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## Extending The Technology Acceptance Model Using Perceived User Resources In Higher Education Web-based Online Learning Courses

Cheng-Hsin Ku  
*University of Central Florida*



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EXTENDING THE TECHNOLOGY ACCEPTANCE MODEL USING PERCEIVED  
USER RESOURCES IN HIGHER EDUCATION WEB-BASED ONLINE LEARNING  
COURSES

by

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A dissertation submitted in partial fulfillment of the requirements  
for the degree of Doctor of Philosophy  
in the Department of Educational Research, Technology and Leadership  
in the College of Education  
at the University of Central Florida  
Orlando, Florida

Spring Term  
2009

Major Professor: Stephen A. Sivo

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## **ABSTRACT**

The purpose of this research was to examine students' acceptance of the World Wide Web Course Tools (WebCT) online learning system. The Perceived Resources and Technology Acceptance Model (PRATAM) was created based on previous research to address the factors of perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use and actual system use. The aim for this research was to investigate the critical determinants and provide the causal relationships regarding students' acceptance behaviors when using WebCT.

While institutions are expecting to adopt online learning to reach more students, there are still many challenges for institutions to retain students in their online courses. The literature review conducted in this research indicated that the Technology Acceptance Model (TAM) has successfully explained students' behaviors when they use educational information systems. In addition, the additional perceived resources variable in the PRATAM also showed a significant influence on the other belief and intention variables.

The study analyzed a total of 115 students responses in two surveys administered during two WebCT based courses taught at a large southeastern public university. The beliefs, attitudes, intentions, and behavioral constructs of PRATAM showed significant goodness-of-fit indices and coefficient of determination after analyzing the data in both

surveys. However, the results indicated several exceptions on PRATAM's constructs and causal relationships. First, the path coefficient between perceived resources to behavioral intention to use in both pre-test and post-test were insignificant. Second, the path coefficient between behavioral intention to use and actual system use in pre-test was insignificant. Third, the path coefficient between perceived resources and perceived usefulness in post-test were insignificant. In addition, the research also suggested an additional link between perceived ease of use and behavioral intention to use at the pre-test data. Overall, this research validated the influences of PRATAM's constructs factors to students' acceptance behaviors toward WebCT. The findings of this research could provide a guideline for future implementations of online learning systems in higher education.

To my parents, Sung-Ken Ku and Li-Chu Chang; my beloved wife, Ching-I Wu,  
my lovely sister Chia-Yu Ku; and all my family members.

## ACKNOWLEDGMENTS

First and foremost, I respectfully express my appreciation to my dissertation committee who were inexhaustible in providing valuable feedback and comments as they reviewed my dissertation. To my dissertation chair, Dr. Stephen A. Sivo, thank you for taking the time from the beginning to shape my research design, mentor the research process, and go through every step of this research with me. I would also like to thank you for putting me back on track when I was lost. Dr. Richard A. Cornell, thank you for your support and wisdom from the very first day I came to the United States. You have been just like my papa who makes me never feel alone and guides me to accomplish my studies. Dr. Edward H. Robinson, thank you for opening my eyes to educational research and sharing your love of higher education. Dr. Vicky I. Zygouris-Coe, thank you for your insightful suggestions and comments. Your input raised my standards to the level that I never expected. Dr. Daniel M. Siegel, thank you for being a knowledgeable editor that noticed every little thing in my writing from the first drafts onward, while always being a sincere friend.

My sincerely thanks also go to the people who provided invaluable assistance during my research. Thank you Dr. Amy Scheick and your colleague instructors Kristin Pilgrim and Rita Kienle; and thank you again Dr. Vicky I. Zygouris-Coe and your colleague instructors Catherine Glass, Lourdes Smith, and Claire Osetek, as well as the

database manager Richard Scott. Your contributions and participation gave me a precious opportunity to collect the data for my research. Thanks must also go to my academic advisors Dr. Gary Orwig and Dr. Atsusi (2c) Hirumi; I deeply appreciate your assistance and guidance during the process. Thank you Mannong (Pamela) Pang for helping me to create a wonderful web-based survey, it really saved me a lot of time during the data collection. I would also like to thank the many different individuals who helped me in my writing, especially all the members in the University of Central Florida Writing Center. In addition, I owe thanks to Nathalia Bauer and other staff members in the Thesis & Dissertation Office of University of Central Florida College of Graduate Studies; your assistances and reviews made this manuscript elegant and classical.

Dad and Mom, I could never reach this far without your constant support and encouragement. I am very grateful for the many sacrifices you made for me and I am so proud to be your son.

Finally, to my beloved wife, I deeply appreciate the patience and sacrifices that you made for me. I most deeply value everything you did to help me survive the chaos of the dissertation; I could never have made it without you.



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# **CHAPTER 1: INTRODUCTION**

## **1.1 Introduction**

The growth of information technology (IT) such as computers and the Internet continue to change our everyday life. In higher education, the implementation of information and communication technologies (ICTs) has become a necessary fashion all over the campus. This implementation can be found in the methods students apply to the degree, register for courses, take classes, compose their assignments, and communicate with instructors and cohorts. The main reason behind the implementation of information and communication technologies in higher education is the expectation that doing so will enhance the quality of teaching and communication, as well as students' learning and persistence (Nora & Snyder, 2009). In addition, because of the capability to deliver content and materials all over the world in real-time; the ultimate goal for institutes to adopt information and communication technologies is to reach the new and larger off-site markets (Gray, 2002).

One of the most noticeable applications of information technology on higher education campuses is online learning. Unlike traditional face-to-face learning that requires students to come to the physical classroom with supervision at a particular time, online learning utilizes information technology and provides the system for students to

pick their favorite time, location, and equipment needed to access the course content. According to a recently published report, Allen and Seaman (2008) found almost 4 million students were taking at least one online course in the Fall 2007 semester, which represented almost 22% of United States higher education students and nearly a 13% increase from the previous year.

However, since the nature of the online learning relies heavily on students' voluntarily accessing and interacting with the computer and the Internet technology, an effective student in a traditional face-to-face class is not necessarily assured that he or she will succeed in an online learning environment. Researchers suggest that one of the biggest challenges for online learning is to retain students in the online courses (Clay, Rowland, & Packard, 2009). Researchers also warned that the attrition rate for online courses is significantly higher than the traditional courses (Carr, 2000; Diaz, 2002; Flood, 2002; Frankola, 2001). What we know regarding teaching, learning, and motivation based on the face-to-face class might not be appropriate for the online learning environment. There were a minimal number of studies that provided explanations or descriptions regarding students' behaviors related to the specific online learning systems (Y.-C. Lee, 2008; Pituch & Lee, 2006). Understanding the factors that influence students' behaviors in the online learning environment is becoming critical for administrators and instructional designers as applied to student persistence and future online learning expansion.

The purpose of this research is to identify and examine the factors that influenced student behaviors when using web-based online learning systems in a large southeastern

public university. A theory-based Perceived Resources and Technology Acceptance Model (PRATAM) was proposed to examine the students' perceived resources, perceived usefulness, perceived ease of use, attitude toward, and behavioral intention as the predictors of the usage behaviors in web-based online learning courses. Understanding and identification of the factors that affected the students' behaviors toward the online learning systems could provide essential information and reference for administrators and instructional designers to improve students' persistence and retention in online courses.

## 1.2 Background

Online learning is continually growing and institutions continue to offer online courses to improve the learning experience, reduce costs, and reach more students. A recent report found that more than 20% of the institutions with online learning offered their first online course in 2007 (Allen & Seaman, 2008). Online learning systems are used in many higher education institutions as overall solutions in providing online learning to meet growing demand. An online learning system such as WebCT or Blackboard is an interactive Internet system that provides overall solutions and various functions to support and enhance teaching and learning activities for online learning (H.-F. Lin, 2007). Within the system, students are able to access the course content materials, turn in their assignments, chat with classmates, and correspond with instructors over the Internet, anytime, anywhere without the limitation of the physical classroom. The University of Central Florida (UCF) chose WebCT as the campus-wide online learning

solution since 1997 (University of Central Florida Center for Distributed Learning, 2008). By Spring 2007, UCF provided more than 5,000 courses over WebCT and 43% of the students registered for at least one WebCT course during that semester.

For more than a decade, online learning system vendors and institutions have worked together on improving the system's functionality and flexibility to fit various curriculums' needs and deliver a better learning experience. For example, WebCT released a new version to increase the system's functionality and compatibility. However, as Mathieson (1991) commented, no matter how many functions and features the systems can provide, the systems that are not used are useless systems. Other researchers also stated that the purpose of the online learning activities won't be achieved if students refuse or fail to use the systems (Pituch & Lee, 2006). Therefore, aside from improving the functionality of the online learning system itself, the understanding of the students' behaviors toward using the system is also crucial for institutions and system developers to further implement and deliver the best online learning environment.

In order to understand students' behaviors toward using the online learning system, this research proposed that the Perceived Resources and Technology Acceptance Model (PRATAM) be used to examine belief, attitude, and intention as the predictors of students' behaviors when using their online learning system. In addition, web-based learning systems rely heavily on the use of technology resources such as the Internet and personal computers to interact and communicate within the system. There are many situations wherein students encounter difficulties in acquiring appropriate resources in order to use the online learning system. Mathieson, Peacock, and Chin (2001) argued that

there is a chance an individual believes a system is easy to use and could increase the job performance, but “think he or she lacks the resources (e.g., time, money and expertise) needed to use it” (p. 108). Gladieux and Swail (1999) commented that the technology resource for institutions is one of the issues related to the growth of technology adoption that have not been fully addressed. For instance, the student who lacks documentation and support to set up his or her computer’s web browser might not be able to log in the course website correctly, even though he or she considered the online learning system useful and easy. Frankola (2001) also insisted that problems with technology and lack of student support were the two leading factors responsible for the high dropout rates of online learning students, and that 24/7 technical support was on the top of the wish list for online learners. Therefore, this current research tried to incorporate the perception of requisite resources toward online learning systems as the other belief factor along with perceived usefulness and perceived ease of use as the belief predictors that underlie students’ usage of an online learning system.

