times a week	37	38.1
Once a week	12	12.4
Once a month	2	2.1
Time spent in an average week		
More than 26 hours	4	4.1
21-25 hours	2	2.1
16-20 hours	1	1.0
11-15 hours	5	5.2
6-10 hours	20	20.6
1-5 hours	49	50.5
Less than 1 hour	16	16.5
Total	*97*	

Measures

Psychometric Properties of the Measurement Model

Measures for each variable were developed to test the theoretical model. Items for subjective norm beliefs and behavioral intention were modified based on Taylor and Todd's (1995) prior study. Items for motivational beliefs were adapted from the subscales in the Motivated Strategies for Learning Questionnaire (Pintrich, et al., 1993). Items for attitudinal beliefs toward technology were modified from Davis' (1989) instrument. Items for technology appropriation were modified based on Lee's (2003) study. Finally, items for satisfaction and facilitating conditions were newly developed based on relevant studies (e.g., Alavi, 1994) and the pilot study in Fall 2003.

Figure 3.1 in Chapter III represents the structural portion of the full structural equation model. Before being able to test this model, the measurement portion of the

structural equation model needs to be established. Multiple indicators of each construct were formulated based on the measures. For example, to measure the effect of three motivational constructs (i.e., intrinsic goal orientation, extrinsic goal orientation, and perceived task value) on students' behavioral intention, 3 scales from MSLQ were utilized. Each scale is composed of 4-6 indicators. In total, 90 indicators were used to measure the hypothesized structural model. Figure 4.1 depicts a schematic presentation of the full structural equation model. It is important to note that, in the interest of clarity, all double-headed arrows representing correlations among the independent variables (i.e., subjective norms, motivation, perceived behavioral control, and perceived ease of use), as well as error terms associated with the observed indicators have been excluded from the figure.

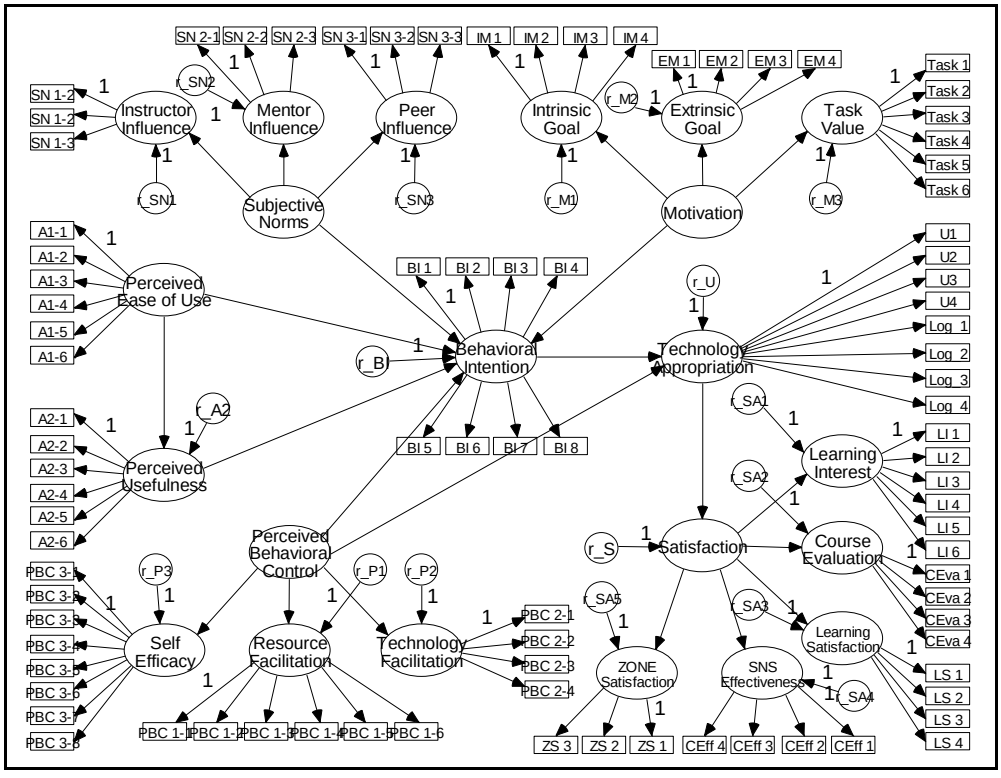

Figure 4.1. Initial (Hypothesized) model of the unified model of technology appropriation (UMTA): measurement and structural components.

The structural portion of a full structural equation model involves relationships among only latent variables. Its primary concern in testing a full model is to assess the extent to which these relationships are valid. Therefore, it is critical that the measurement of each latent variable is psychometrically sound (Byrne, 2001). Following the approach suggested by Anderson and Gerbin (1988), the psychometric properties of the measures including item reliabilities, composite reliabilities, and average variance extracted were assessed through examining the measurement model.

Item reliability refers to the degree of variance explained by the construct instead of by error. This is typically measured by squared factor loadings (SFLs) which represent the item's ability to capture variance within the construct. According to Fornell and Larcker (1981), criteria levels more than .50 suggest a high level of item reliability.

The construct reliability refers to the ability of observed variables to tap a similar underlying construct (McFarland, 1999). It can be assessed through the composite reliability developed by Werts, Linn, and Joreskog (1974) and the average variance extracted (AVE) proposed by Fornell and Larcker (1981). The composite reliability is calculated by use of the formula: $\rho = \left(\sum \lambda_i\right)^2 / \left(\left(\sum \lambda_i\right)^2 + \sum \theta_i\right)$, where λ_i refers to the i th factor loading and θ_i to the i th error variance. The coefficient is similar to Cronbach's alpha, but the actual factor loadings are taken into account instead of assuming each item is equally weighted in determining the composite (Perugini & Bagozzi, 2001). According to Nunnakkt (1978), criteria levels near .90 suggest a high level of consistency, levels near .70 reflect a moderate level of consistency, and levels near .30 indicate an inadequate level of consistency. It is recommended that coefficient

values of all items should be equal or more than 0.7 in social sciences (Hung, Ku, & Chang, 2002).

The average variance extracted, on the other hand, refers to the amount of variance captured by the measurement model versus the amount due to measurement error. It can be calculated by use of the formula: $AVE = \Sigma \lambda_i^2 / \left(\Sigma \lambda_i^2 + \Sigma \theta_i \right)$, where λ_i refers to the i th factor loading and θ_i to the i th error variance. It has been suggested that AVE should be greater than .50 to demonstrate significant variance captured by the measurement model (Barclay, Thompson, & Higgins, 1995).

Table 4.3 lists the item reliability, composite reliability, and average variance extracted for the initial measurement model. Confirmatory factor analysis (CFA) procedures were used in testing the validity of the indicator variables. The CFA using AMOS 5.0 focused on the 90 indicators that comprised the eighteen latent variables: instructor influence, mentor influence, peer influence, perceived ease of use, perceived usefulness, resource facilitating conditions, technology facilitating conditions, self-efficacy, intrinsic goal orientation, extrinsic goal orientation, perceived task value, behavioral intention, technology appropriation and utilization, learning interest, course evaluation, learning satisfaction, courseware effectiveness, and Zone satisfaction. Most of the items have SFL greater than the .50 recommended value. In addition, 13 of the 18 scales exhibited composite reliabilities close to or above the recommended level of .70. Ten of the 18 scales exhibited AVE close to or above the recommended threshold of .50. However, to ensure each construct is psychometrically sound, items having SFL below the .50 threshold were removed (Segars & Grover, 1993).

A second set of similar tests were performed and presented in Table 4.4. The tests show a considerably better measurement model with more parsimony (17 of the 18 latent variables exhibited the composite reliabilities above the .70 threshold, and 15 of the 18 scales have AVE close to or above the .50 recommended value). The revised measurement model contains 65 indicators. In an attempt to reach construct parsimony, the construct, extrinsic goal orientation, was deleted from the measurement model. A third set of similar tests on a total of 62 indicators were performed. As shown in Table 4.5, all indicators load highly on hypothesized constructs. Squared factor loadings range from .45 to 1.29, AVEs range from .42 to .84, and the composite reliabilities range from .71 to .93, all close to or exceeding the recommended minimums. According to Kline (2004), SFL values greater than .90 may suggest multicollinearity. The issue is considered in the later section (structural equation modeling) in this chapter.

Table 4.3

Initial Test of Item and Construct Reliabilities

Indicators		Constructs	Standardized Regression Weights	Squared Factor Loadings	Composite Reliability	Averaged Variance Extracted	Disposition
Recommended Value			> .7	> .5	> .7	> .5	Retain/Remove
SN 1-1	←	Instructor Influence	.8052	.6483			Retain
SN 1-2	←	Instructor Influence	.9779	.9562	0.80	0.58	Retain
SN 1-3	←	Instructor Influence	.6813	.4642			Remove
SN 2-1	←	Mentor Influence	.7717	.5955			Retain
SN 2-2	←	Mentor Influence	.9886	.9774	0.75	0.52	Retain
SN 2-3	←	Mentor Influence	.5726	.3278			Remove
SN 3-1	←	Peer Influence	.9063	.8215			Retain
SN 3-2	←	Peer Influence	.9900	.9802	0.76	0.53	Retain
SN 3-3	←	Peer Influence	.6745	.4549			Remove
A1-1	←	Perceived Ease of Use	.9112	.8302			Retain
A1-2	←	Perceived Ease of Use	.9580	.9178			Retain
A1-3	←	Perceived Ease of Use	.9699	.9408	0.92	0.63	Retain
A1-4	←	Perceived Ease of Use	.9305	.8659			Retain
A1-5	←	Perceived Ease of Use	.8896	.7914			Retain
A1-6	←	Perceived Ease of Use	.8612	.7416			Retain
A2-1	←	Perceived Usefulness	.8505	.7233			Retain
A2-2	←	Perceived Usefulness	.8904	.7928			Retain
A2-3	←	Perceived Usefulness	.9214	.8490	0.90	0.59	Retain
A2-4	←	Perceived Usefulness	.9548	.9117			Retain
A2-5	←	Perceived Usefulness	.9660	.9331			Retain
A2-6	←	Perceived Usefulness	.9028	.8150			Retain
PBC 1-1	←	Resource Facilitation	.7684	.5905			Retain
PBC 1-2	←	Resource Facilitation	.8410	.7072			Retain
PBC 1-3	←	Resource Facilitation	.8294	.6879			Retain
PBC 1-4	←	Resource Facilitation	.4940	.2441	0.57	0.21	Remove
PBC 1-5	←	Resource Facilitation	.3281	.1076			Remove
PBC 1-6	←	Resource Facilitation	.1243	.0154			Remove

PBC 2-1	←	Technology Facilitation	.7400	.5476	0.33	0.19	Retain
PBC 2-2	←	Technology Facilitation	.9020	.8136			Retain
PBC 2-3	←	Technology Facilitation	-.0265	.0007			Remove
PBC 2-4	←	Technology Facilitation	.0137	.0002			Remove
PBC 3-1	←	Self Efficacy	.7030	.4942	0.93	0.61	Retain
PBC 3-2	←	Self Efficacy	.8320	.6922			Retain
PBC 3-3	←	Self Efficacy	.7780	.6053			Retain
PBC 3-4	←	Self Efficacy	.7749	.6004			Retain
PBC 3-5	←	Self Efficacy	.8602	.7400			Retain
PBC 3-6	←	Self Efficacy	.7275	.5292			Retain
PBC 3-7	←	Self Efficacy	.8448	.7136			Retain
PBC 3-8	←	Self Efficacy	.8365	.6998			Retain
IM 1	←	Intrinsic Goal	.8168	.6672	0.75	0.43	Retain
IM 2	←	Intrinsic Goal	.7930	.6288			Retain
IM 3	←	Intrinsic Goal	.7296	.5323			Retain
IM 4	←	Intrinsic Goal	.6095	.3715			Remove
EM 1	←	Extrinsic Goal	.6550	.4290	0.61	0.29	Retain
EM 2	←	Extrinsic Goal	.6381	.4071			Remove
EM 3	←	Extrinsic Goal	.7118	.5067			Retain
EM 4	←	Extrinsic Goal	.8257	.6818			Retain
Task 1	←	Task Value	.5506	.3032	0.89	0.58	Remove
Task 2	←	Task Value	.8441	.7125			Retain
Task 3	←	Task Value	.8167	.6670			Retain
Task 4	←	Task Value	.7991	.6386			Retain
Task 5	←	Task Value	.7984	.6374			Retain
Task 6	←	Task Value	.7955	.6328			Retain
BI 1	←	Behavioral Intention	.8972	.8049	0.37	0.11	Retain
BI 2	←	Behavioral Intention	.0847	.0072			Remove
BI 3	←	Behavioral Intention	.8619	.7428			Retain
BI 4	←	Behavioral Intention	.0450	.0020			Remove
BI 5	←	Behavioral Intention	.5472	.2994			Remove
BI 6	←	Behavioral Intention	.2564	.0658			Remove
BI 7	←	Behavioral Intention	.5097	.2598			Remove
BI 8	←	Behavioral Intention	-.0722	.0052			Remove