Because more and more institutions offer online learning courses to fulfill the rapid growing demand and the online learning system keeps adding new features and functions in its arsenal of attributes, there is a need to address students’ usage behaviors toward online learning. This current research employed PRATAM resources to examine such student behaviors in higher education’s online learning environments.

### 1.3 Purpose and Objective

The purpose of this current research is to identify factors that influence students' behaviors when using a web-based online learning system and to examine resulting causal relationships in a large southeastern public university. Based on the constructs of the Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989) and Mathieson's et al. (2001) extended technology acceptance model, a new model called Perceived Resources and Technology Acceptance Model (PRATAM) was proposed in this study. PRATAM was designed to examine the students' perceived resources, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use as the predictors of the usage behaviors in WebCT courses.

The TAM has been widely applied to explain and predict the intended usage and acceptance behaviors of various information systems (Adams, Nelson, & Todd, 1992; Davis, 1986; Davis, et al., 1989; Mathieson, 1991; Taylor & Todd, 1995a, 1995c; Venkatesh, 2000). However, researchers commented that the TAM-related hypotheses-regarding WebCT-has not been verified (Ngai, Poon, & Chan, 2007). Based on the constructs of TAM, the objective of the current research intends to provide understanding and identification of the factors that affect students' usage behavior in an online learning system. The findings obtained could bring the essential information and reference for administrators, instructors, and instructional designers to improve students' persistence and retention in online learning courses, as well as improving the effective delivery of future online learning system.

Researchers suggest that one's perceptions and beliefs change along with the individual's experiences toward the system over time (Mathieson, et al., 2001; Venkatesh & Davis, 1996), and the formation of the intention requires a significant period of time (Davis, 1986; Einhorn & Hogarth, 1981; Janis & Mann, 1977; Warshaw & Davis, 1985). This research conducted two assessments (i.e., pre-test and post-test) with the participants to monitor and analyze changes on the beliefs, attitude, intention, and the actual system use behavior during the progress of the web-based online learning courses. An identical survey instrument, conducted twice on the same participants during the same semester, collected the longitudinal data. From the data collected from the surveys, this study tracked changes of the variables that affect students' usage behaviors while using the WebCT online learning system over time.

#### 1.4 Research Model

This current study was based on the Perceived Resources and Technology Acceptance Model (PRATAM) to analyze and examine the students' perceived resources, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use as the predictors of the usage behaviors in the WebCT web-based online learning courses by a large southeastern public university. In addition to the constructs proposed by Davis et al. (1989) in the Technology Acceptance Model (TAM), the PRATAM further extended the TAM to include the perceived resources (Mathieson, et al., 2001) to consider students' general perception of their available resources for using



the online learning system. The PRATAM illustrates the categories, organization and potential flow of the six latent constructs (i.e., perceived usefulness, perceived ease of use, perceived resources, attitude toward using, behavioral intention to use, and actual system use) and arrowed solid lines to indicate the causal relationships suggested by Mathieson et al. (2001). The PRATAM for the higher education WebCT courses was proposed as shown in Figure 1-1:

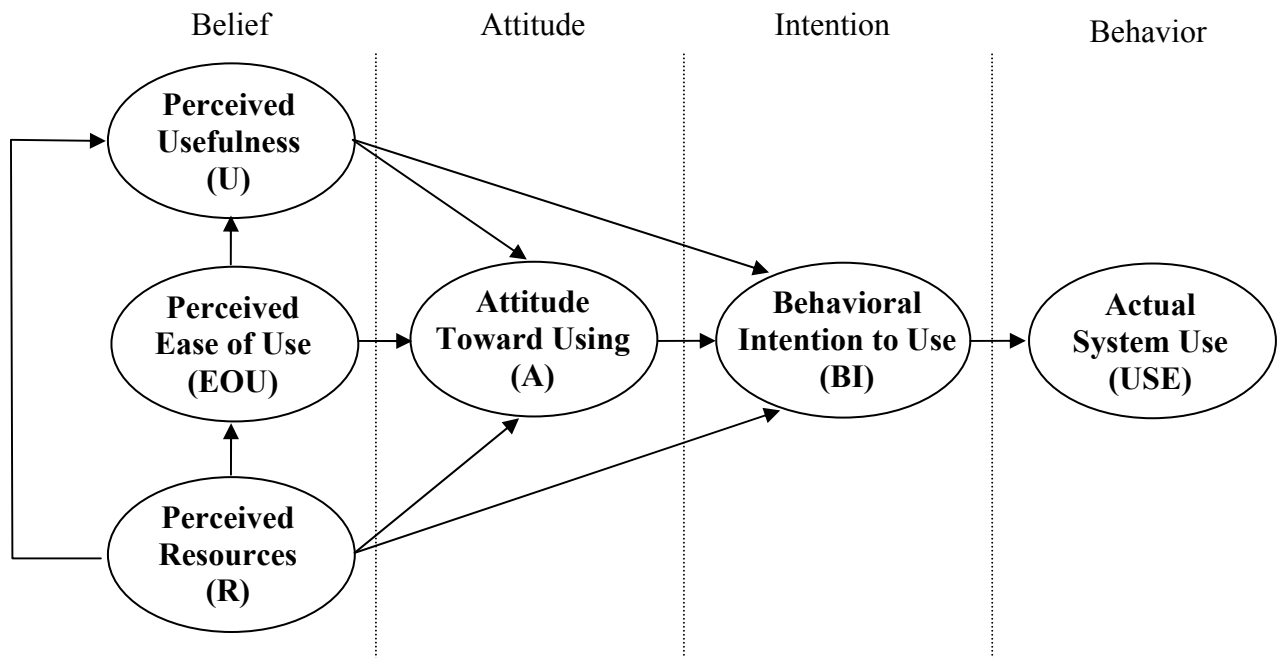


Figure 1-1 Structural Model of the Perceived Resources and Technology Acceptance Model (PRATAM)

The TAM proposed by Davis et al. (1989) employed a belief-attitude-intention-behavior structure to address the learners acceptance on using a computer based information system. Davis employed two key belief variables, perceived usefulness and perceived ease of use, as the system characteristics that represent an individual's beliefs

that using the particular information system will “increase his or her job performance” and be “free of effort” (Davis, et al., 1989, p. 985). For instance, a student may find using the e-mail system can increase the communications with their cohorts (perceived usefulness) and do not require any additional skills to use email (perceived ease of use). Davis assumed these two beliefs influence users’ attitude toward using the system, therefore, perceived usefulness and perceived ease of use were hypothesized to have direct effects on the individual’s attitude toward using the system, while perceived ease of use was also hypothesized to have a direct impact on perceived usefulness. Attitudes toward using the system and perceived usefulness were hypothesized to predict behavioral intention to use, and the actual system use then hypothesized to be directly impacted by the behavioral intention to use.

In addition, researchers suggested that users’ perception of resources might be a key determination toward learning with an information system (Ajzen, 1991; Ajzen & Madden, 1986; Gable, 1991; Guimaraes, Gupta, & Rainer, 1999; Igarria, Zinatelli, Cragg, & Cavaye, 1997; Y.-C. Lee, 2008; Mathieson, 1991; Mathieson, et al., 2001; Thong, Yap, & Raman, 1996). While Davis et al. (1989) noticed that training, documentation, and user support consultants were the external variables that influenced users’ ease of use, Davis et al. (1989) also stated that future researchers should also look for external variables that may affect the beliefs of usefulness and ease of use. Mathieson et al. (2001) proposed an extended technology acceptance model to incorporate the user perception of resources as additional perception variables to determine the constructs of the TAM. Mathieson’s et al. extended technology acceptance model successfully

explained and predicted students' behavioral on using a bulletin board system. The current research used the PRATAM to accommodate the usage behaviors of the WebCT web-based learning system in a large southeastern public university.

### 1.5 Research Hypotheses

Based on the Technology Acceptance Model (TAM) proposed by Davis et al., (1989), this study further addressed the inclusion of perceived resources as a viable extension that suggested by Mathieson et al. (2001) in the Perceived Resources and Technology Acceptance Model (PRATAM). This current research examined perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual use behavior in the belief-attitude-intention-behavior relationship in the higher education WebCT courses. The purpose of this research was to answer the research question: How does the PRATAM explain the students' usage behaviors of WebCT?

Several studies (Y.-C. Lee, 2008; Mathieson, et al., 2001; Oh, Ahn, & Kim, 2003) have shown perceived resources could be an important external variable to predict perceived usefulness and perceived ease of use. In this study, a latent construct "perceived resources" was defined as "a student's belief that he or she has the resources needed to use WebCT" (Y.-C. Lee, 2008; Mathieson, et al., 2001; Oh, et al., 2003; Taylor & Todd, 1995a, 1995c). This study proposed perceived resources as the belief construct and the pre-determinant to perceived usefulness, perceived ease of use, attitude toward

using, and behavioral intention to use. As a result, the constructs of the PRATAM were proposed as depicted in Figure 1-2. Hypothesis 1 to hypothesis 4 present the direct effect from perceived resources to perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use WebCT.

H1. Perceived resources will have a positive direct effect on perceived usefulness.

H2. Perceived resources will have a positive direct effect on perceived ease of use.

H3. Perceived resources will have a positive direct effect on attitude toward using WebCT.

H4. Perceived resources will have a positive direct effect on behavioral intention to use WebCT.

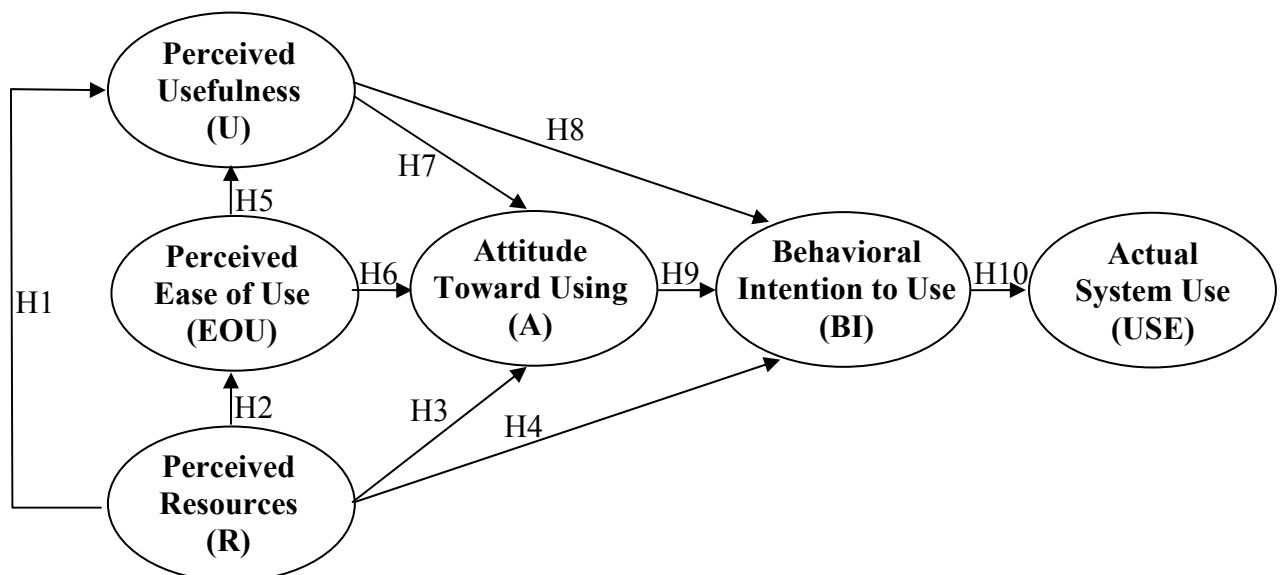


Figure 1-2 Hypothesis Model of the Perceived Resources and Technology Acceptance Model (PRATAM)

In addition to the hypotheses based on perceived resources, hypothesis 5 to hypothesis 10 present the hypotheses based on the construct of TAM (Davis, et al., 1989). The belief-attitude-intention-behavior constructs included perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual use behavior on the WebCT system in the higher education courses. According to Davis (1989), this study defined the belief constructs perceived usefulness as “the degree to which a student believes that using the WebCT would enhance his or her job performance” (p. 320), and perceived ease of use as “the degree to which a student believes that using the WebCT would be free of effort” (p. 320). In addition, based on Davis’ et al. (1989) study, the attitude toward using was defined as the degree of a student’s positive or negative feelings about using WebCT; behavioral intention to use was defined as the strength of a student’s intention to use WebCT; and actual system use was defined as student's actual direct usage of WebCT.

Based on previous studies (Davis, 1986; Davis, et al., 1989; Mathieson, et al., 2001; Szajna, 1996), the PRATAM posited that perceived ease of use has a direct effect on perceived usefulness, while both perceived ease of use and perceived usefulness have the direct effects on attitude toward using. Furthermore, behavioral intention to use was determined by both perceived usefulness and attitude toward using, and therefore directly affected actual system use. As a result, the following six hypotheses were proposed in Figure 1-2:

- H5. Perceived ease of use will have a positive direct effect on perceived usefulness.

- H6. Perceived ease of use will have a positive direct effect on attitude toward using WebCT.
- H7. Perceived usefulness will have a positive direct effect on attitude toward using WebCT.
- H8. Perceived usefulness will have a positive direct effect on behavioral intention to use WebCT.
- H9. Attitude toward using will have a positive direct effect on behavioral intention to use WebCT.
- H10. Behavioral intention to use will have a positive direct effect on actual WebCT usage.

### 1.6 Contributions of the Study

The current research proposed the Perceived Resources and Technology Acceptance Model (PRATAM) to extend and include perceived resources (Mathieson, et al., 2001) as an additional belief variable to Davis' et al. (1989) Technology Acceptance Model (TAM). The purpose of the current research was to understand and identify the factors that affect students' behaviors toward an online learning system. Those findings could provide essential information and references for administrators and instructional designers to improve students' persistence and retention in online learning.

Since Davis et al. (1989) suggested that the belief-attitude-intention-behavior structure of the TAM can be generalized to "different computer systems and user

populations” (p. 988), it has been widely applied to a plethora of technology acceptance studies (Pituch & Lee, 2006). In the application of the instructional technology, the TAM has been adopted to validate and examine the acceptance of the Internet applications such as: World Wide Web (Moon & Kim, 2001), web-browsers (Morris & Dillon, 1997), e-mail (Szajna, 1996), web-sites (Babenko-Mould, Andrusyszyn, & Goldenberg, 2004; J. C.-C. Lin & Lu, 2000; Selim, 2003). However, researchers (Y.-C. Lee, 2008; Pituch & Lee, 2006) found that studies provided explanations related to students’ beliefs, attitude, intention, and acceptance to the web-based learning systems are limited. The intent of this study was to provide additional information regarding the usage behavior of WebCT through the TAM.

In addition to the TAM constructs identified by Davis et al. (1989), this study incorporated the perceived resources as the additional belief predictor in the belief-attitude-intention-behavior construct to assess the usage behavior of the WebCT online learning system in higher education. Lee (2008) adopted the itemized formative perceived resources into an online learning system, the overall reflective perceived resources have not been adopted into the WebCT system yet. Therefore, the understanding of students’ overall perception of resources in higher education WebCT courses could provide increased understanding of the issue of resources for school administrators, instructional designers, and researchers. The finding could further lead to develop effective strategies and pedagogies on supporting and locating resources to enhance student usage behavior in an online learning system.

## 1.7 Limitations of the Study

The following were the recognized limitations in this current research:

1. As an empirical study, the result data in the study will be limited to those participating university students enrolled in the Fall 2008 semester. The course delivery method was also limited to the M-Type (Mixed Mode Courses) and W-Type (World Wide Web Courses) EME 2040 “Introduction to Educational Technology“, and the W-Type RED 5147 “Foundation of Developmental Reading” courses within an education department in a large southeastern public university. Proper modifications of the research model were considered before any future application.
2. The different online learning system components and functions might result different rates on the usage of WebCT. Instructors normally determine different values and weights of those components and functions depending to their teaching styles and the contents of their web-based courses. For example, one instructor may emphasize the use of WebCT message forum and promote students to post on the forum, which may result the higher WebCT usage for this instructors’ students. Therefore, the WebCT usage may not represent the comparable data over different course contents and instructors.
3. This current research adopted the self-reported usage as the measurement for actual system use. There is an argument on the correction between self-reported usage data and the computer-recorded data. Barnett, Kellermanns, Pearson, and Pearson (2006) found a strong correlation between self-reported and computer-recorded data but



- Straub, Limayen, and Karahanna-Evaristo (1995) argued that the relationship between these two measurements could be relatively low. Therefore, the result on actual use of WebCT could be limited on explaining in this current research.
4. As Mathieson et al. (2001) proposed perceived resources to the expanded Technology Acceptance Model (TAM), Mathieson et al. also defined perceived resources could be measured in two dimensions-reflective measurements and formative measurements. Mathieson et al. (2001) commented that the reflective measurements are focused on “an individual’s belief having the personal and organizational resource need to use an IS at a general level” (p. 94), while the formative measurements “identify specific resources perceptions that should at least partially determine the overall belief” (p. 94). This current research, however, only adopted the reflective measurements to determine the students’ overall perception toward the WebCT online learning system. The explanation toward specific resources could be limited in this study.
  5. Both Davis’ et al. (1989) TAM, and Mathieson’s et al. (Mathieson, et al., 2001) extended TAM suggested the belief constructs are influenced by certain external variables. This current research, however, did not consider any external variables that may influence perceived usefulness, perceived ease of use, and perceived resources. Therefore, the explained variances for perceived usefulness and perceived ease of use may be lower than attitude toward using, behavioral intention to use, and actual system use.

## 1.8 Assumptions of the Study

The assumptions of the study included the following four points:

1. This study accepted the assumption that all the students responded to the survey questionnaires honestly.
2. This study accepted the assumption that there is no collinearity within the measurement items on the proposed latent constructs (i.e., perceived usefulness, perceived ease of use, perceived resources, attitude, behavioral intention and actual system use).
3. This study accepted the assumption that the students were able to express their beliefs individually through the provided web-based survey questionnaires.
4. This study accepted the assumption that the instruments used in this study were able to represent the students' beliefs on perceived usefulness, perceived ease of use, perceived resources, attitude, behavioral intention and actual use of WebCT accurately.
5. This study accepted the assumption that all the instructors in the participant courses delivered and utilized the contents by the WebCT components and functions in the same manner.
6. This study accepted the assumption that the use of WebCT online learning system is under student's volitional decision.

## 1.9 Definition of Terms

The definitions of terms used in this current research are:

*Actual System Use:* Based on the definitions of the Technology Acceptance Model (TAM) in Davis' et al. (1989) research. This current research defined actual system use as a student's actual direct usage of WebCT.

*Attitude toward Using:* Based on the definitions of the TAM in Davis' et al. (1989) research. This current research defined attitude toward using as the degree of a student's positive or negative feelings about using WebCT online learning system.

*Behavioral Intention to Use:* Based on Davis' et al. (1989) definitions of the TAM. This current research defined behavioral intention to use as the strength of a student's intentions to use WebCT online learning system.

*Information Technology (IT):* Defined by the Information Technology Association of America (ITAA) as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware" (Information Technology Association of America, 1997).

*Information and Communication Technology (ICT):* Defined as "all kinds of electronic systems used for broadcasting, telecommunications and computer-mediated communications" (Dutton & Peltu, 1996, p. 7). This includes the technologies that

are used for delivering information such as personal computers, the Internet, MP3 players, mobile phones, and software applications.

*Latent Construct / Variable:* Defined as “research construct that is not observable or measured directly, but measured indirectly through observable variables that reflect or form the construct” (Gefen, Straub, & Boudreau, 2000). In this study, for example, the latent construct “perceived resources” will be measured by four reflective observed variables.