U1	←	Tech Appropriation Utilization	.5004	.2504			Remove
U2	←	Tech Appropriation Utilization	.7968	.6348			Retain
U3	←	Tech Appropriation Utilization	.7613	.5796			Retain
U4	←	Tech Appropriation Utilization	.7997	.6396	0.54	0.16	Retain
Log_1	←	Tech Appropriation Utilization	.3448	.1189			Remove
Log_2	←	Tech Appropriation Utilization	.2928	.0857			Remove
Log_3	←	Tech Appropriation Utilization	.1045	.0109			Remove
Log_4	←	Tech Appropriation Utilization	.2877	.0828			Remove
LI 1	←	Learning Interest	.6240	.3894			Remove
LI 2	←	Learning Interest	.8223	.6762			Retain
LI 3	←	Learning Interest	.8117	.6589	0.69	0.27	Retain
LI 4	←	Learning Interest	.8285	.6864			Retain
LI 5	←	Learning Interest	.5523	.3050			Remove
LI 6	←	Learning Interest	.6896	.4756			Retain
CEva 1	←	Course Evaluation	.8902	.7924			Retain
CEva 2	←	Course Evaluation	.9197	.8458	0.79	0.48	Retain
CEva 3	←	Course Evaluation	.8329	.6937			Retain
CEva 4	←	Course Evaluation	.7695	.5922			Retain
LS 1	←	Learning Satisfaction	.7299	.5328			Retain
LS 2	←	Learning Satisfaction	.9580	.9178	0.88	0.65	Retain
LS 3	←	Learning Satisfaction	.9480	.8986			Retain
LS 4	←	Learning Satisfaction	.8861	.7852			Retain
CEff 1	←	SNS Effectiveness	.9283	.8618			Retain
CEff 2	←	SNS Effectiveness	.8103	.6566	0.79	0.49	Retain
CEff 3	←	SNS Effectiveness	.8694	.7559			Retain
CEff 4	←	SNS Effectiveness	.8736	.7632			Retain
ZS 1	←	ZONE Satisfaction	.7053	.4974			Retain
ZS 2	←	ZONE Satisfaction	.6382	.4073	0.69	0.44	Remove
ZS 3	←	ZONE Satisfaction	.9699	.9408			Retain

Table 4.4

Results of Revised Measurement Model

Indicators		Constructs	Standardized Regression Weights	Squared Factor Loadings	Composite Reliability	Averaged Variance Extracted	Disposition
Recommended Value			> .7	> .5	> .7	> .5	Retain/Remove
SN 1-1	←	Instructor Influence	.7927	.6283	0.85	0.75	Retain
SN 1-2	←	Instructor Influence	1.0250	1.0506			Retain
SN 2-1	←	Mentor Influence	.6699	.4487	0.91	0.84	Retain
SN 2-2	←	Mentor Influence	1.1348	1.2877			Retain
SN 3-1	←	Peer Influence	.8843	.7820	0.87	0.76	Retain
SN 3-2	←	Peer Influence	1.0143	1.0289			Retain
A1-1	←	Perceived Ease of Use	.9054	.8197	0.91	0.62	Retain
A1-2	←	Perceived Ease of Use	.9547	.9114			Retain
A1-3	←	Perceived Ease of Use	.9688	.9385			Retain
A1-4	←	Perceived Ease of Use	.9289	.8628			Retain
A1-5	←	Perceived Ease of Use	.8865	.7859			Retain
A1-6	←	Perceived Ease of Use	.8575	.7353			Retain
A2-1	←	Perceived Usefulness	.8488	.7205	0.90	0.59	Retain
A2-2	←	Perceived Usefulness	.8882	.7890			Retain
A2-3	←	Perceived Usefulness	.9196	.8456			Retain
A2-4	←	Perceived Usefulness	.9539	.9100			Retain
A2-5	←	Perceived Usefulness	.9656	.9324			Retain
A2-6	←	Perceived Usefulness	.9012	.8122			Retain
PBC 1-1	←	Resource Facilitation	.7834	.6137	0.75	0.50	Retain
PBC 1-2	←	Resource Facilitation	.8526	.7269			Retain
PBC 1-3	←	Resource Facilitation	.8072	.6516			Retain
PBC 2-1	←	Technology Facilitation	.7295	.5322	0.83	0.71	Retain
PBC 2-2	←	Technology Facilitation	.9105	.8290			Retain

PBC 3-1	←	Self Efficacy	.6973	.4862			Retain
PBC 3-2	←	Self Efficacy	.8291	.6875			Retain
PBC 3-3	←	Self Efficacy	.7753	.6010			Retain
PBC 3-4	←	Self Efficacy	.7713	.5949	0.93	0.61	Retain
PBC 3-5	←	Self Efficacy	.8573	.7350			Retain
PBC 3-6	←	Self Efficacy	.7230	.5228			Retain
PBC 3-7	←	Self Efficacy	.8414	.7079			Retain
PBC 3-8	←	Self Efficacy	.8328	.6936			Retain
IM 1	←	Intrinsic Goal	.8213	.6746			Retain
IM 2	←	Intrinsic Goal	.7964	.6342	0.77	0.52	Retain
IM 3	←	Intrinsic Goal	.7080	.5013			Retain
EM 1	←	Extrinsic Goal	.5993	.3592			Remove
EM 3	←	Extrinsic Goal	.6701	.4491	0.60	0.34	Remove
EM 4	←	Extrinsic Goal	.9122	.8321			Remove
Task 2	←	Task Value	.8456	.7150			Retain
Task 3	←	Task Value	.8167	.6670			Retain
Task 4	←	Task Value	.7950	.6320	0.91	0.66	Retain
Task 5	←	Task Value	.7966	.6345			Retain
Task 6	←	Task Value	.7924	.6279			Retain
BI 1	←	Behavioral Intention	.9368	.8777	0.76	0.61	Retain
BI 3	←	Behavioral Intention	.8568	.7342			Retain
U2	←	Tech Appropriation Utilization	.7162	.5130			Retain
U3	←	Tech Appropriation Utilization	.8134	.6617	0.71	0.45	Retain
U4	←	Tech Appropriation Utilization	.8386	.7033			Retain
LI 2	←	Learning Interest	.8573	.7350			Retain
LI 3	←	Learning Interest	.7069	.4997	0.74	0.42	Retain
LI 4	←	Learning Interest	.8900	.7921			Retain
LI 6	←	Learning Interest	.7058	.4981			Retain
CEva 1	←	Course Evaluation	.8845	.7823			Retain
CEva 2	←	Course Evaluation	.9163	.8396			Retain
CEva 3	←	Course Evaluation	.8245	.6798	0.78	0.48	Retain
CEva 4	←	Course Evaluation	.7603	.5781			Retain

LS 1	←	Learning Satisfaction	.7223	.5217	0.88	0.65	Retain
LS 2	←	Learning Satisfaction	.9563	.9145			Retain
LS 3	←	Learning Satisfaction	.9459	.8948			Retain
LS 4	←	Learning Satisfaction	.8819	.7778			Retain
CEff 1	←	SNS Effectiveness	.9257	.8569	0.79	0.49	Retain
CEff 2	←	SNS Effectiveness	.8016	.6425			Retain
CEff 3	←	SNS Effectiveness	.8639	.7463			Retain
CEff 4	←	SNS Effectiveness	.8661	.7502			Retain
ZS 1	←	ZONE Satisfaction	.6999	.4898	0.73	0.58	Retain
ZS 3	←	ZONE Satisfaction	.9626	.9266			Retain

Table 4.5

Final Results of Revised Measurement Model

Indicators		Constructs	Standardized Regression Weights	Squared Factor Loadings	Composite Reliability	Averaged Variance Extracted	Disposition
Recommended Value			> .7	> .5	> .7	> .5	Retain/Remove
SN 1-1	←	Instructor Influence	.7927	.6283	0.85	0.75	Retain
SN 1-2	←	Instructor Influence	1.0250	1.0506			Retain
SN 2-1	←	Mentor Influence	.6698	.4487	0.91	0.84	Retain
SN 2-2	←	Mentor Influence	1.1348	1.2878			Retain
SN 3-1	←	Peer Influence	.8843	.7819	0.87	0.76	Retain
SN 3-2	←	Peer Influence	1.0143	1.0289			Retain
A1-1	←	Perceived Ease of Use	.9053	.8196	0.91	0.62	Retain
A1-2	←	Perceived Ease of Use	.9546	.9113			Retain
A1-3	←	Perceived Ease of Use	.9688	.9385			Retain
A1-4	←	Perceived Ease of Use	.9288	.8627			Retain
A1-5	←	Perceived Ease of Use	.8865	.7858			Retain
A1-6	←	Perceived Ease of Use	.8574	.7351			Retain
A2-1	←	Perceived Usefulness	.8489	.7205	0.90	0.59	Retain
A2-2	←	Perceived Usefulness	.8883	.7891			Retain
A2-3	←	Perceived Usefulness	.9196	.8456			Retain
A2-4	←	Perceived Usefulness	.9539	.9100			Retain
A2-5	←	Perceived Usefulness	.9656	.9324			Retain
A2-6	←	Perceived Usefulness	.9013	.8123			Retain
PBC 1-1	←	Resource Facilitation	.7834	.6138	0.75	0.50	Retain
PBC 1-2	←	Resource Facilitation	.8520	.7259			Retain
PBC 1-3	←	Resource Facilitation	.8078	.6525			Retain
PBC 2-1	←	Technology Facilitation	.7300	.5329	0.83	0.71	Retain
PBC 2-2	←	Technology Facilitation	.9099	.8279			Retain

PBC 3-1	←	Self Efficacy	.6972	.4861	0.93	0.61	Retain
PBC 3-2	←	Self Efficacy	.8292	.6876			Retain
PBC 3-3	←	Self Efficacy	.7753	.6010			Retain
PBC 3-4	←	Self Efficacy	.7714	.5950			Retain
PBC 3-5	←	Self Efficacy	.8572	.7348			Retain
PBC 3-6	←	Self Efficacy	.7229	.5226			Retain
PBC 3-7	←	Self Efficacy	.8414	.7080			Retain
PBC 3-8	←	Self Efficacy	.8328	.6935			Retain
IM 1	←	Intrinsic Goal	.8212	.6744	0.77	0.52	Retain
IM 2	←	Intrinsic Goal	.7969	.6351			Retain
IM 3	←	Intrinsic Goal	.7055	.4978			Retain
Task 2	←	Task Value	.8457	.7152	0.91	0.66	Retain
Task 3	←	Task Value	.8159	.6657			Retain
Task 4	←	Task Value	.7941	.6306			Retain
Task 5	←	Task Value	.7955	.6328			Retain
Task 6	←	Task Value	.7917	.6268			Retain
BI 1	←	Behavioral Intention	.9370	.8781	0.76	0.61	Retain
BI 3	←	Behavioral Intention	.8567	.7339			Retain
U2	←	Tech Appropriation Utilization	.7162	.5130	0.71	0.45	Retain
U3	←	Tech Appropriation Utilization	.8134	.6617			Retain
U4	←	Tech Appropriation Utilization	.8385	.7032			Retain
LI 2	←	Learning Interest	.8574	.7351	0.74	0.42	Retain
LI 3	←	Learning Interest	.7069	.4997			Retain
LI 4	←	Learning Interest	.8900	.7921			Retain
LI 6	←	Learning Interest	.7058	.4981			Retain
CEva 1	←	Course Evaluation	.8844	.7821	0.78	0.48	Retain
CEva 2	←	Course Evaluation	.9162	.8395			Retain
CEva 3	←	Course Evaluation	.8245	.6798			Retain
CEva 4	←	Course Evaluation	.7603	.5781			Retain
LS 1	←	Learning Satisfaction	.7222	.5216	0.88	0.65	Retain
LS 2	←	Learning Satisfaction	.9563	.9145			Retain
LS 3	←	Learning Satisfaction	.9459	.8947			Retain
LS 4	←	Learning Satisfaction	.8819	.7777			Retain

CEff 1	←	SNS Effectiveness	.9257	.8569	0.80	0.49	Retain
CEff 2	←	SNS Effectiveness	.8014	.6423			Retain
CEff 3	←	SNS Effectiveness	.8637	.7460			Retain
CEff 4	←	SNS Effectiveness	.8662	.7502			Retain
ZS 1	←	ZONE Satisfaction	.6996	.4869	0.73	0.58	Retain
ZS 3	←	ZONE Satisfaction	.9628	.9310			Retain

Figure 4.2 depicts the revised hypothesized measurement and structure model. Circles indicate latent variables; while rectangles represent manifest measured variables.