*M-Type Courses:* Also known as “Mixed Mode Courses”. The UCF Course Development and Web Services defines M-type courses are reduced seat time and “include both required classroom attendance and online instruction...have substantial content delivered over the Internet, which will substitute for some classroom meetings” (University of Central Florida Course Development & Web Services, 2005).

*Online Learning:* Online learning can also be referred as web, web-based, Internet, Internet-based, and computer-based learning. “These terms are recognizably interchangeable and lack significant distinction” (Stapleton, Wen, Starrett, & Kilburn, 2007). However, this current research defined online learning as the learning method that encompasses any types of Internet delivered electronic educational content.

*Online Learning System:* Followed the clarification by Lin (2007), this current research defined online learning system as the interactive Internet systems that provide various functions to support and enhance teaching and learning activities, which is

also known as Course Management System (CMS) or Learning Management System (LMS).

*Perceived Ease of Use:* Based on Davis' (1989) TAM, this current research defined perceived ease of use as the degree to which a student's believes that using the WebCT online learning system would be free of effort.

*Perceived Resources:* Mathieson et al. (2001) proposed perceived resources as "the extent to which an individual believes that he or she has the personal and organizational resources needed to use an information system". This current research defined perceived resources as the overall belief on having the needed resources to use the WebCT online learning system.

*Perceived Resources and Technology Acceptance Model (PARTAM):* Derived from the Davis' et al. (1989) TAM and included Mathieson's et al. (2001) perceived resources to examine students' behaviors toward WebCT online learning system. The six latent constructs adopted in PRATMA are perceived usefulness, perceived ease of use, perceived resources, attitude toward using, behavioral intention to use and actual system use.

*Perceived Usefulness:* Based on Davis' (1989) TAM, this current research defined perceived usefulness as the degree to which a student's believes that using the WebCT online learning system would enhance his or her learning performance.

*Structural Equation Modeling (SEM):* Defined as "Multivariate technique combining aspects of multiple regression (examining dependence relationships) and factor analysis (representing unmeasured concepts with multiple variables) to estimate a

series of interrelated dependence relationships simultaneously” (Gefen, et al., 2000).

*World Wide Web Course Tools (WebCT)*: Also known as “Blackboard Learning System” after the acquisition by Blackboard Inc. in 2006. WebCT is an online learning system that utilized a set of tools (e.g., syllabus, discussions board, course mail, chat room, calendar, and quizzes) to facilitate online learning in a secure (password protected) and convenient (anytime and anywhere) manner (Lu, Yu, & Liu, 2003).

*W-Type Courses*: Also known as “World Wide Web Courses”. The UCF Course Development and Web Services defines W-type courses are “conducted fully via web-based instruction and collaboration....may require proctored examinations, and may include opportunities for face-to-face orientations, but there will be no class attendance requirements” (University of Central Florida Course Development & Web Services, 2005).

## **CHAPTER 2: REVIEW OF LITERATURE**

### 2.1 Introduction

This chapter will focus on the following three major components: (1) online learning, online learning systems and their challenges, (2) the major theories based on the beliefs, attitude, intentions, and behaviors framework; and (3) the applications and modifications of the Technology Acceptance Model (TAM). In the beginning of the chapter, a brief review will be given on the history and applications of the Internet, online learning, online learning systems, and the challenges of online learning. The following section reviews the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), the Theory of Planned Behavior (TPB) (Ajzen, 1985), and the technology acceptance model (Davis, 1986, 1989; Davis, et al., 1989). Based on the original constructs, researchers have expanded TAM with factors such as social influence processes, cognitive instrumental processes, computer self-efficacy, perceived enjoyment, and perceived resources and support. The last sections briefly reviews on those major modifications of TAM. This section also reviews the TAM applications that focused on the higher education web-based system in the past decade.

## 2.2 Online Learning

### *2.2.1 Background*

Widespread information and communication technologies (ICTs) such as the Internet or the World Wide Web (WWW) have revolutionized the domain of education like nothing else before. Eynon (2008) argued that university managers and policy makers have seen the information and communication technologies as “an integral part of teaching and learning in higher education.” The expectations of information and communication technologies in higher education include increasing efficiency, access, and flexibility (Newby, 1999); improving students’ learning and persistence (Nora & Snyder, 2009); promoting universities’ global competitiveness (Eynon, 2008); reaching students in wider social, demographic and geographical bases (Gell, Cochrane, & Dutton, 1996); and expanding the “new or larger off-site markets” (Gray, 2002). Educators are enthusiastic about finding the way to utilize the capabilities and abilities to support the learning and teaching activities. However, the benefits from the information and communication technologies remain in debates; there is no empirical supports on the direct influence of the technologies (Eynon, 2008). The beginning of this section explains the brief history of the Internet, and how those technologies evolved into today’s online learning in higher education. Following is the discussion on the challenges of the current online learning environment.



### 2.2.2 *The Internet*

The Internet is “at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location” (Kahn, et al., 1997, p. 129) The predecessor of the modern Internet can be traced to J. C. R. Licklider’s idea on interactive and network computing. His vision “a network...connected to one another by wide-band communication lines and to individual users” (Licklider, 1960, p. 7) led the United States Department of Defense funded Advanced Research Projects Agency (ARPA) to create the Advanced Research Projects Agency Network (ARPANET) for military purposes (Boettcher & Conrad, 1999). In 1969, the first ARPANET connection between University of California, Los Angeles and Stanford Research Institute declared the beginning of the Internet era. The connected computers in the ARPANET grew quickly from the four in the beginning to around 200 in the early 1980. In addition, academia also noticed the needs for data transferring for the academic and research purpose. In 1987, the National Science Foundation build the National Science Foundation Network (NSFNET) as a university based open network. The same year ARPANET and NSFNET interconnected with each other and formed the basic structure of the Internet. Today, a personal computer, printer, or even cell phone could be part of the Internet and connected with hundreds of millions of other Internet devices.

According to Merriam-Webster Dictionary, the Internet is “an electronic communications network that connects computer networks and organizational computer

facilities around the world” (Internet., 2009). With the gigantic global Internet network and the universal TCP/IP Protocols (also known as Transmission Control Protocol and Internet Protocol), the electronic data and information can be transferred all over the world in seconds with a relatively lower cost. It is no longer impossible to see people using the Internet to read news, order tickets, pay bills, listen to music, watch movies, manage accounts, connect with others and share pictures. The Internet information technologies such as E-mail, World Wide Web (WWW), streaming media, Voice-over-IP, and file sharing have changed our world dramatically and have become the most indispensable daily activities in our lives. Recent reports found that the American population that has Internet access has grown from 44% in 2000 to more than 72% in 2008 (Internet World Stats, 2008) and around half of adult Americans have a broadband connection at home (Horrigan & Smith, 2007).

### *2.2.3 E-Learning and Online Learning*

Along with the wide spread use of Internet technology, because of the ability to provide a more efficient and dynamic system to deliver knowledge and information, Internet oriented learning approaches and applications were becoming the fastest growing Internet applications in organizations and institutions (Harun, 2001). In the field of education, the Federal Communications Commission (FCC) implemented the Telecommunications Act of 1996, and the Schools and Libraries Division (SLD) of the Universal Service Administrative Company (USAC) set up an Education Rate (E-rate)

program in 1997. The E-rate program provided discounts on telecommunications, Internet access and internal connections services from 20 to 90 percent for eligible schools and libraries (Hudson, 2004). According to a report from the Institute of Education Sciences, almost all American schools and colleges have had Internet access since 2005 (National Center for Education Statistics, 2007).

E-learning is defined by eLearning Network chairman Vaughan Waller as “the effective learning process created by interaction with digitally delivered content, learning support and services”, which represented a wide range of applications (e.g., online learning, computer-based learning, virtual classroom, and digital collaboration) and delivery methods (e.g., videotape, satellite broadcast, interactive TV, CD-ROM, and Internet) (Little, 2006). Little (2006) comments that the benefits offered by e-learning include: (1) the reduced time and cost associated with traditional classroom-based methods; (2) the coverage to a widely geographically dispersed audience; (3) the delivery method to fit every learners’ learning style; and (4) the possibilities from games and simulations. The elearning market is expected to expand from \$17.5 billion in 2007 to \$52.6 billion by 2010 (Kopf, 2007).

Online learning is an Internet enhanced e-learning method which refers to training, education, coaching, information, and any learning content that is delivered digitally or electronically (Broadbent, 2002; Fallon & Brown, 2003). Along with the recent emergence of innovative Internet-based applications such as blog and online communities, adopting Internet into teaching and learning pedagogies has become the most common innovation in education.

Online learning applications such as synchronous chat sessions and asynchronous posts and emails (Jolliffe, Ritter, & Stevens, 2001) provide the possibilities for instructors to communicate with students in various ways (Romanov & Nevgi, 2006). Through the adoption of online learning, institutions provided a more flexible, interactive, rich, engaging, and easy to use learning environment to support students in collaborative learning, knowledge building, and idea sharing (Bonk, 2002; Lu, et al., 2003). In order to respond to faculties' interest to enhance the learning experience, reach a dispersed population, increase enrollment, and respond to students' demand for convenience, online learning has been a high priority for many institutions (Arabasz & Baker, 2003). A recent study by Allen and Seaman (2007) indicated a consecutive five year growth of online enrollment rates since 2002 for degree-granting postsecondary institutions. According to the research, 83% of institutions with online offerings expect increased online enrollments over the coming years.

A report from the U.S. Department of Commerce in 2004 also suggested that Internet users with broadband at home are more likely to engage in online activities such as communications, entertainment, transactions, and information, as well as education (United States National Telecommunications and Information Administration, 2004). The emerging Internet technologies and the widespread broadband connections further break the limitations of time and space for many existing learning approaches. The new era of e-learning starts as Lee (2008) indicated "students having access to an online learning system can now interact with instructional materials in various formats (text, pictures,

sound, video on demand, and so on) anywhere, and at any time, as long as they can log on to the Internet”.