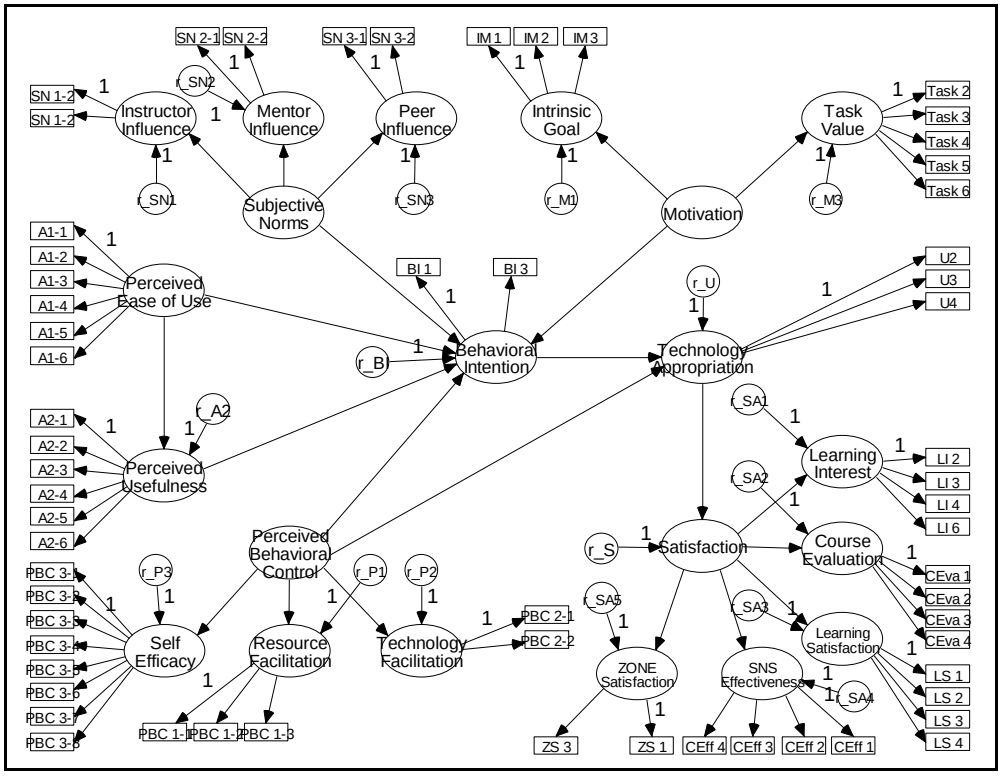

Figure 4.2. Revised model of the unified model of technology appropriation (UMTA): measurement and structural components. *Note.* All double-headed arrows representing correlations among the independent variables, as well as error terms associated with the observed indicators have been excluded from the figure.

Descriptive Statistics

Table 4.6 presents descriptive statistics and correlations of the ten independent variables with the mediating variable, behavioral intention, as well as the two dependent variables, satisfaction and technology appropriation after validating the measurement model. All of the variables had mean scores over than 4.5 showing that participants had a positive perception toward each construct. In addition, 4 of the 10 independent variables

had significant relationships to behavioral intention. For technology appropriation, almost all of the independent variables except the "technology facilitating conditions" and "self-efficacy" variables had significant relationships to students' technology appropriation. These 10 independent variables were all found to have significant relationships to students' satisfaction. A tendency of positive change between each independent variable and behavioral intention, technology appropriation, and satisfaction was confirmed.

Table 4.6

Descriptive Statistics and Correlations of Each Construct

				Correlation		
Constructs	Mean	S.D.	Variance	BI	TA	S
Independent variables						
Intrinsic goal orientation	5.8694	.89953	.809	.188	.294**	.369***
Task value	6.2969	.76709	.588	.157	.264**	.507***
Perceived usefulness	4.6806	1.71723	2.949	.372***	.258*	.431***
Perceived ease of use	5.0625	1.58356	2.508	.357***	.486***	.792***
Instructor influence	5.7396	1.27879	1.635	.116	.503***	.423***
Mentor influence	5.7135	1.23057	1.514	.289**	.361***	.429***
Peer influence	4.6146	1.60805	2.586	.088	.423***	.444***
Resource facilitating conditions	5.5533	1.16755	1.363	.439***	.315**	.787***
Technology facilitating conditions	6.3557	.86590	.750	.065	.176	.311**
Self-efficacy	6.0335	.84443	.713	.014	.163	.435***
Mediated variable						
Behavioral intention (BI)	5.3505	1.55316	2.412	1.000	.504***	.458***
Dependent variable						
Technology appropriation (U)	5.0619	1.24288	1.545	.504***	1.000	.492***
Satisfaction (S)	5.4009	1.17360	1.377	.458***	.492***	1.000

Note. Coefficient of correlation with behavioral intention, technology appropriation, and satisfaction is significant at *** $p < .000$, ** $p < .01$, or * $p < .05$.

Structural Equation Modeling

SEM allows relationships to be specified a priori for inferential purposes. Byrne (2001) asserts that SEM also allows estimating error variances, and is able to incorporate both observed and latent variables. When the requirements of reliability and validity in the measurement model are met, the next step is to evaluate the goodness-of-fit of the structural models. In the analysis, multiple items were summed together for each

construct. These sums were then divided by the numbers of the items included (i.e., the mean score of items comprising the corresponding construct), and an index number was created. For example, the index number for "perceived ease of use" was calculated by summing the six items measuring students' perceived ease of use toward the courseware together and divided by six. According to Grapentine (2000), summated scales have the following two benefits: "First, they help manage multicollinearity's effects on the estimation of regression coefficients and second, they help focus attention on more fundamental dimensions, of which the individual attributes are indicators" (p.14). Since the measures for the three constructs that comprise the subjective norm beliefs might have a problem of multicollinearity (i.e., squared factor loadings are greater than 1) (Cole, 2005; Chen, 2001), it is reasonable to calculate index numbers for the following SEM analyses.

Joreskog and Sorbom (1993) suggest that the chi-square value, the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI), and the Root Mean Square Error of Approximation (RMSEA) are commonly used fit indices reported in SEM. Satisfactory fits are obtained when the chi-square test is non-significant, but given the dependence of the chi-square test on sample size, and the need for fit indices normed from 0 to 1, it is recommended to evaluate the other indices as well. Good fits are obtained when the CFI and GFI are equal to or greater than .90 and the RMSEA is equal to or less than .10. Alternative models can be compared with chi-square difference tests for nested models. In addition, paths can be interpreted as standardized beta weights in a regression analysis. Predictive power can be examined by reading squared multiple correlations (R^2) for each endogenous variable.

To summarize the procedures of examining a full structural model, Byrne (2001) asserts that a measurement model is basically a confirmatory factor analysis and deals with the relation of the indicator variables to the latent constructs. A structural model relates to the causal interrelationships of the latent variables and any additional observed or manipulated variables. According to Gefen, Straub, and Boudreau (2000), the combined analysis of the measurement and the structural model enables:

1. measurement errors of the observed variables to be analyzed as an integral part of the model, and
2. factor analysis to be combined in one operation with the hypotheses testing (p.5).

Overall Goodness-of-Fit Statistics

Currently, there is no generally accepted single measure of overall model goodness of fit. Researchers therefore recommend the use of multiple fit criteria. In the present study, five fit indices commonly used to report SEM are employed (Joreskog & Sorbom, 1993). The five fit indices are: the chi-square value, the chi-square/degrees of freedom value, the comparative fit index (CFI), the goodness of fit index (GFI), and the root mean square error of approximation (RMSEA).

The chi-square (χ^2) value tests the proposed model against the general alternative where all variables are correlated. With this index, significant values indicate poor model fit, whereas nonsignificant values indicate good fit. The χ^2 value, the most popular index, however, has a widely known limitation (Wheaton, 1987). The value is directly influenced by the sample size. “With a small sample an alternative hypothesis which departs violently from the null hypothesis may still have a small probability of yielding a

significant value of χ^2. In a very large sample, small and unimportant departures from the null hypothesis are almost certain to be detected" (Arbuckle & Wothke, 1999, p. 398).

The chi-square/degree of freedom ratio provides an indication of the fit of the model per degree of freedom used. The ratio should be close to indicate better fit. Two thresholds for acceptable fit have been proposed in the literature: 5 or less (Marsh & Hocevar, 1985; Wheaton, Muthern, Alwin, & Summers, 1977), and 3 or less (Carmines & MacIver, 1981).

The comparative fit index (CFI), proposed by Bentler (1990), has been found to fit well at all sample sizes and is thought to provide a more stable estimate than other indices. CFI values range from 0 to 1. CFI values close to 1 indicate a very good fit. Values greater than 0.9 are considered to reflect reasonable model fit (Hartwick & Barki, 1994).

The Goodness of Fit Index (GFI) measures the amount of variances and covariances jointly attributed to the model. The index also ranges from 0 to 1, where 1 indicates a perfect fit. However, similar to χ^2 value tests, it is cautioned that the GFI value can be also overly influenced by sample size (Fan, Thompson, & Wang, 1999).

Finally, the Root Mean Square Error of Approximation (RMSEA), developed by Steiger and Lind (1980), is sensitive to the number of estimated parameters in the model (i.e., the complexity of the model). "A value of 0.08 or less for the RMSEA would indicate a reasonable error of approximation" (Arbuckle & Wothke, 1999, p. 403). RMSEA values greater than .10 indicate poor fit.

Intraclass Correlations

The present study surveyed all students enrolling in the Zone classes in Winter 2004. Given that students within the same class might score more similar to one another than

individuals from different classes, the statistical assumption of independence might be violated "when individual scores are analyzed and group ignored" (p. 341, Kenny & La Voie, 1985). To examine the possible group-level effects, intraclass correlations (ICC's) were calculated by use of the formula: ICC = $(MS_B - MS_W)/ (MS_B+(C-1) MS_W)$, where C refers to the average group size and MS_B and MS_W are the mean square between and within groups, respectively. ICC is a measure of the relatedness of grouped data. In other words, it indicates the amount of variance at the group level and affects the accuracy of the estimates (Muthév, Wisnicky, & Nelson, 1991). Due to the unbalanced number of participants in each class, Muthén's pseudobalanced solution (McDonald, 1994) was used to compute the average group size (C): $C=(N^2 - \sum_{j=1}^{G} n_j^2)/ N(G-1)$, where *N* equals to the total number of participants in the study, *n* equals to the number of participants in each class, and *G* equals to the total number of Zone classes. Table 4.7 shows results of the mean square between and within groups and intraclass correlation for each endogenous variable. In general these ICC's indicate that the observed data did not violate the assumption of independence of observations.

Table 4.7

Mean Squares between and within Groups and Intraclass Correlations

Measure	MS_B	MS_W	ICC	Measure	MS_B	MS_W	ICC
Instructor influence	2.962	1.370	0.178	Task value	0.384	0.629	-0.078
Mentor influence	1.957	1.426	0.065	Behavioral intention	2.762	2.342	0.032
Peer influence	4.989	2.105	0.204	Tech appropriation	3.064	1.241	0.215
Perceived usefulness	2.091	3.120	-0.066	Learning interest	1.908	1.715	0.021
Resource facilitation	1.661	1.304	0.049	Course evaluation	4.223	1.529	0.248
Technology facilitation	0.790	0.742	0.012	Learning satisfaction	3.411	1.482	0.196
Self efficacy	1.381	0.580	0.205	SNS effectiveness	1.608	2.600	-0.077
Intrinsic goal	0.793	0.812	-0.004	Zone satisfaction	1.486	1.528	-0.005

Note. MS_B and MS_w are the mean squares between and within groups, respectively. ICC is the intraclass correlation.

Analyses of Results

Research Question 1: What are the factors that significantly influence students' intention of using the technology, technology appropriation behavior, and satisfaction in online learning environments?

To answer this question, causal paths among latent variables (i.e., structural models) were examined. An initial test was performed on the initial model depicted in Figure 4.3. Figure 4.3 indicates the initial measurement and structure model for the goodness-of-fit tests of UMTA. Again, for the purpose of ease of seeing the important relationships all double-headed arrows representing correlations among the independent variables (i.e., motivation, subjective norms, perceived behavioral control, and perceived ease of use) have been excluded from the figure.