#### *2.2.4 Online learning systems*

Online learning systems (also known as course management systems, classroom management software, or courseware) are the software systems that are specifically designed and marketed for faculty and students to use in online learning (Morgan, 2003). Online learning systems provide the Internet based platforms and learning tools such as discussion boards, chat rooms, course content management, etc. needed to support e-learning. Since online learning systems provide the accessibility and scalability of learning content, one-to-one learner central instructions, and a trial and error simulation environment (Galagan, 2000), the use of online learning systems in higher education courses is rapidly increasing from 14.7% in 2000 to 49.6% in 2007 (Green, 2007).

Many institutions of higher education have already contracted with online learning system providers such as World Wide Web Course Tools (WebCT), Web Course Homepage System (WebCH), Blackboard Learning System, and the System for Multimedia Integrated Learning (Smile) to customize their own specific system to facilitate e-learning courses (Ngai, et al., 2007). In the EDUCAUSE report, Arabasz and Baker (2003) listed online learning systems as an important factor that affects the acceptance of e-learning in the campuses because the findings suggested that ease of use of an online learning system has a big influence on the adoption of e-learning.

WebCT is a well-known online learning system that was formed by Murray Goldberg in 1997 and has been adopted by many institutions to conduct and deliver web-based courses. WebCT provides a number of learning tools such as discussion boards, e-mail, chat rooms, content searches, course calendars, auto-marked quizzes, navigation tools, access control, grading tools, student progress tracking, and multimedia course pages to support online learning courses (Lu, et al., 2003).

WebCT was adopted by UCF as their major online learning system in 1997 and by 2005, provided more than 3500 WebCT courses. During the 2004-2005 academic year, more than 25% of the UCF students were enrolled at least one online WebCT course (Blackboard Inc., 2005). Willett (2002) suggested that the key value of using WebCT is its flexibility, not only flexibility of the classroom location and time, but also flexibility for students to demonstrate their real learning styles and capability.

### *2.2.5 Challenge for Online Learning*

Along with the expansion of the Internet, the information system has changed dramatically in the recent years. The technology resources for accessing the information system such as computer hardware and computer software used to be limited by business necessities and their involuntary nature (Cakici, 2007). As the personal computer and the Internet has become affordable in the recent years, vendors are rushed to deploy the information systems to the market for the ordinary people. However, unlike the business environment where software and hardware are particularly customized for an information

system and the technical difficulties are handled by a specified support staff, ordinary people use the computer software and hardware at their convenience with a minimal support. As most online learning systems face the ordinary people as the main users, Willett (2002) noticed that various technical difficulties such as system incompatibilities, firewalls, software design, human error, and insufficient knowledge could be the barriers for students to interact with and learn from the online learning system. The frustrations caused by perceived or real technical difficulties, therefore, might influence the students' beliefs, attitudes, intentions, and behaviors toward using WebCT.

In addition to the influences of the technical difficulties, the other challenge for online learning systems is the consistently high drop-out rates. A survey report from the MASIE center found the drop-out rates for e-learning was approximately 26%, compared to only 3% for traditional classroom learning (O'Connor, Sceiford, Wang, Foucar-Szocki, & Griffin, 2003). Svetcov (2000) found the online student drop-out rates at around 35%, which was almost twice the average 20% attrition rates for college freshmen at U.S. universities. The other report from the American Society for Training & Development and the MASIE Center also found a 58% overall start rate (the rate of learners who were offered an e-learning course actually started the course) for e-learning courses. The start rate for voluntary participation courses was merely 32%, significantly lower than a 69% start rate for mandatory courses (American Society for Training & Development & The MASIE Center, 2001).

Frankola (2001) also concerned the resources issues toward the retention of online learning. Frankola argued the reasons that caused the high dropout rates of online learning include:

- Lack of Time
- Distraction caused by coworkers
- Limited network access
- Lack of management oversight
- Lack of motivation
- Problems with technology
- Lack of student support
- Individual learning preferences
- Poorly designed courses
- Substandard/inexperienced instructors

Mosher (2006) questioned whether the ways we use online learning allows learners to maximize each learning interaction, as many of today's online learning classes simply imported the content from a well-designed classroom. For example, an instructor may simply move all the face-to-face classroom content on the web. Mosher (2006) argued that "content designed for one environment might not play out equally as well in another". Furthermore, Mosher (2006) also commented that the time arrangement for online learning should be reconsidered to incorporate various learning tools and strategies such as practice labs and assessments.



## 2.3 Beliefs, Attitudes, Intentions, and Behaviors

### 2.3.1 Background

In order to describe and predict human behavior, Fishbein and Ajzen (1975) proposed a beliefs, attitudes, intentions, and behaviors framework based on the trilogy of affection, cognition, and conation. The trilogy of affection, cognition, and conation was developed by the German psychology faculty in the eighteenth century to represent the three stage of an individual's mental activities (Hilgard, 1980). Fishbein and Ajzen (1975) extended the trilogy with human behavior and formed the causal structural of beliefs, attitudes, intentions, and behaviors (as shown in Figure 2-1).

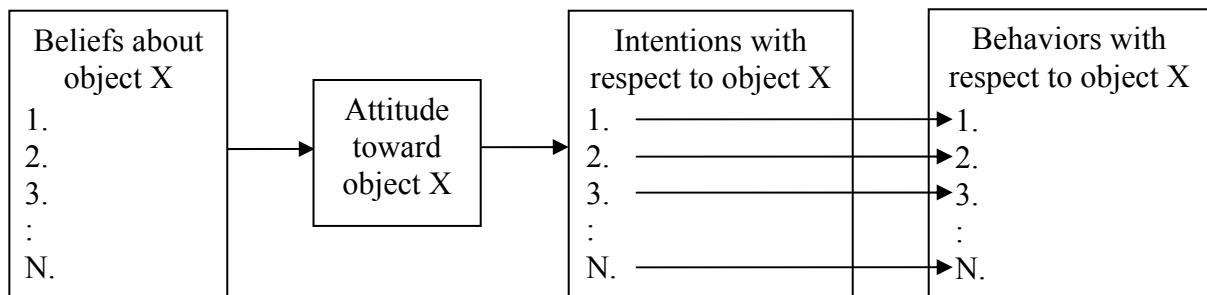


Figure 2-1 Beliefs, Attitudes, Intentions, and Behaviors Conceptual Framework

The constructs of beliefs, attitudes, intentions, and behaviors are defined as the following (Fishbein & Ajzen, 1975):

- Belief: Belief refers to cognition in the trilogy, which denotes the information and opinions an individual has about a particular object.

- Attitude: Attitude refers to affection in the trilogy, which represents an individual's favorable or unfavorable feelings and evaluation of a particular object.
- Behavioral Intention: Behavioral intention refers to conation in the trilogy, which denotes an individual's intention to perform a particular behavior.
- Behavior: Behavior is defined as the observable behavior.

According to these four categories, Fishbein and Ajzen (1975) assumed an individual's attitude toward a particular object is a bipolar effect that is determined by a set of probabilities of beliefs regarding that object. This attitude will then affect a set of intentions that correspond to that object, where each of the intentions represents the probabilities for the individual to perform its specific behavior. For example, a student may consider online learning is convenient and easy to access, however, this student may think online learning is lacking immediate feedback. The combination of these positive and negative beliefs lead the student to form an attitude toward online learning. This attitude toward online learning influences a set of this student's intentions such as the intention to take more online courses and the intention to invite friends to the online courses. Those intentions may eventually affect this student's behaviors.

Since the constructs of beliefs, attitudes, intentions, and behaviors covered the formation of human behavior, much research has been conducted based on this framework to analyze the determinants of the particular behavior. The following sections briefly review the three major theories, that is the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), the Theory of Planned Behavior

(TPB) (Ajzen, 1985), and the Technology Acceptance Model (TAM) (Davis, 1986, 1989; Davis, et al., 1989).

### *2.3.2 Theory of Reasoned Action*

The Theory of Reasoned Action (TRA) was developed by Fishbein and Ajzen (1980; 1975) to predict human behaviors. Based on the beliefs, attitudes, intentions, and behaviors framework, TRA assumed an individual's beliefs on the results of performing a particular behavior would affect the individual's attitude. Since Ajzen and Fishbein (1977) found that attitude toward the behavior has a stronger impact than attitude toward the object, TRA defined attitude as the individual's positive or negative feelings regarding the particular behavior. This attitude determines the relative strength of the individual's intention to perform that behavior. The individual is more likely to perform that behavior if this individual has a higher degree of intention. In addition, TRA proposed that the intention to perform a particular behavior is jointly influenced by the attitude and the subjective norm, where the subjective norm is affected by the normative beliefs regarding that particular behavior. The subjective norm was defined as an individual's perception of the importance of the behavior that should be performed, which addressed the influences from the individual's social environment. Fishbein and Ajzen (1975) further clarified the subjective norm as the "perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975). The construct model for TRA is shown in Figure 2-2.