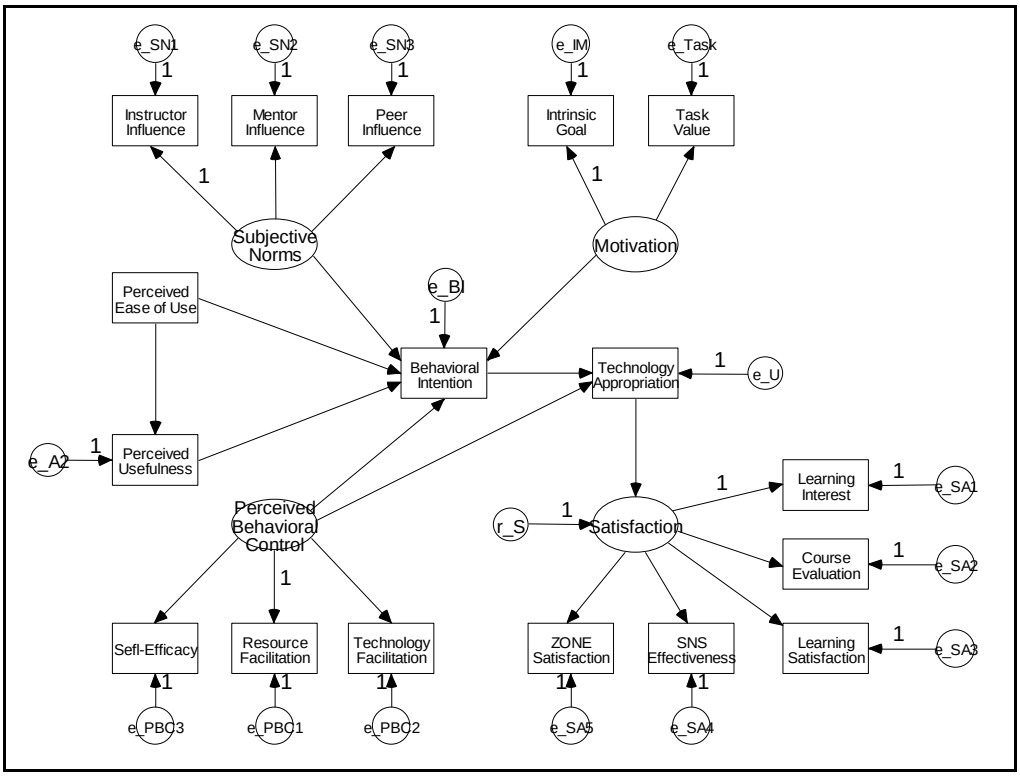

Figure 4.3. Initial UMTA for goodness-of-fit tests. *Note.* All double-headed arrows representing correlations among the independent variables have been excluded from the figure for the interest of clarity. In addition, one parameter in each set of antecedents measuring the same construct was fixed to 1 for purposes of model identification.

The overall chi-square value, with 108 degrees of freedom, is 423.4616. Other goodness-of-fit indices for this initial model were chi-square/degree of freedom= 3.9209, CFI= .6809, GFI= .6941, and RMSEA= .1744. The CFI, GFI, and RMSEA were outside the acceptable levels, indicating a poor model fit. Evidence of misfit was captured by the modification indices (MI's) in AMOS 5.0. The MI's, as a part of the output, suggested that a path from subjective norm beliefs to technology appropriation (Subjective Norms →Technology Appropriation), a path from perceived ease of using the technology to satisfaction (Perceived Ease of Use →Satisfaction), and a path from behavioral control

beliefs to satisfaction (Perceived Behavioral Control →Satisfaction) should be added. The model was modified and examined accordingly. Figure 4.4 shows the final UMTA after the adjustments.

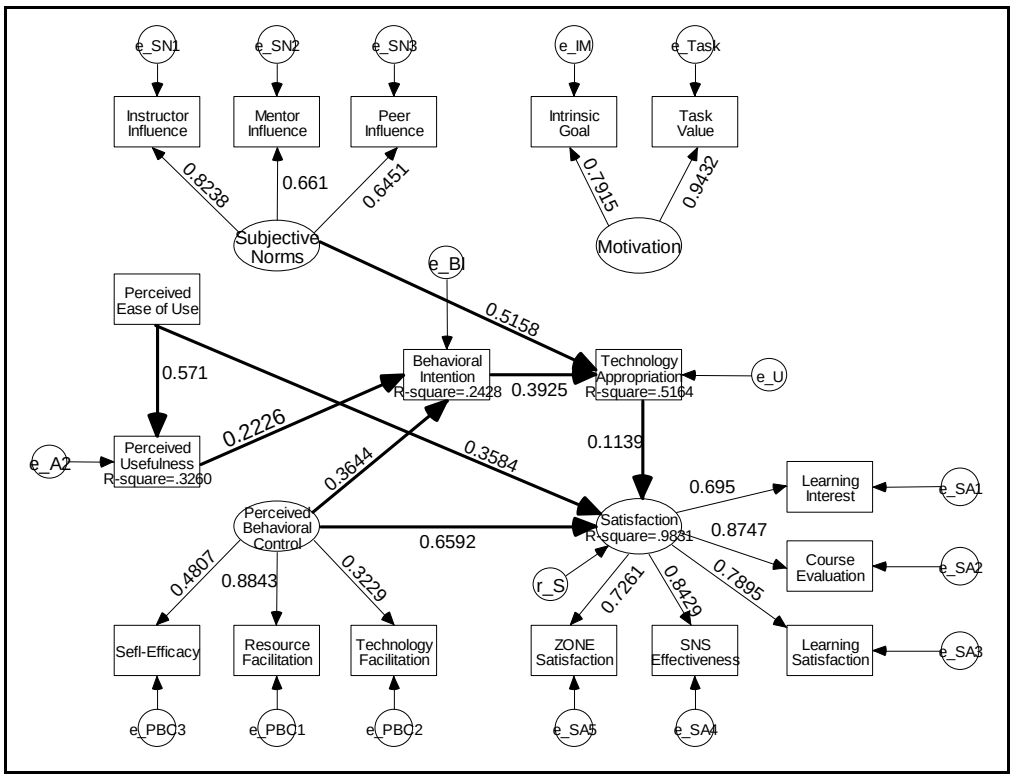

Figure 4.4. Final UMTA. *Note.* All double-headed arrows representing correlations among the independent variables have been excluded from the figure for the interest of clarity. Significantly positive correlations were seen among the four independent variables, motivation, subjective norms, perceived ease of use, and perceived behavioral control.

Table 4.8 presents the summary fitting results for both the initial as well as the revised best fitting models. The overall fit indices evidenced good support for the final

UMTA model (χ^2 = 168.9552, χ^2 /*df*= 1.6728, CFI= .9313, GFI= .8336, and RMSEA= .0837).

Table 4.8

Goodness-of-Fit Indices: Initial Model vs. Final Best Fitting Model

Model	χ^2	*df*	χ^2 /*df*	CFI	GFI	RMSEA		
Recommended Value	N/A	N/A	< 5	> .90	> .90	< .10	LO 90	HI 90
Initial model	423.4616	108	3.9209	.6809	.6941	.1744	.1571	.1921
Final model	168.9552	101	1.6728	.9313	.8336	.0837	.0610	.1054

Table 4.9 exhibits the total, direct, and indirect effects of subjective norms, perceived ease of use, perceived usefulness, and perceived behavioral control on behavior intention, technology appropriation behavior, and satisfaction, respectively.

Table 4.9

Total, Direct, and Indirect Effects for UMTA

	Total effects	Direct effects	Indirect effects
To behavioral intention			
Subjective norms	-	-	-
Perceived ease of use	.1271	-	.1271
Perceived usefulness	.2226	.2226	-
Perceived behavioral control	.3644	.3644	-
To technology appropriation			
Subjective norms	.5158	.5158	-
Perceived ease of use	.0499	-	.0199
Perceived usefulness	.0874	-	.0874
Perceived behavioral control	.1430	-	.1430
To satisfaction			
Subjective norms	.0587	-	.0587
Perceived ease of use	.3641	.3584	.0057
Perceived usefulness	.0100	-	.0100
Perceived behavioral control	.6744	.6592	.0153

Of the nine paths hypothesized in the initial UMTA (Figure 4.3), five (Perceived Ease of Use →Perceived Usefulness, Perceived Usefulness →Behavioral Intention, Perceived Behavioral Control →Behavioral Intention, Behavioral Intention

→Technology Appropriation, Technology Appropriation →Satisfaction) were found to be statistically significant for students taking Zone courses at $p < .05$. These paths reflected the impact of (1) perceived ease of using the technology on perceived usefulness of the technology, (2) perceived usefulness of the technology on one's behavioral intention of using the technology, (3) perceived behavioral control on one's behavioral intention of using the technology, (4) behavioral intention on one's actual technology use, and (5) one's actual technology use on satisfaction. In addition, three paths (Perceived Ease of Use →Satisfaction, Perceived Behavioral Control →Satisfaction, and Subjective Norms →Technology Appropriation) proved to be essential components of the causal structure. These three paths were added to the model. Finally, four hypothesized paths (Subjective Norms →Behavioral Intention, Motivation →Behavioral Intention, Perceived Ease of Use →Behavioral Intention, and Perceived Behavioral Control →Technology Appropriation) were subsequently deleted from the model due to the insignificant impacts.

The coefficient for determination indicates that the model explains 33% of the variance associated with Perceived Usefulness, 24% of the variance associated with Behavioral Intention, 52% of the variance associated with Technology Appropriation, and lastly, 98% of the variance associated with Satisfaction.

Research Question 2: How does the proposed model, UMTA, compare with the TAM, TRA and TPB for explaining the variances of students' behavioral intention, technology appropriation behavior, and satisfaction?

To compare UMTA to TAM, TRA, and TPB for their contribution to the understanding of students' behavioral intention, technology appropriation behavior, and satisfaction in a distance learning program, a four-step approach was adopted. The technology acceptance model was tested and adjusted for goodness-of-fit, followed by the theory of reasoned action, and the theory of planned behavior. Finally, the overall fit, predictive power, and significance of paths for the four models were considered. The R^2 of each dependent variable (i.e., Behavioral Intention, Technology Appropriation, and Satisfaction) was examined to assess the explanatory power for each model. Standardized path coefficients were used for path coefficients.

The Technology Acceptance Model (TAM)

TAM, proposed by Davis (1989), specifies two beliefs, perceived ease of use and perceived usefulness, as determinants of attitude towards behavioral intention. Behavioral intention is, in turn, the sole determinants of technology appropriation. The initial TAM model, depicted in Figure 4.5, was tested for goodness-of-fit.

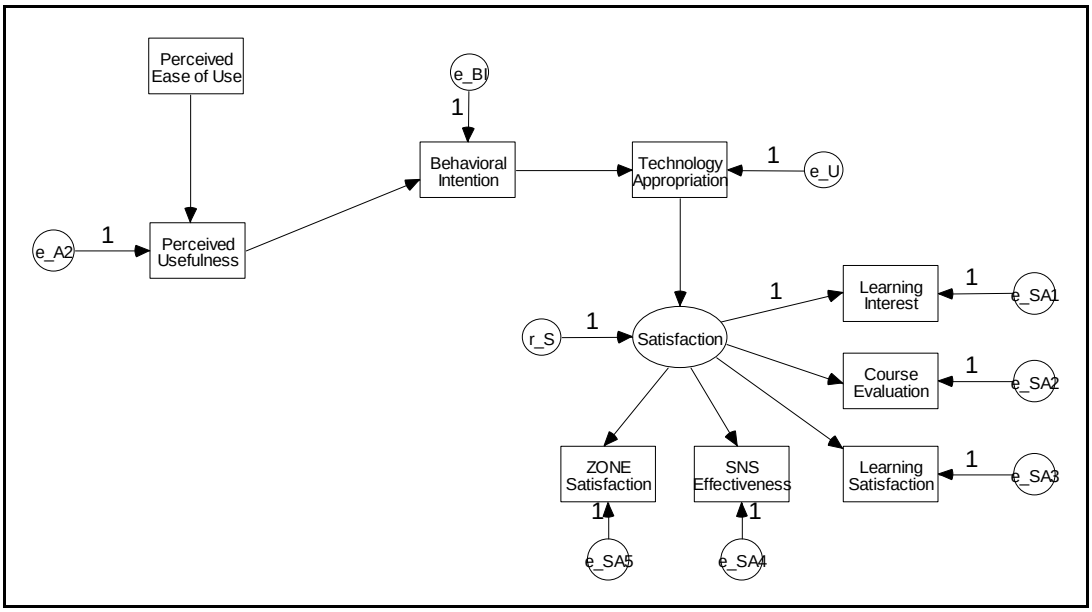

Figure 4.5. Initial TAM.

As a result, the overall model fit indices for the initial TAM were not satisfactory ($\chi^2 = 179.6897$, $\chi^2/df = 6.6552$, CFI= .7143, GFI= .7659, and RMSEA= .2427). The modification indices (MI's) from the AMOS output suggested that two paths from perceived ease of use to technology appropriation and to satisfaction (Perceived Ease of Use →Technology Appropriation and Perceived Ease of Use →Satisfaction) had significant impacts on the model fit. The model was adjusted accordingly. Figure 4.6 shows the results of the adjusted model. The fit indices indicated that the revised model provided a moderate fit to the data ($\chi^2 = 47.2430$, $\chi^2/df = 2.0540$, CFI= .9546, GFI= .9073, and RMSEA= .1048)

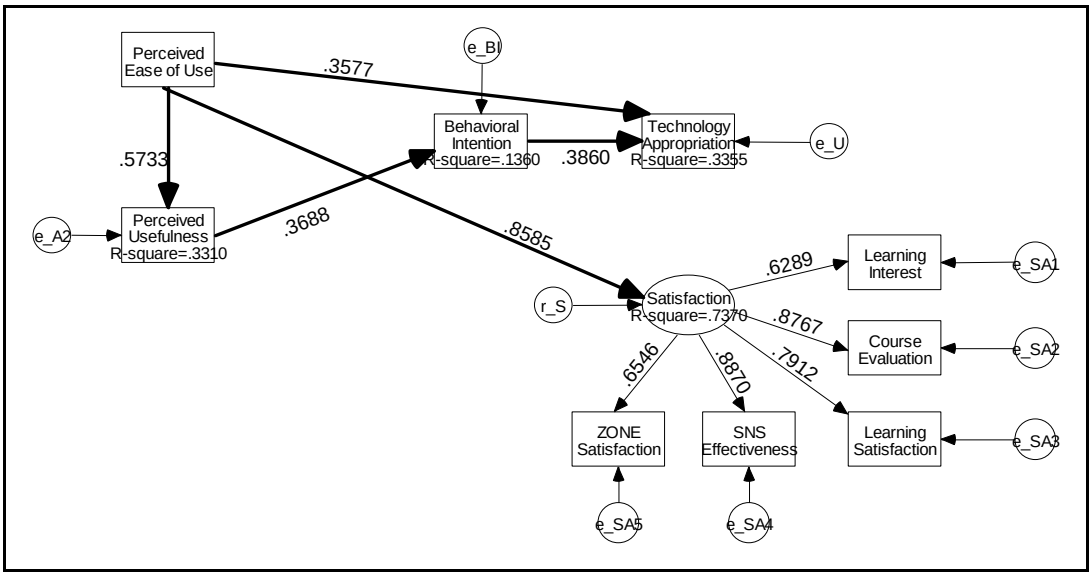

Figure 4.6. Final TAM.