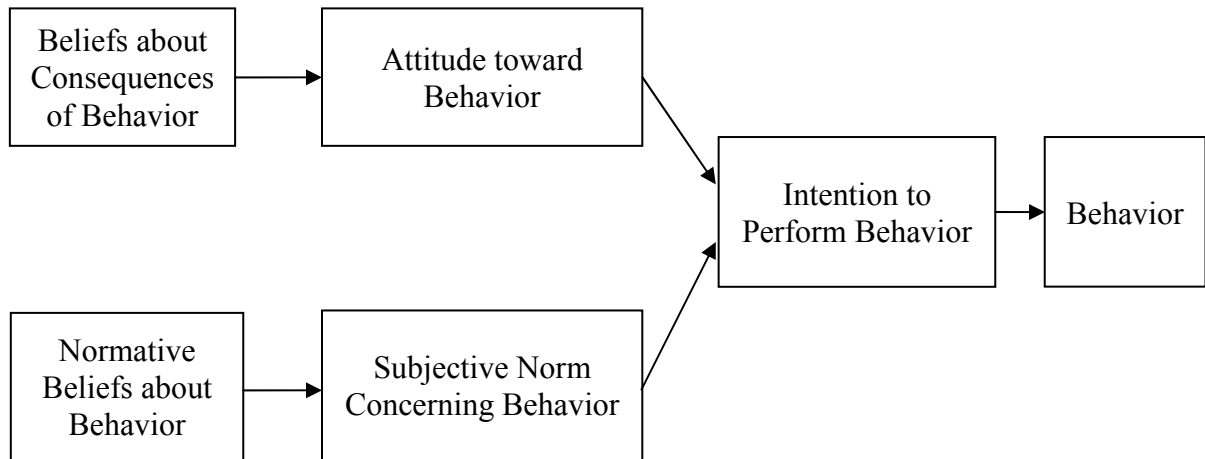


Figure 2-2 Theory of Reasoned Action (TRA)

TRA is widely adopted by social psychologists to explain and predict human behavior in specific situations. An empirical review conducted by Hale, Householder, and Greene (2002) found TRA has been validated by various research regarding consumer and health behavior (Greene, Hale, & Rubin, 1997; Sparks, Shepherd, & Frewer, 1995). Sheppard, Hartwick, and Warshaw (1988) also comments that TRA has been successfully applied to the field of consumer behavior to predict the consumer's intentions and behaviors. However, Sheppard et al. (1988) warned that the intentions may be influenced by time, events or other factors that are unrelated to the behavior before the individual actually performs the behavior. Some researchers (Davis, et al., 1989; Yeaman, 1988) also found evidence of the insignificant contributions of subjective norms when applying TRA to the domain of information systems. In addition, researchers (Ajzen, 1985, 1991; Hale, et al., 2002; Sheppard, et al., 1988) suggested that the behaviors applied in TRA

were only limited to the behaviors with volitional control. In other words, an individual will only perform the behavior if he or she has intention to do so. However, there are many chances that the behavior is not voluntary or out of the individual's control. For example, a behavior might be performed habitually or unconsciously, and another behavior might require the skills that the individual doesn't have.

### *2.3.3 Theory of Planned Behavior*

The Theory of Planned Behavior (TPB) was proposed by Ajzen in 1985 to extend Fishbein and Ajzen's (1980; 1975) Theory of Reasoned Action (TRA). TPB incorporated the factor of perceived behavioral control as the additional determinant on users' behavioral intentions and the actual behavior (Madden, Ellen, & Ajzen, 1992). Based on the constructs of TRA, TPB adopted the assumption that an individual's behavior is decided by the intention to the behavior, and that intention is jointly affected by the individual's attitude and subjective norm toward the behavior. However, as mentioned in the previous section, one of the limitations regarding TRA is that behavior should be under the individual's volitional control. In addition, Ajzen (1985) found that some other factors regarding the particular behaviors such as time, money, and skills also influenced the performance of those behaviors. Other researchers (Bandura, Adams, & Beyer, 1977; Bandura, Adams, Hardy, & Howells, 1980) also found that an individual's confidence regarding his or her ability to perform a particular behavior would directly influence the actual behavior.

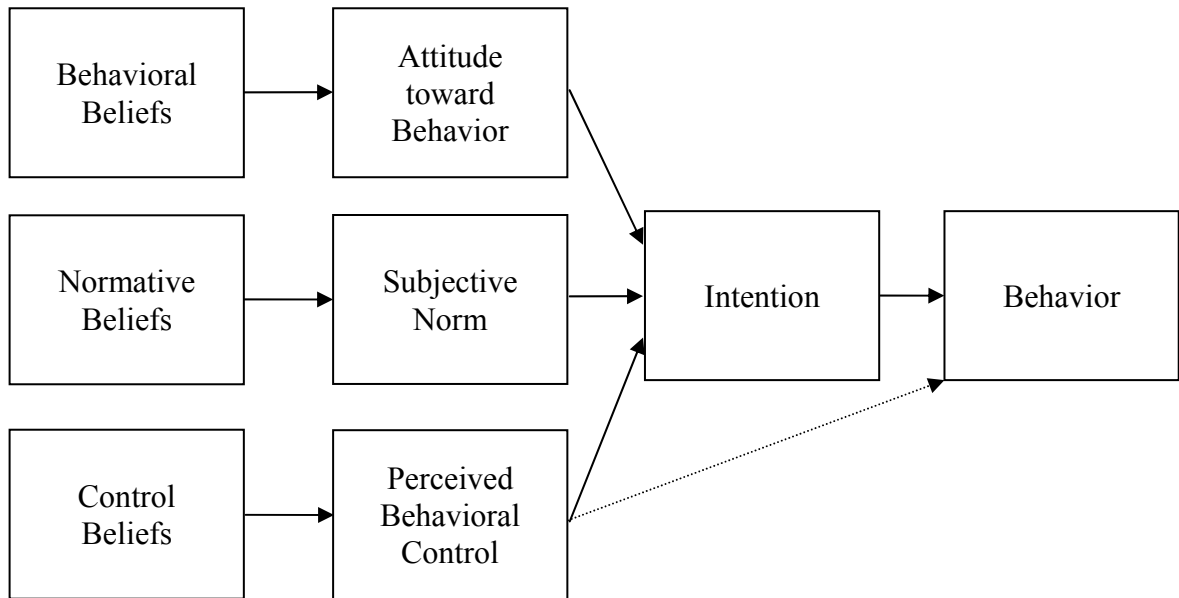


Figure 2-3 Theory of Planned Behavior (TPB)

Figure 2-3 displays the construct of TPB. In order to address the volitional issue toward the behavior, Ajzen (1985) adopted all the constructs from TRA and proposed perceived behavioral control as the additional determinant on an individual's intention. The control beliefs are defined as the individual's beliefs regarding the availability of factors (e.g., time, money, and skills) that correspond to particular behaviors. The perceived behavioral control is defined as an individual's evaluation of the easiness on performing a particular behavior based on control beliefs (Ajzen, 1991). Ajzen and Madden (1986) comments that perceived behavioral control represents the presence or absence of the overall requisite resources and opportunities that are necessary to perform a particular behavior. The concept of perceived behavioral control was originated from Bandura's (1977, 1978, 1982, 1986) self-efficacy (Ajzen, 1991). Self-efficacy was

proposed based on the social cognitive theory (Bandura, 1977, 1978, 1982, 1986), which “concerned with judgments of how well one can execute courses of action required to deal with prospective situations” (Bandura, 1977, p. 122).

TPB has become one of the popular theories to explain the individual’s beliefs toward the behaviors. Several meta-analysis researches (Ajzen, 1991; Armitage & Conner, 2001; Godin & Kok, 1996; Hausenblas, Carron, & Mack, 1997) were conducted from the TPB based studies and concluded that the constructs of TPB provide the explanation power to predict human behaviors. Mathieson et al. (2001) also commented that TPB can be used “to predict a wide range of behaviors” (p. 88). However, several criticisms were found from the application of TPB. Ogden (2003) found inconsistent roles in the constructs of attitudes, subjective norms, and perceived behavioral control when reviewing previous studies regarding TPB. Ajzen and Fishbein (2004) recognized Ogden’s concern and argued that the importance of those constructs may vary or even may not be necessary depends on the different situations, populations, and behaviors. Mathieson et al. (2001) also suggested that customized instruments are needed when adopting TPB research into every different circumstance. In addition, Sharma (2007) commented that TPB may not be appropriate for the studies focused on the behavior modification because the constructs of TPB do not provide the explanation on behavior change over time.

#### *2.3.4 Technology Acceptance Model*

The technology acceptance model (Davis, 1986, 1989; Davis, et al., 1989) is a model that targets on users' acceptance behaviors toward an information system (IS). Based on the beliefs, attitudes, intentions, and behaviors framework, TAM is “specifically meant to describe computer usage behavior...across a broad range of end-user computing technologies and user populations” (Davis, et al., 1989). TAM has become one of the most widely applied models for explaining and predicting usage intentions and acceptance behaviors of information technologies (Venkatesh, 2000). For more than two decades, TAM has been accepted as a valid model for predicting the acceptance of information technology in work and academics (Chau, 1996; Davis, et al., 1989; Johnson & Hignite, 2000; Kim & Bonk, 2006; Lu, et al., 2003; Mathieson, 1991; Morris & Dillon, 1997; Szajna, 1996; Venkatesh, 2000; Venkatesh & Davis, 2000; Yi & Hwang, 2003).

In order to explain and predict user acceptance of specific types of computer-based information systems (IS) in a work environment, Davis (1986) modified the belief-attitude-intention-behavior relationship of TRA and proposed the technology acceptance model (TAM; Figure 2-4). TAM provided the linkages between two key belief determinants, perceived usefulness (U) and perceived ease of use (EOU), and user's attitudes toward using (A), behavioral intentions to use (BI) and actual system use of the computer systems (USE) (Davis, 1986; Davis, et al., 1989).