As indicated in Figure 4.6, three of four path coefficients were as hypothesized (Perceived Ease of Use →Perceived Usefulness, Perceived Usefulness →Behavioral Intention, and Behavioral Intention →Technology Appropriation). The two additional paths (Perceived Ease of Use →Technology Appropriation and Perceived Ease of Use →Satisfaction) also have statistically significant coefficients in the model. However, the path, Technology Appropriation to Satisfaction, from the initial model, was insignificant and therefore deleted.

The significant path from Perceived Ease of Use to Perceived Usefulness indicates that 33% of the variance associated with Perceived Usefulness is explained by Perceived Ease of Use. In addition, the model accounts for 14% of the variance in Behavioral Intention, 34% of the variance in Technology Appropriation, and 74% of the variance in Satisfaction.

The Theory of Reasoned Action (TRA)

According to TRA, proposed by Fishbein and Ajzen (1975), one's action is determined by his/her behavioral intention to perform the action. Behavioral intention is jointly determined by the person's attitude and subjective norms concerning the action in question. TRA does not specify the determinants of attitude towards behavioral intention. Thus, the constructs, Perceived Ease of Use and Perceived Usefulness, in UMTA (Figure 4.4) were modeled as a single construct using the mean score of the summation of the two constructs. An initial test was performed on the initial TRA model illustrated in Figure 4.7.

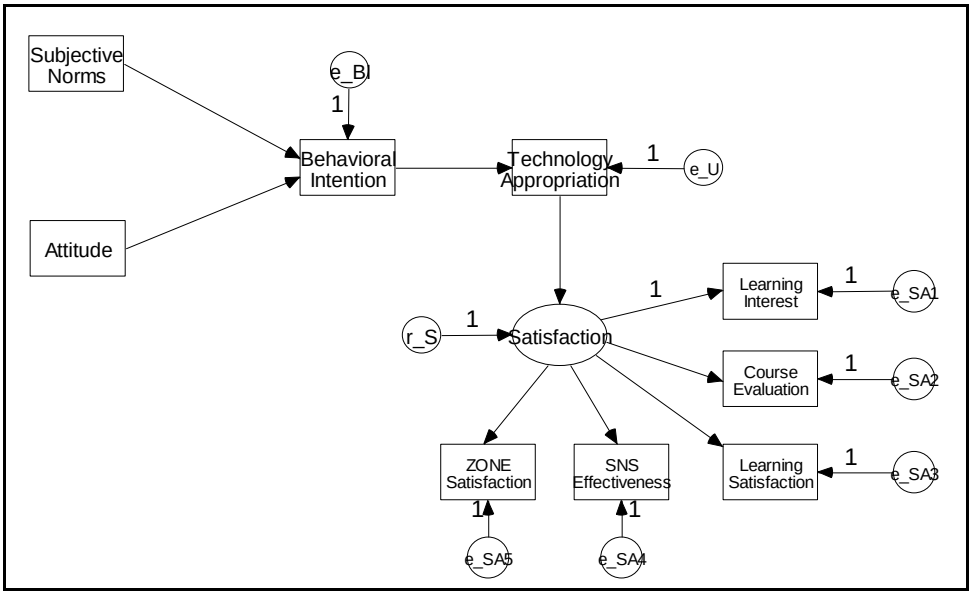

Figure 4.7. Initial TRA.

The goodness-of-fit indices suggested a poor fit for the initial model (χ^2 = 158.3067, χ^2/df= 6.0887, CFI= .7350, GFI= .7871, and RMSEA= .2302). The modification indices (MI's) from the AMOS output suggested that a path from Subjective Norms to Technology Appropriation, a path from Subjective Norms to Satisfaction, and a

path from Attitude to Satisfaction should be added. Analyses to examine the adjusted TRA resulted in a significant χ^2 (43.1740, p=.0045). Other model fit indices were satisfactory for a moderate model fit (χ^2/df= 1.9625, CFI= .9576, GFI= .9139, and RMSEA= .1001). Figure 4.8 shows the results of the adjusted model.

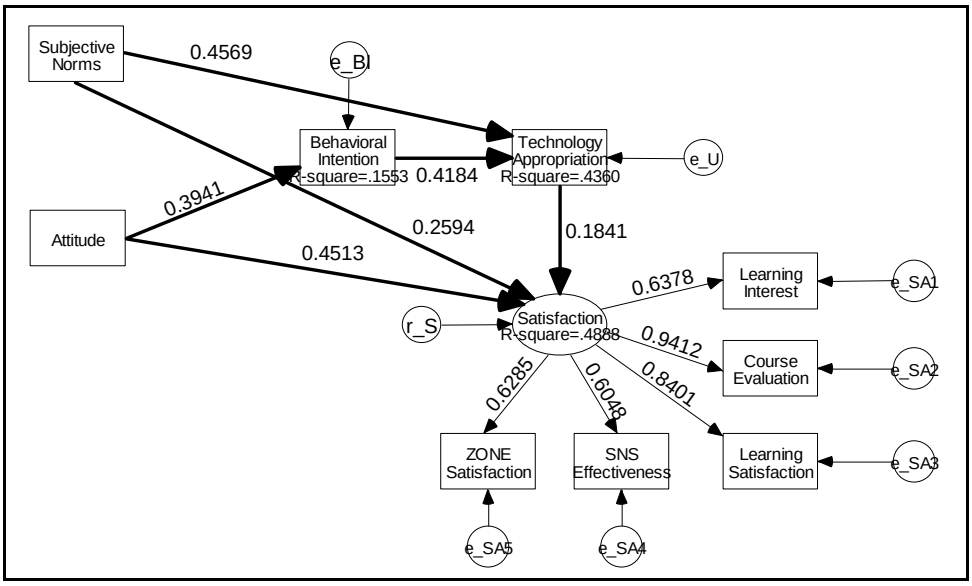

Figure 4.8. Final TRA.

As shown in Figure 4.8, all hypothesized paths but one (Subjective Norms →Behavioral Intention) were significant. Three additional paths (Subjective Norms →Technology Appropriation, Subjective Norms →Satisfaction, and Attitude →Satisfaction) were added, and accordingly, significantly improved the fit indices. However, the insignificant path from Subjective Norms to Behavioral Intention implies that one's behavioral intention was directly influenced by his/her attitude toward the technology (i.e., the courseware). The model accounts for approximately 16% of the variance in Behavioral Intention, 44% of the variance in Technology Appropriation, and 49% of the variance in Satisfaction.

The Theory of Planned Behavior (TPB)

TPB (Ajzen, 1985) extends TRA to account for conditions where individuals do not have complete control over their behavior. In TPB, Behavioral Intention is the weighted sum of Subjective Norms, Attitude, and Perceived Behavioral Control constructs. It, in turn, jointly impacts one's action (i.e., Technology Appropriation in the study) with Perceived Behavioral Control. Figure 4.9 shows the initial TPB for goodness-of-fit tests.

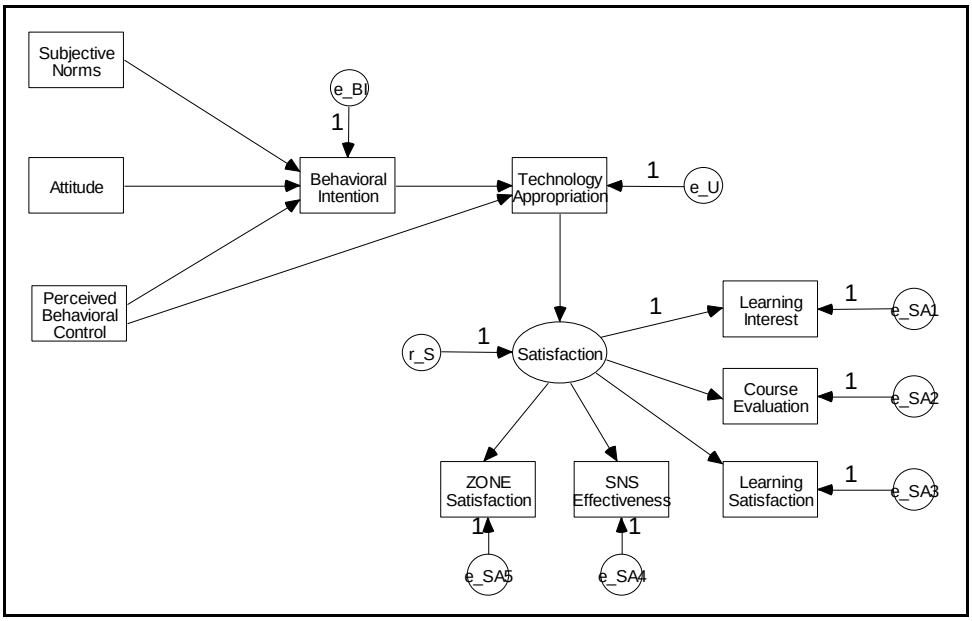

Figure 4.9. Initial TPB.

Analyses to examine TPB resulted in a poor model fit (χ^2 = 197.9162, χ^2/df= 6.3844, CFI= .7051, GFI= .7649, and RMSEA= .2368). The modification indices (MI's) suggested that three additional paths, Subjective Norms →Technology Appropriation, Attitude →Satisfaction, and Perceived Behavioral Control →Satisfaction, should be added. In addition, the three insignificant paths, Subjective Norms →Behavioral Intention, Perceived Behavioral Control →Behavioral Intention, and Perceived Behavioral Control →Technology Appropriation, were deleted. Based on the results, a

best fitting model (Figure 4.10) was proposed and tested. As a result, the fit statistics indicate that the adjusted model provides a good fit to the data ($\chi^2 = 51.2272$, $\chi^2/df = 1.7665$, CFI= .9607, GFI= .9048, and RMSEA= .0894). The path coefficients for the model are presented in Figure 4.10.

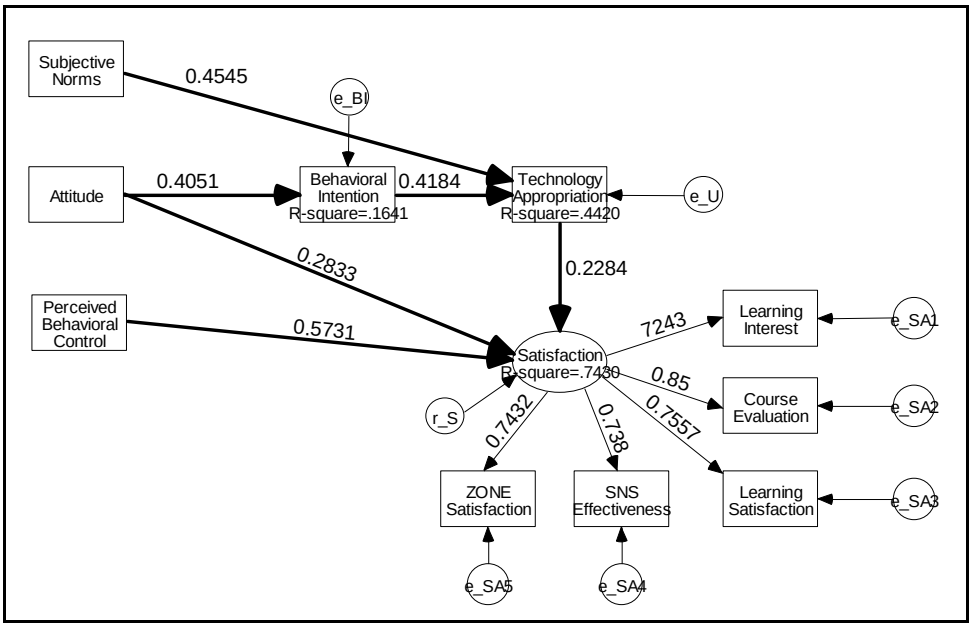

Figure 4.10. Final TPB.

As shown in Figure 4.10, three hypothesized paths (Attitude →Behavioral Intention, Behavioral Intention →Technology Appropriation, and Technology →Satisfaction) were found to be statistically significant. The insignificant paths from Subjective Norms to Behavioral Intention and from Perceived Behavioral Control to Behavioral Intention indicate that one's intention was solely determined by the person's attitude towards the technology. The model accounts for 16% of the variance in Behavioral Intention, 44% of the variance in Technology Appropriation, and 74% of the variance in Satisfaction.

Model Comparison

Table 4.10 presents a summary of the goodness-of-fit indices and the explanatory power for each model after adjustments. Overall, these four models all provide a good fit to the data. Note that the UMTA had the lowest χ^2/df ratio close to 1 and the smallest RMSEA (.0837), suggesting that even when the increased complexity of UMTA is taken into account, the fit of UMTA is at least equivalent to the other three models. UMTA, however, provides better predictive power of Behavioral Intention, Technology Appropriation, and Satisfaction relative to the TAM, TRA, and TPB models. In particular, there is a substantial increase in R^2 for satisfaction in UMTA, compared with TRA (R^2 =0.9831 for UMTA, compared with 0.4888 for TRA). In addition, though the causal paths among Perceived Ease of Use, Perceived Usefulness, and Behavioral Intention showed in UMTA were comparable to those in TAM, UMTA explains more variance in Behavioral Intention (R^2 =0.2428, relative to R^2 =0.1360 for TAM). Therefore, the additional path of Perceived Behavioral Control in UMTA does help to better understand one's intention of using the technology relative to TAM. The results support the researcher's expectation toward UMTA that additional (decomposed) information of social, attitudinal, and control beliefs would increase a model's ability to explain Behavioral Intention, Technology Appropriation, and Satisfaction. However, the insignificant path from motivational beliefs to one's behavioral intention shows that there is no support for the hypothesis of incorporating motivational beliefs into the model.

Table 4.10

Overall Fit and Explanatory Power for Each of the Models

Model	χ^2	χ^2/df	CFI	GFI	RMSEA			Explanatory Power		
Recommended Value	N/A	< 5	> .90	> .90	< .10	LO 90	HI 90	BI	TA	S
TAM	47.2430	2.0540	.9546	.9073	.1048	.0615	.1473	.1360	.3355	.7370
TRA	43.1740	1.9625	.9576	.9139	.1001	.0545	.1441	.1553	.4360	.4888
TPB	51.2272	1.7665	.9607	.9048	.0894	.0468	.1288	.1641	.4420	.7430
UMTA	168.9552	1.6728	.9313	.8336	.0837	.0610	.1054	.2428	.5164	.9831

Note. BI – Behavioral Intention, TA – Technology Appropriation, S - Satisfaction

Chapter Summary

The objectives of this study were to identify specific social and technological factors affecting students' behavior of using technology and satisfaction in online learning environments, and to compare the explanatory power of the four models, the TRA, TPB, TAM, and UMTA, for the extent to which each can be used to explain students' behavior and satisfaction. This chapter presented the results of the study. Procedures to analyze the data included descriptive statistics, Pearson's correlation, and structural equation modeling. Chapter V presents a discussion of the results and a summary of the study.

CHAPTER V

Discussion and Implications

Distance learning is a growing part of higher education. About 127,400 online courses were offered in 2001 to 2002, and approximately 3.1 million enrollments in distance education. In addition, over 50 percent of degree-granting institutions offered credit-granting distance education, and another 12 percent planned to offer distance education courses in the next 3 years (NPEC, 2004).

Distance education has the unique characteristic of using technology to mediate the entire learning experience. The requirement of mediating all human to human and human to content interactions presents many practical and theoretical challenges. Theories of learning and social interaction are challenged to describe and explain new forms of behavior such as establishing an identity online, forming teacher-student relationships, and making judgments about participation and contribution through new social mechanisms. However, Phipps and Merisotis (1999) in a review of contemporary literature on the effectiveness of technology mediated distance learning in higher education concluded that many of the documents are how-to articles and policy papers and fail to contribute to testing and advancing theory. Moreover, in its latest report on how technology affects access in postsecondary education, NPEC (2004) concluded that "original research is in short supply, and those limited studies suffer from poor methodology" (p. xii).

The present study, contributes to addressing the need of "true, original research dedicated to explaining or predicting phenomena related to distance learning" (Phipps & Meriosotis, 1999, p. 2), and has four objectives: (1) to identify specific social and

technological factors affecting online students' behavior of using technology, (2) to conceptualize a theoretical model to better represent the relationships among the salient factors, (3) to examine how the elements in the theoretical model influence students' learning perceptions and satisfaction in the distance education program, and (4) to compare the proposed model with prior work to model and explain online behavior and satisfaction.

Summary and Discussion

Demographics and Background of Subjects

All of the participants in this study were students enrolled in a distance education program in Winter 2004. After the initial data clean-up process, analyses for this study were preformed using data from 97 students. The sample included 52 female (53.6%) and 45 male (46.4%) students. Twenty-six students were undergraduate, and 22 (22.7%) were under age 25. In addition, 75 students accessed their online courses at home most of the time. Approximately 48% of the participants reported that they accessed their courses at least once everyday, and half of the participants (N=49) indicated that they spent 1-5 hours on their courses in an average week.

The demographics of the sample were, to some extent, consistent with the national profile of participation in distance programs. According to the Postsecondary Education Descriptive Analysis Reports in 2002, about 56.6% of the students enrolled in online courses were female, and 43.4% were male. About 37.7% were under age 24 and 62.3% were age 24 and over.

Factors that Impact Behavioral Intention, Technology Appropriation, and Satisfaction

The study's first question asked what factors significantly affect online students' intention of using technology, behavior, and satisfaction. In the UMTA model, norm beliefs of important others, perceived ease of use, perceived usefulness of the courseware, behavioral control beliefs, and motivational beliefs were hypothesized to influence online students' intention of using the courseware. Perceived behavioral control and intention together were then expected to impact students' technology appropriation behavior. Finally, students' satisfaction about their overall learning experience in the distance education program was expected to be affected by their appropriation of the courseware.

Two sets of instruments were administered at the beginning and near the end of the semester in Winter 2004. The study measurement scales were shown to be valid and appropriate. All retained items showed high levels of reliability, and the proposed latent constructs for subjective norm beliefs, attitudinal beliefs, behavioral control beliefs, and motivational beliefs also demonstrated satisfactory composite reliabilities. The following sections summarize the findings from structural equation modeling analyses as well as present discussions of the findings.

Behavioral Intention

The direct effects of factors to explain student intention to use courseware were examined. As hypothesized, perceived usefulness and perceived behavioral control were significant predictors on intention. However, contrary to the initial UMTA formulation subjective norm, motivational beliefs, and perceived ease of use did not significantly impact on intention to use courseware. An examination of the indirect effects indicates that perceived ease of use, however, had an indirect impact (β =.13) on students'

intention. Additionally, perceived behavioral control had the strongest total effect (β =.36) on intention, followed by perceived usefulness (β =.22) and perceived ease of use (β =.13). These variables together explained 24% of the variance in intention. The result shows that students consider both internal (i.e., self-efficacy) and external controls (i.e., resource facilitating conditions and technology facilitating conditions) when trying to estimate whether they will use the courseware to achieve their goals. Perceived usefulness and ease of use also influence the choice to use courseware but to a lesser extent than perceived behavioral control.

Interestingly, the study found that motivational beliefs (i.e., intrinsic-goal orientation and task value), while significantly correlated with the other latent variables, did not have the expected direct influence on students' intention of using the courseware. A plausible explanation of this result is that the use of the courseware was mandatory rather than voluntary in the distance program. No matter how they evaluated the importance and usefulness of their tasks and what their preferences of learning were, students, in essence, needed to use the courseware to interact with others and meet the requirements of the course. Moreover, the low explanatory power of BI found in this study is also consistent with Sheppard et al.'s (1988) findings where models performed better when used to study activities involving choices. This result confirms the need to understand the context of use for IT systems. In an organization setting use of IT systems may range from high degrees of individual autonomy to very limited options, and this degree of choice appears to be an important dimension of intention and use.

Technology Appropriation

As the final UMTA model suggests, subjective norm and intention were direct determinants of students' technology appropriation behavior, where subjective norm had a stronger positive effect (β =.52, relative to β =.39) relative to behavioral intention for appropriation. Furthermore, perceived ease of use, perceived usefulness, and perceived behavioral control had indirect effects on technology appropriation (β =.05, .09, and .14, respectively). The total impacts of these significant paths accounted for 52% of the variance in students' technology appropriation behavior. In addition, the correlation between intention and technology appropriation was 0.50, which is consistent with the average correlation of 0.47 for the intention-behavior relationship involving no choice reported in Sheppard et al.'s (1988) meta-analysis of 87 studies.

It is also interesting to note that subjective norm directly impacts students' appropriation but not their intention to use the courseware. According to Hartwick and Barki (1994), the most important antecedent of mandatory users' intentions is subjective norm. Venkatesh and Davis (2000) as well as Hartwick and Barki (1994) also have similar conclusion that normative influences only matter in mandated-use situations. The present study, however, didn't support their contention. Instead, subjective norm had a stronger direct influence (β =.52) on technology appropriation behavior. Two possible explanations for the findings are discussed next.

A possible explanation of this phenomenon is that when students think about or plan for the use of technology they consider and are influenced by behavioral controls and their sense of the usefulness of the system. However, actual use may be more influenced by their interactions and expectations for interactions with other members of

their social context. Another possible explanation might be found in the work of Hartwick and Barki (1984). They took user participation into consideration while testing their models. Their results showed that subjective norm had stronger impacts on regular-use users, compared to heavy-use users. Attention to how different types of users may form their intentions to use the system needs to be considered in future research.

Student Satisfaction

Students' satisfaction was hypothesized to be influenced by their technology appropriation behavior. Students who reported using the courseware more frequently were expected to be generally more satisfied with their learning experiences in the distance program. Their satisfaction was measured through five subscales: learning interests, course evaluation, learning satisfaction, courseware effectiveness, and Zone satisfaction. The final UMTA model demonstrated that not only students' technology appropriation behavior but also their perceived ease of use of the courseware and behavioral control beliefs had significant direct impacts on their satisfaction. The model accounted for 98% of the variance in satisfaction. Furthermore, the relatively small indirect effects of subjective norm (β =.06), perceived usefulness (β =.01), perceived ease of use (β =.01), perceived behavioral control (β =.02), and behavioral intention (β =.04) suggested that the direct effects of perceived behavioral control (β =.66), perceived ease of use (β =.36), and technology appropriation (β =.11) on students' satisfaction form a strong explanation of satisfaction in learning system use. The heavy weights of students internal (i.e., self-efficacy) and external (i.e., resource and technology facilitating conditions) on their satisfaction about overall learning experiences imply that students' perceived own capabilities of performance and perceived availability and

accessibility of external supports are critical to their satisfaction and evaluation of the learning experience in distance education programs.

Comparisons to Prior Models

Another research question in this study was to compare the explanatory power of different models (i.e., TAM, TRA, TPB, and UMTA) for predicting and understanding online students' intention, technology appropriation behavior, and satisfaction. The comparison examined model fit indices and explanatory power in predicting the three dependent variables (i.e., intention, technology appropriation, and satisfaction).

In general, each of the models provided a good fit to the data. It is noteworthy to see that even with the increased model complexity, the fit indices of UMTA were equivalent to the other three models. Moreover, the results clearly illustrated that UMTA provided better predictive power of students' behavioral intention, technology appropriation behavior, and overall learning satisfaction.

TAM vs. UMTA

Consistent with TAM, perceived ease of use directly impacted perceived usefulness and students' satisfaction in UMTA. In addition, students' intention to use the courseware was influenced by perceived usefulness, and in turn, impacted their technology appropriation behavior. However, UMTA, compared with TAM, explained relatively higher levels of variances in intention (R^2=.24, relative to .14 for TAM), technology appropriation (R^2=.52, relative to .34 for TAM), and satisfaction (R^2=.98, relative to .74 for TAM). The addition of perceived behavioral control helped to successfully predict students' intention and satisfaction, whereas subjective norm added more to the explanatory power of technology appropriation behavior. Therefore, given that the total

effects of intention on appropriation behavior in both TAM and UMTA are approximately equal (β =.39), it can be concluded that online students' behavior (i.e., technology appropriation) is greatly impacted by their perceived expectations of important others. Furthermore, the strong total effects of behavioral control beliefs on students' intention (β =.36) and overall learning satisfaction (β =.68) show that online students' intention and satisfaction might not completely under volitional control as hypothesized in TRA. Rather, their perceptions of own capabilities to succeed in their online courses and the availability of additional supports to learning and technical problems appear to significantly affect students' intention and satisfaction.