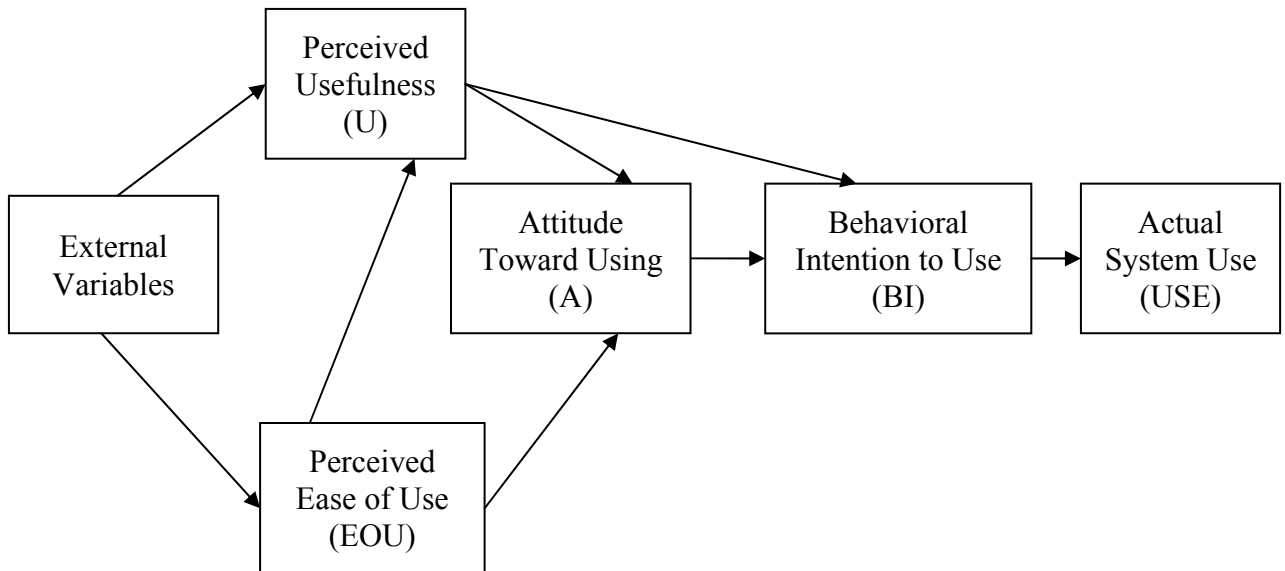


Figure 2-4 Technology Acceptance Model (TAM)

TAM adopted the same assumptions of user’s attitudes toward using, behavioral intentions to use and actual behavior of system use from TRA. However, Mathieson (1991) and Taylor and Todd (1995c) found that perceived usefulness and perceived ease of use only minimally overlap with the belief constructs in TPB (i.e., normative beliefs and control beliefs). Davis (1989) defined perceived usefulness and perceived ease of use in Table 2-1.

Table 2-1 Definition of Perceived Usefulness and Perceived Ease of Use (Davis, 1989)

	Definition
Perceived Usefulness	“the degree to which a person believes that using a particular system would enhance his or her job performance”
Perceived Ease of Use	“the degree to which a person believes that using a particular system would be free of effort”

In addition, Davis et al. (1989) also found the existence of external variables that represent individual differences, situational constraints and managerially controllable interventions to be important determinants on perceived usefulness (U), perceived ease of use (EOU), and even the behavior on using the system. Chau (1996) also suggested that external variables could be system features, training, documentation, and user support. Therefore, future investigations of the implementations of the external variables will be needed (Davis, et al., 1989).

Since Davis conducted the first TAM research in 1986, TAM has been applied to the information systems in many different areas. A meta-analysis conducted by Lee, Kozar, and Larsen (2003) found TAM has been applied in several different areas such as communication systems, general purpose systems, office systems, and specialized business systems. This meta-analysis also commented on the several limitations of TAM. First, most of the previous articles adopted the self-reported usage as the measurement of actual system use, however, researchers argued that kind of self-report could be bias for the causal relationships of TAM (Agarwal & Karahanna, 2000; Y. Lee, et al., 2003; Podsakoff & Organ, 1986). Second, most previous research examined the TAM only at a single point of time or a minimal period of exposure toward the systems. However, the individual's beliefs and intentions may change over time and the forming of beliefs and intentions require a period of time (Davis, 1986; Y. Lee, et al., 2003). In addition, the results from previous studies also showed low variance explanations of TAM, especially the studies that did not consider any external variables other than the original constructs of TAM. Overall, most of the researchers agree that perceived usefulness is the main

determination of the actual use of the system, while perceived ease of use has a strong influence on perceived usefulness and a slight effect on the use of the system (Venkatesh, 2000; Venkatesh & Davis, 2000).

## 2.4 Applications and Modifications of the Technology Acceptance Model

### *2.4.1 Application of Technology Acceptance Model*

The Perceived Resources and Technology Acceptance Model (PRATAM) in this current research adopted the basic constructs from the Technology Acceptance Model (TAM) and applied it in a higher education web-based online learning system. This section reviews the modifications and extensions of TAM based on the previous studies that were conducted on the web-based systems. In addition, this section also reviews the previous applications of TAM, which includes the studies conducted by Davis (1986, 1989), Davis et al. (1989), and other studies regarding the web-base systems or conducted previously in a large southeastern public university during the past decade.

Davis conducted the first study in 1986 via TAM to analyze 40 master of business administration (MBA) students' acceptance toward two business graphic systems. The results found perceived usefulness had strong effects on both the attitude toward using and the actual system. In addition, perceived ease of use had minor effects on the attitude toward using and a moderate effect on the perceived usefulness. Attitudes toward the systems had only moderate effects on system use (Davis, 1986).

However, because the design of the study didn't provide enough time for subjects to form their intentions, the behavioral intention variable had been omitted from the study (Davis, 1986). Davis et al. (1989) later conducted a longitudinal study by 107 full-time MBA students on a word processing program. The result further confirmed the validity of the linkages and suggested that computer use can be predicted by the user's intentions.

Perceived usefulness is a major determinant of the user's intentions while perceived ease of use still has significant effects on the user's intentions. The other two studies conducted by Davis (1989) on a total 152 users also found the usage of four computer applications (two applications in each study) were significantly correlated between perceived usefulness and perceived ease of use.

The following sections provide a review of the modifications and extensions of TAM based on the previous studies that were conducted on web-based systems, especially the studies regarding the web-base online learning systems or conducted previously in a large southeastern public university during the past decades.

#### *2.4.2 Technology Acceptance Model 2*

In order to address the concerns by Davis (1993) regarding the external variables toward perceived ease of use and perceived usefulness, Venkatesh and Davis (2000) proposed a theoretical extension of TAM, which also referred to as TAM2. TAM2 revised the original TAM and proposed factors from two main categories: social

influence processes and cognitive instrumental processes. The definitions of these factors are presented in Table 2-2.

Table 2-2 Definitions of Social Influence Processes and Cognitive Instrumental Processes Factors (Chismar & Wiley-Patton, 2002; Venkatesh & Davis, 2000)

	Definition
Social Influence Processes	
Subjective Norm	“an individual’s perception that people who are important to he or she think he or she should or should not use the technology”
Voluntariness	“the degree to which one perceives the use of the technology as a means of enhancing one’s status within a social group”
Image	The extent to which one perceives the adoption decision as non-mandatory
Cognitive Instrumental Processes	
Job Relevance	“an individual’s perception of the degree to which the technology is applicable to his or her job”
Output Quality	“an individual’s perception of how well a system performs tasks necessary to his or her job”
Result Demonstrability	“the tangibility of the results of using the technology”

Social influence processes represented the social forces that influence an individual’s decision to accept or reject a new system. Venkatesh and Davis (2000) claimed that subjective norm, voluntariness, and image are the three interrelated factors belonging to this category. On the other hand, along with perceived ease of use, Venkatesh and Davis (2000) proposed job relevance, output quality, and result demonstrability as the factors of cognitive instrumental processes. In addition, the factors of experience also proposed to decrease the influences from subjective norm to perceived

usefulness and intention to use. These factors were introduced into the TAM as the external determinants toward perceived usefulness and intention to use (Figure 2-5).

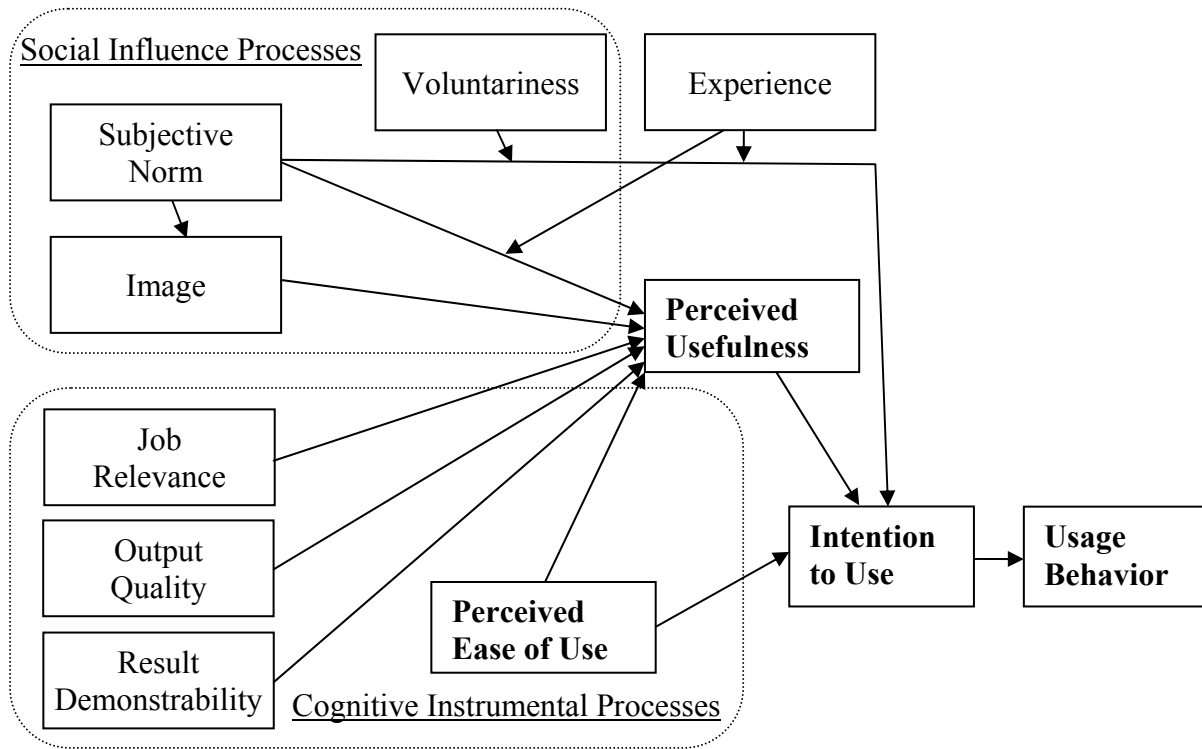


Figure 2-5 Technology Acceptance Model 2 by Venkatesh and Davis (2000)

Four longitudinal data across different industries and systems were adopted in this research to validate the constructs of TAM2. Each data set contains about 50 samples. According to the results, both social influence processes and cognitive instrumental processes showed consistent effects on the individual's perceived usefulness, intentions, and actual usage behaviors. The results claimed that TAM2 could explain up to 60% of the variance in the usage intentions. The overall finding also indicated that intention to

use was significantly affected by subjective norm ( $\beta = 0.44$ ,  $p < 0.001$ ), which shows more influences on intention to use than the effects from perceived ease of use.