TRA vs. UMTA

UMTA differs from TRA in two key aspects. First, UMTA introduces perceived behavioral control and motivational beliefs as two additional determinants of students' intention. Second, UMTA decomposes the attitude construct into perceived ease of use (the belief that one's use of the courseware will be free of effort) and perceived usefulness (the belief that using the courseware will increase one's performance. Unlike TRA where attitude is hypothesized to directly impact students' intention, UMTA omits the attitude construct and theorizes both perceived ease of use and perceived usefulness have a direct influence on intention. Results of both models revealed somewhat similar causal patterns. Attitude was found to directly impact students' intention and satisfaction, whereas subjective norm directly affected technology appropriation behavior. Additionally, UMTA took a closer look at the attitude construct, and found students' satisfaction was primarily influenced by their perceived ease of use. However, UMTA provided better explanatory power than did TRA (R^2=.24 for intention, .52 for

appropriation, and .98 for satisfaction in UMTA, relative to .16, .44, and .49, respectively in TRA). As a result, it can be concluded that the additional information of decomposed subjective norm and attitude constructs add power to the explanation of students' intention, appropriation behavior, and satisfaction in distance education programs.

TPB vs. UMTA

In comparing UMTA and TPB, UMTA articulates more specific information than TPB. In TPB belief constructs are unidimensional, whereas in UMTA specific antecedents to attitude, subjective norm, and perceived behavioral control are taken into account. The unidimensional view of belief may lead to invalid predictions. For instance, Burnkrant and Page (1988) found that although normative belief was found significant on subjective norm, only one of two groups of important referents showed significant impacts after decomposing normative belief into two groups (Park, 2003). Results of the present study indicate that TPB and UMTA shared similar causal relationships among factors: (1) subjective norm had a direct impact on technology appropriation behavior, (2) intention mediated the relationship between attitude and technology appropriation behavior, (3) technology appropriation behavior directly affected students' satisfaction, and (4) perceived behavioral control had a direct impact on students' satisfaction. However, the better explanatory power of intention, appropriation behavior, and satisfaction in UMTA (R^2=.24 for intention, .52 for appropriation, and .98 for satisfaction in UMTA, relative to .16, .44, and .74, respectively in TPB) shows the value of providing specific and directive antecedents for each construct (i.e., decomposing unidimensional constructs).

Selections of Models

Because UMTA accounted for more variance in explaining intention, appropriation behavior, and satisfaction, the present results show that UMTA is the "best" model to understand social and technical factors in online learning environments. However, UMTA is a more complex model than the other three models. According to Bagozzi (1992), the "best" model is the one the most parsimonious (i.e., with the fewest predictors). Clearly the selection of a "best" model depends on research purposes. Both parsimony and contributions to understanding a phenomenon should be taken into consideration when evaluating models (Taylor & Todd, 1995). If the research interest is to predict, parsimony may be more heavily weighted. If a focus of research is to "obtain the most complete understanding of a phenomenon, a degree of parsimony may be sacrificed" (Taylor & Todd, 1995, p.169). Since the primary research goals of the current study were to understand and explain students' technology appropriation behavior and to examine how the salient social and technical factors influence students' overall satisfaction in a distance education program, the selection of UMTA has proven to have significant empirical advantages over the other three models.

The findings, consistent with what Taylor and Todd (1995) and Park (2003) found, support that the decomposition approach used in the present study may strengthen the ability to explain participation, experience, and outcomes in technology mediated distance learning. The partition of normative influences into instructor, mentor, and peer influences and the decomposition of behavioral control beliefs into efficacy and external resource and technical facilitating factors in UMTA result in an increase of explanatory power relative to TRA and TPB where beliefs are treated as monolithic constructs.

Limitations

Notwithstanding the contributions of the present study to the existing literature, there are a number of limitations and cautionary notes that need to be considered. The key limitations are the reliance on self-report measures, the limited power for explaining behavioral intention, the generalizability of the findings, the independence-of-observations assumption, and the timing of survey administration.

First, the original measurement of use behavior included items from both self-report data (i.e., technology appropriation) and computer-record information (i.e., technology utilization). However, items that contained the system log information failed to meet the criteria of item reliability and construct validity. They were removed from the final measurement model accordingly. As a result, only self-report measures of use behavior were used for structural equation modeling, and self reports may not accurately represent actual behavior. Nevertheless, Ajzen (1987) and Hartwick and Barki (1994) defend the use of self reports and argue their importance. According to Hartwick and Barki (1994), "individuals, when they respond to such measures, likely consider actions that they have performed in a variety of contexts and at many different times. On the other hand, objective assessments of behavior, for pragmatic reasons, are often restricted in scope (with assessment made only in certain contexts or at certain times)" (p. 460). Consequently, they argue that self report measures might be more valid in terms of comprehensive assessments of behavior.

Second, the four models tested in the present study did not account for more than 25% of the variance in students' behavioral intention. There are three possible explanations for the result.

1. Similar to other TPB and TRA research, the present study did not distinguish between individuals' intention to perform a specific behavior and their subjective estimates of actually performing the behavior (Warshaw & Davis, 1985; Sheppard, Hartwick, & Warshaw, 1988). These two measures are often used interchangeably. According to Sheppard, Harwick, and Warshaw (1988), however, there are times where what one's intention to do (i.e., intentions) and what one's actual expectation to do (i.e., estimates) are quite different. For example, people might respond to questions like "Do you intend to do X?" (intentions) and "Will you do X?" or "Do you really think you'll do X?" (estimates) differently. Sheppard, Harwick, and Warshaw (1988) contended that when individuals try to estimate whether they actually will perform some behavior, they are likely to think over various factors that could influence their attempt to carry out such intentions. Thus, normative beliefs, attitudinal beliefs, motivational beliefs, and behavioral control beliefs might weigh more in studies using an estimation measure of behavior. Further revision of the measurement to distinguish between intentions and estimates is needed.
2. An alternative explanation is that in the distance education program although students have control of many of the ways in which they use courseware, usage of the courseware is also mandated. Students likely believe that they need to use the courseware to achieve their goals (e.g., interacting with others, completing assignments, getting good grades), no matter what their perceived expectations from others, their feelings of favorableness or unfavorableness toward the courseware, and their perceived own efficacy and availability of external supports are. Therefore,

caution about directly interpreting the findings under conditions of voluntary usage must be exercised.

3. A third possible explanation for the result is that factors other than the primary determinants identified in UMTA might greatly influence ones' intention of using the courseware to perform some behavior in distance education. It is suggested that future research use more qualitative approaches to expand the scope of antecedents that might influence students' intention.

The third limitation concerns the genealizability of the research findings.

1. The distance education program examined in the present study provides both physical and online support environments. The online environment includes online access to the course virtual space and online mentor supports through discussion board, instant messaging, email, and telephone. Unlike most other distance education programs, the studied program also provides a physical computer laboratory that has advanced technological tools and software for media development as well as mentors to consult with students on their questions and needs (Laffey, Lin, & Lin, 2005). No measures were taken of the extent to which students used the physical and face-to-face features of the Zone. The relationships described in UMTA are related to the domain and should be extrapolated to other domains with caution. Further research is needed to investigate the relationships across different domains.
2. In Hox and Maas' (2001) simulation study on the accuracy of multilevel SEM with pseudobalanced groups and small samples, they concluded that sample sizes lower than 100 may lead to nonconvergence results and inaccurate estimates. In addition, in

his Monte Carlo investigation of confirmatory factor analytic models, Jackson (2001) also found that sample sizes had the largest effect on the variance in parameter estimates. The result replicates findings from most Monte Carlo's studies (e.g., Gerbing & Anderson, 1985; Velicer & Fava, 1998) and reinforces the significance of having substantial sample sizes to reduce the error of estimation. Given that the findings of the present study were derived from 97 students' self report data, further investigations with larger sample sizes are strongly recommended before drawing general conclusions.

Another limitation is the potential for violation of the independence-of-observations assumption. We assume that people are at least to some degree affected by who and what they interact with. "Shared experience and environments can make people more similar to (or more different from) one another than they would have been without such experiences and environments" (p. 17, O'Connor, 2004). To investigate the magnitude of interdependence between classes, intraclass correlations (ICC's) were computed for all the dependent variables in UMTA. ICC's were found to range from -.078 to .248. Among the 16 endogenous variables, five had a value for the ICC approaching or exceeding .20. Although Barcikowski (1981) indicated that it is reasonable to have a value for the ICC around .20 and Hox and Maas (2001) considered values under .25 to be relatively small, it is important to keep in mind that larger ICC's tend to bias standard errors, affect χ^2 values, and reject models too frequently. Further work should account for the relatedness of grouped data and examine the within- and between-group effects.

Finally, the four independent constructs, subjective norm, perceived behavioral control, attitude, and motivation, and their antecedents were not assessed contemporaneously in the present study. The MSLQ measuring students' goal-orientation, perceived task value, and self-efficacy was administered at the start of the term, whereas the rest of variables including instructor influence, peer influence, mentor influence, perceived usefulness, perceived ease of use, resource facilitating conditions, technology facilitating conditions, intention, technology appropriation behavior, and satisfaction were measured near the end of the semester. This method might reduce the observed relationship, relative to contemporaneous measurement, between motivational beliefs and the dependent variables. Therefore, necessary cautions must be exercised when interpreting the results. Further exploration of how the timing of measurements might lead to different findings is needed.

Implications and Recommendations for Further Study

Findings of the final UMTA suggest that subjective norm strongly impacts students' technology appropriation behavior and behavioral control beliefs greatly influence students' satisfaction. In addition, UMTA appears to be the best model to understand both social and technical factors in distance education systems. Several implications and recommendations for further study will be considered in this section.

Theoretical Implications and Recommendations for Further Study

This study sought empirical support for a unified model, UMTA (Unified Model of Technology Appropriation), which modified from TAM (Technology Acceptance Model), TRA (Theory of Reasoned Actions), TPB (Theory of Planned Behavior), and MGDB (Model of Goal Directed Behavior). Findings of the present study support our hypothesis

that through incorporating additional factors, such as the influence of significant others including instructors, peers, and mentors, perceived ability, and perceived availability and accessibility of additional supports, UMTA could provide a more complete understanding of usage.

The major theoretical contribution of this study is the advancement of knowledge in technology acceptance in distance education literature. In addition, prior to this study, no research had addressed the potential reciprocal relationships among intention, use behavior and satisfaction, and the salient constructs identified in different models. The results of the study indicate that use behavior mediates the impact from behavioral intention to satisfaction. Moreover, the relatively high R^2 values in UMTA compared with TAM, TRA, and TPB suggest that UMTA is a reliable model, which can be used effectively within similar contexts.

The construct, motivational beliefs including intrinsic goal orientation and perceived task value, however, had no direct impact on students' intention as hypothesized in UMTA. The result might be due to the mandatory use of the courseware in distance learning. Nevertheless, there are significant covariances between motivation and the other independent variables. Further future investigation into these interrelationships may help to better understand online students' technology use behavior.

As Harter and Connell pointed out, the best fitting model in any analysis can only maximize the functional relationships among the specific variables included in the network. The addition of a new variable may change the pattern of relationships. Variables that may be considered in future modeling attempts include demographic variables (e.g., gender, prior experience, and age) and learning achievement. Results from

such studies will have the important benefit of enhancing the overall generalizability of UMTA.

Gender. Venkatesh et al. (2003) posited that it is imperative to understand the importance of gender because it moderated key relationships among performance expectancy, effort expectancy, social influence, and behavioral intention. In addition, in their study in end-user programming environments, Beckwith & Burnett (2004) concluded that gender potentially impacts end-user programmers' success. Furthermore, Lin and Laffey (2005) found that females' intention of use is heavily weighted by their perceptions and assessment of own ability and the availability of external supports (i.e., perceived behavioral control) and of subjective norm. However, these two constructs have no impact on males' intention. Rather, the intention of males is influenced by their attitude toward the courseware. With the continual rise in technology use and distance education programs, the need to consider the impact of gender on technology appropriation (Ma & Clark, 2003) and behavior are warranted.

Prior experience. Park (2003) used multi-group analysis to compare the effect of prior experience on online shopping behavior. He found that attitudinal beliefs played a more important mediating role between usefulness and intention to shop online for low-experience groups. In addition, studies such as Atkinson and Kydd (1997) and Compeau and Higgins (1995) also found past experience directly and indirectly affects one's current behavior. Future work might be directed at more closely examining the importance of experience for better understanding its moderating role.

Age. Venkatesh et al. (2003) found that age moderates all of the key relationships in their proposed model. Their results suggest that social norm is more likely to be salient to

older female workers. In another study, Morris and Venkatesh (2000) conclude that attitude is more salient for younger people while perceived behavioral control is more salient for older workers. As a result, it is evident that age is a key moderating influence that needs to be further examined.

Learning achievement. Students' learning achievement is often used as an objective assessment of their knowledge attainment. In addition, because of the social nature of learning, Wenger (1998) as well as other advocates of social theories of learning (Lave & Wenger, 1991; Vygotsky, 1978; Laffey, Lin, & Lin, 2005) argue that knowledge construction should be measured by our ability to contribute to valued practices. Given the fact that subjective norm and perceived internal and external control beliefs play an important part in explaining students' technology use behavior and satisfaction in online learning environments, future study should include multiple measures of achievement (e.g., grade point average, perceptions of academic competence, perceptions of social ability) as new dependent variables and examine their relationships with the proposed factors in UMTA.

Other variables such as task characteristics, types of sophistication of system use, and self-regulations, may also influence the inter-relationships among social factors, technical factors, intention, use behavior, and satisfaction. In addition, to counter the limitations of sole reliance on self-report measurements as well as to systematically explore the effects of these constructs on use and satisfaction, future research can use multiple approaches including observations, case studies, computer recorded usage logs, and interviews in combination with self-report instruments.

Practical Implications and Recommendations for Further Study

The present study found that subjective norm has a substantial impact on students' technology appropriation behavior in distance education programs. Since online courseware is one of the core means of online learning, online educators should consider ways to facilitate social interaction among learning networks for successful outcomes. For example, instructors can design learning activities which provide students some experience of exploring different functions available in the courseware at the start of a term. The goal is to bring all students "up to speed" on how to effectively use the online environment to interact with others, accomplish assignments, and acquire knowledge.

Results of the study also suggest that students' belief in their own ability (i.e., self-efficacy) and external resource and technical supports have strong influence (β =.68) on students' satisfaction within their overall leaning experience, followed by students' perceptions that the use of courseware is free of effort (β =.36). These findings have important implications for system designers, online educators, and distance education program managers. In order to reduce students' frustration, not only online instructors but also program managers need to provide and assure the availability of external supports including mentoring and technical supports. System designers, on the other hand, have to enhance the system's ease of use through good design and by providing clear instructions.

When assessing their attitude, perceived subjective norm, perceived control conditions, and intention, students in the study were asked to reflect upon their perceptions toward the overall courseware rather than feelings about functions in the courseware. Because the courseware provides many functions such as discussion boards, instant messenger, email, real-time chat rooms, collaborative writing applications, etc.,

different relation patterns might emerge if these functions were assessed separately. It is assumed that subjective norm might still have the strongest impact on students' use of discussion boards given the fact that discussion boards are the primary means for interaction. Nevertheless, for some functions such as the collaborative writing application, if collaborative activities are not a part of the instruction, the use of it becomes voluntary. In voluntary use situations, students' attitude toward the tool (i.e., ease of use and usefulness) might be weighted more heavily. Future research is needed to validate this speculation.

Conclusion

To identify specific factors that impact students' intention, technology use behavior, and satisfaction in distance education programs, this study modified and decomposed the belief constructs of TPB and added motivational beliefs (i.e., intrinsic-goal orientation, extrinsic-goal orientation, and perceived task value). Similar to Venkatesh et al.'s (2003), Taylor and Todd's (1995), and Park's (2003) contention, this study agrees that using a unitary set of beliefs to understand students' use of technology in online learning environments may lead to "important relationships being obfuscated" (Venkatesh et al., 2003, p. 471). This approach found that compared to TAM, TRA, and TPB, the proposed UMTA provided a greater understanding of how the factors in social and technical systems may influence students' intention, behavior and satisfaction in online learning environments by accounting for more of the variance.

Among the statistically significant paths found in UMTA, subjective norm had the strongest relationship to students' technology appropriation behavior, while perceived behavioral control had the strongest impact on students' satisfaction. Motivational beliefs,

however, did not have direct impacts on students' behavior and satisfaction. Results of the present study should help to better manage online courses by focusing attention on social influences and control factors in a distance education program.

Nevertheless, further exploration of alternative factors that might influence use behavior and intention are warranted. Other variables may include demographic information, learning achievement, task characteristics, types of sophistication of system use, and self regulations. In addition, the relationships described in UMTA are specific to academic domains which share similar characteristics with the examined distance education program. Research needs to look at generalization of the findings across different domains. Moreover, multiple approaches of data collection including observations, case studies, computer recorded usage, and interviews can be used along with self-report instruments to counterbalance the measurement limitations.

APPENDIX A

Cover Letter to the Students

College of Education
School of Information Science and Learning Technologies
University of Missouri-Columbia

James M. Laffey, Ph.D.
221 L Townsend
Columbia, MO 65211
Phone: (573) 882-5399
Email: LaffeyJ@missouri.edu

Dear Zone Course Student,

This letter/form is to request your permission to allow the Zone Experience Study (also known as the Shadow Implementation Study) investigators to interview you about your learning experiences and interaction in the Zone. The primary purpose of this interview is to learn about the ways you participate in your courses and how the tools such as SNS and other Zone resources support your learning.

Your participation is completely voluntary, and you may withdraw from the study at any time. There are no reasonably foreseeable risks or discomforts that might occur as a result of your participation. Your participation will NOT affect your grade in this class; however, your participation is greatly appreciated and will benefit all students by helping us understand how the Zone can best facilitate learning. The average time commitment for completing the interview is approximately 30 minutes.

All records and information collected in this interview will be confidential. The interview will be audio-taped and will ONLY be heard by the investigators for subsequent transcription and analyses, unless I specify otherwise. All audio-tapes will be digitized as a file and stored on a computer in the Center for Technology Innovations in Education at the University of Missouri. In any reporting of the data all individuals will be anonymous, so there is no risk of your participation in this study to becoming publicly known.

Please fell free to contact me, James Laffey, with any questions about the study and/or your participation.

By entering your full name and contact information and submitting the agreement below, you will provide consent to be interviewed about your impressions and learning experiences in the Zone.

Full Name: _____
Student ID: _____
Phone Number: _____
Email: _____

Thank You,
James M. Laffey

If you have any questions about human subject research you can contact the University of Missouri Campus Institutional Board at (573) 882-9585

APPENDIX B

Demographic Survey

Gender: M F

Age: _____

Current Academic Status: __ Undergraduate __ Master __ PhD

1. How many online courses have you taken prior to this semester? _____

2. How many Zone courses have you taken prior to this semester? _____

3. Where did you access the Internet for your Zone coursework primarily?

__ Home
__ ZONE
__ IAT computer lab
__ Work
__ Other, please state:_____

APPENDIX C

Zone Experience Study Questionnaire

Direction: In this questionnaire, rating scales with strongly disagree-strongly agree as end points. Remember there are no right or wrong answers, just answer as accurately as possible. Please use the scale below to the questions. For example, if you strongly agree the statement, circle 7; if you strongly disagree, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

Part A: Attitude

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
1.	My **INSTRUCTORS** expect me to use SNS	1	2	3	4	5	6	7
2.	My **INSTRUCTORS** want me to use SNS frequently	1	2	3	4	5	6	7
3.	Generally speaking I try to do what **INSTRUCTORS** think I should do	1	2	3	4	5	6	7
4.	The **ZONE MENTORS** expect me to use SNS	1	2	3	4	5	6	7
5.	The **ZONE MENTORS** want me to use SNS frequently	1	2	3	4	5	6	7
6.	Generally speaking I try to do what the **ZONE MENTORS** think I should do	1	2	3	4	5	6	7
7.	My **CLASSMATES** expect me to use SNS	1	2	3	4	5	6	7
8.	My **CLASSMATES** want me to use SNS frequently	1	2	3	4	5	6	7
9.	Generally speaking I try to do what **CLASSMATES** think I should do	1	2	3	4	5	6	7

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
10.	Using SNS helps me learn about & accomplish the course requirements quickly	1	2	3	4	5	6	7
11.	Using SNS helps me to be a productive student	1	2	3	4	5	6	7
12.	Using SNS enhances my effectiveness on the course coursework	1	2	3	4	5	6	7
13.	Using SNS makes it easy to do the course coursework	1	2	3	4	5	6	7
14.	Using SNS improves my academic performance	1	2	3	4	5	6	7
15.	I find SNS a useful tool for my learning in this course	1	2	3	4	5	6	7
16.	Learning to use SNS is easy for me	1	2	3	4	5	6	7
17.	SNS is flexible to interact with	1	2	3	4	5	6	7
18.	I find it's easy to get SNS to do what I want to do	1	2	3	4	5	6	7
19.	It's easy for me to become skillful at using SNS	1	2	3	4	5	6	7

20.	My interaction with SNS is clear and understandable	1	2	3	4	5	6	7
21.	SNS is easy to use	1	2	3	4	5	6	7

Part B: Facilitation & Appropriation

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
1.	The mentors are available when I need help with any software issues	1	2	3	4	5	6	7
2.	The information needed to do well in the course is easily accessible	1	2	3	4	5	6	7
3.	I am able to learn what I need to succeed in this course	1	2	3	4	5	6	7
4.	I have the time it takes to succeed in this course	1	2	3	4	5	6	7
5.	For me it is important to get support/help from the **ZONE MENTORS & INSTRUCTORS** to succeed in this course	1	2	3	4	5	6	7
6.	For me it is important to get support/help from **FELLOW STUDENTS** to succeed in this course	1	2	3	4	5	6	7
7.	The computer I use to access the course and Zone meets my needs	1	2	3	4	5	6	7
8.	The network connection I use to access the course and Zone meets my needs	1	2	3	4	5	6	7
9.	For me it is important to use the **SOFTWARE and OTHER MEDIA DEVELOPMENT TOOLS** of the Zone to succeed in this course	1	2	3	4	5	6	7
10.	For me it is important to use the **COMMUNICATION TOOLS** (instant messaging, discussion boards, email) provided by the Zone to succeed in this course	1	2	3	4	5	6	7

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
11.	When I need to communicate with my **Instructors & Zone Mentors**, I use **SNS tools** such as Shadow Express and discussion board	1	2	3	4	5	6	7
12.	When I need to communicate with my **Instructors & Zone Mentors**, I use **tools** such as Email, instant messenger, and telephone	1	2	3	4	5	6	7
13.	When I need to interact with **fellow students**, I use **SNS tools** such as Shadow Express and discussion board	1	2	3	4	5	6	7
14.	When I need to interact with **fellow students**, I use **tools** such as Email, instant messenger, and telephone	1	2	3	4	5	6	7

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
15.	I frequently find myself using **SNS tools** to meet the requirements of the course	1	2	3	4	5	6	7
16.	I frequently find myself using **tools other than SNS** to meet the requirements of the course	1	2	3	4	5	6	7
17.	Overall, I use SNS a lot	1	2	3	4	5	6	7

18. Can you estimate how many hours you use SNS for this course in an average week?

___ Less than 1 hour

___ 1-5 hours

___ 6-10 hours

___ 11-15 hours

___ 16-20 hours

___ 21-25 hours

___ More than 26 hours

19. How often do you access SNS site?

___ Several times a day

___ Once a day

___ 2-3 times a week

___ Once a week

___ 2-3 times a month

___ Once a month

20. Please indicate the extent to which you did the following **Course-Related** activities

	Never Used						**A Great Extent**
Posted messages on the discussion board	1	2	3	4	5	6	7
Read messages on the discussion board	1	2	3	4	5	6	7

Part C: Satisfaction

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
1.	If I had a chance to take another course similar to the one I am taking now I would be happy if it used SNS	1	2	3	4	5	6	7
2.	If I had a chance to take another course similar to the one I am taking now I would be happy if was being taught in the Zone	1	2	3	4	5	6	7

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
3.	If I had a chance to take another course similar to the one I am taking now and it used SNS I would be confident that I could do well	1	2	3	4	5	6	7
4.	If I had a chance to take another course similar to the one I am taking now and it was taught in the Zone I would be confident that I could do well	1	2	3	4	5	6	7
5.	If I had the chance to teach a course I would like to use software similar to SNS	1	2	3	4	5	6	7
6.	If I had the chance to teach a course I would like an environment similar to the Zone	1	2	3	4	5	6	7
7.	Course learning objectives were clear	1	2	3	4	5	6	7
8.	I usually have a clear idea of where I am going and what is expected of me in this course	1	2	3	4	5	6	7
9.	The teaching materials for this course are extremely good at explaining things	1	2	3	4	5	6	7
10.	The course really tries to get the best out of all the students	1	2	3	4	5	6	7

		Strongly **DISAGREE**			Neutral			Strongly **AGREE**
11.	I developed knowledge and competencies in this course	1	2	3	4	5	6	7
12.	The course activities were a good fit for the way I like to learn	1	2	3	4	5	6	7
13.	The course activities met my expectations for what I had hoped to learn	1	2	3	4	5	6	7
14.	The knowledge and competencies taught through the course activities are personally meaningful and important to me	1	2	3	4	5	6	7
15.	SNS effectively helped me know what to do and easily access course materials	1	2	3	4	5	6	7
16.	SNS effectively helped me communicate with others in the course	1	2	3	4	5	6	7
17.	SNS effectively helped me present my work to others in the course and complete assignments	1	2	3	4	5	6	7
18.	I am satisfied with using SNS in this course	1	2	3	4	5	6	7
19.	The mentors helped me solve problems and met my needs for assistance	1	2	3	4	5	6	7
20.	I am satisfied with the physical space of the Zone	1	2	3	4	5	6	7
21.	I am satisfied with the web-based supports from the Zone	1	2	3	4	5	6	7

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