Chismar and Wiley-Patton (2002) conducted a survey study regarding Internet-based health applications based on TAM2. Due to the setup of the research, experience and voluntariness were removed from this research. The results explained around 60% of the variances on perceived usefulness and intention to use. However, this study only found significant effects on perceived usefulness from the cognitive instrumental processes (i.e., job relevance and result demonstrability).

#### *2.4.3 Extended Technology Acceptance Model with Computer Self-Efficacy*

Social cognitive theory and self-efficacy (Bandura, 1977, 1978, 1982, 1986) has been applied in many areas to address human learning behavior. Bandura (1977, 1978, 1982, 1986) found individuals' beliefs and behaviors are influenced by self-efficacy, researchers (Compeau, Higgins, & Huff, 1999) suggested that self-efficacy has shown strong impacts on the adoption and learning behaviors regarding computer technologies in many information system researches. Researchers (Mathieson, 1991; Taylor & Todd, 1995c) found that the constructs of technology acceptance model (i.e., perceived usefulness and perceived ease of use) only minimally overlap with the perceived behavioral control of Theory of Planned Behavior. The extension of self-efficacy in TAM has been proposed by many researchers (Igbaria & Iivari, 1995; Pan, 2003; Yang, 2007).

Self-efficacy was defined by Bandura (1986) as the individual's "judgments of their capabilities to organize and execute courses of action required to attain designated types of performances.... not with the skills one has but with judgments of what one can do with whatever skills one possesses" (p. 391). Regarding the computer and information system, Compeau and Higgins (1995) further defined computer self-efficacy as the individual's "judgment of one's capability to use a computer" (p. 192). The concept of computer self-efficacy is mainly focused on the ability "to use computers in the accomplishment of a task (ie., using a software package for data analysis, writing a mailmerge letter using a word processor), rather than reflecting simple component skills (ie., formatting diskettes, booting up a computer, using a specific software feature such as "bolding text" or "changing margins")" (Compeau & Higgins, 1995, p. 191).

Igbaria and Iivari (1995) proposed a modified TAM to incorporate self-efficacy (Figure 2-6). In addition to the variables from TAM (i.e., perceived ease of use, perceived usefulness, and system usage), this extended TAM further introduced self-efficacy, computer anxiety, computer experience and organization support to address the influences of self-efficacy on the usage of computer technology. While self-efficacy is jointly influenced by computer experience and organization support, computer anxiety is also jointly affected by self-efficacy, computer experience, and organization support. Self-efficacy, computer anxiety, computer experience and organization support are then proposed to affect perceived ease of use, perceived usefulness, and system usage. This extended model examined 450 computer users in the top 120 companies in Finland in 1993. The results suggested that perceived ease of use is significantly affected by self-



efficacy, computer anxiety, computer experience and organization support (26% of variance explained), and perceived usefulness is significantly affected by computer anxiety, computer experience, organization support, and perceived ease of use (30% of variance explained). However, only computer experience and perceived usefulness showed direct effect toward system usage.

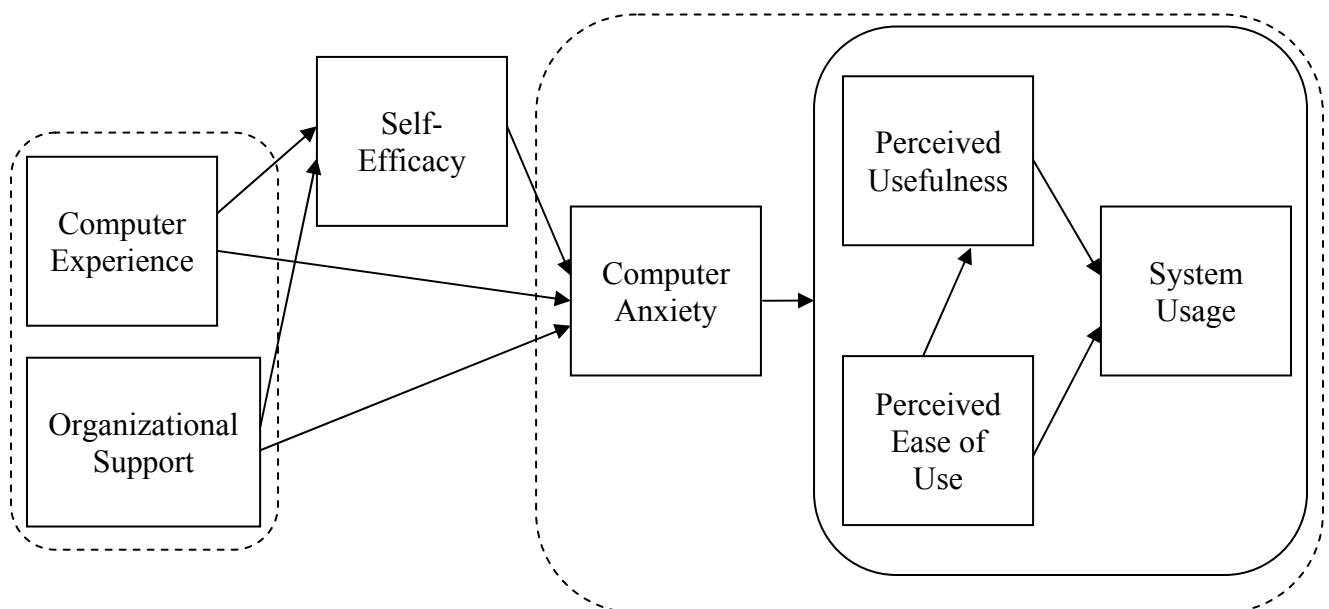


Figure 2-6 The Extended Technology Acceptance Model with Self-Efficacy by Igarria and Iivari (1995)

Pan (2003) conducted similar research based on TAM and self-efficacy on the WebCT system at a large southeastern public university. Based on the constructs of TAM, Pan further expanded the model with subjective norm and computer self-efficacy (Figure 2-7). In addition to the basic constructs of TAM, Pan proposed that subjective

norm will have a direct effect on attitude toward WebCT and actual use, while computer self-efficacy will also have a direct effect on perceived ease of use and actual use.

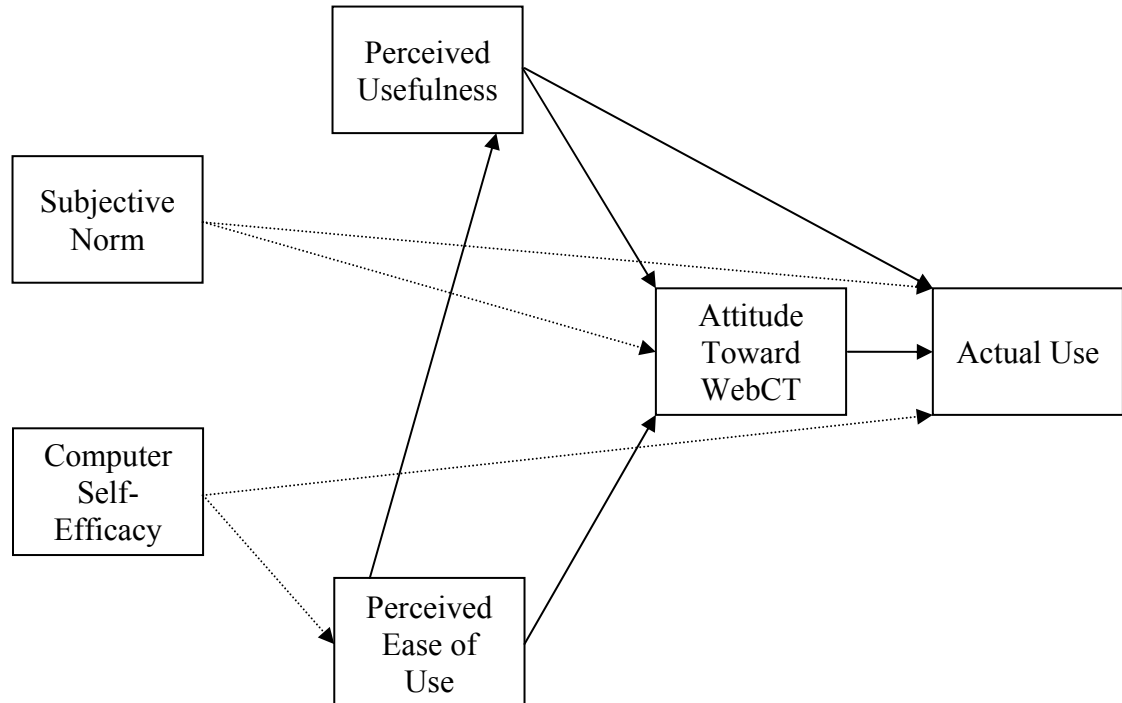


Figure 2-7 The Extended Technology Acceptance Model with Subjective Norm and Computer Self-Efficacy by Pan (2003)

Pan conducted two surveys in the research and a total of 469 college level students participated in both surveys. This research also incorporated the computer recorded usage data as the actual use. The extended TAM successfully explained the collected data and the results showed a minor difference from two different points of time. The results in time 1 indicated that subjective norm has a direct effect on perceived usefulness, perceived ease of use and attitude toward WebCT, while computer self-efficacy also has a direct effect on perceived usefulness, perceived ease of use and actual

use. In addition, as expected in TAM, perceived ease of use has a direct effect on perceived usefulness and attitude toward WebCT; perceived usefulness has a direct effect on attitude toward WebCT; and attitude toward WebCT has a direct effect on actual system use. On the other hand, while the same paths remain significant in time 2, the results found a insignificant path from perceived ease of use to attitude toward WebCT. In addition, perceived usefulness in time 2 also reveals significant influence on the actual use.

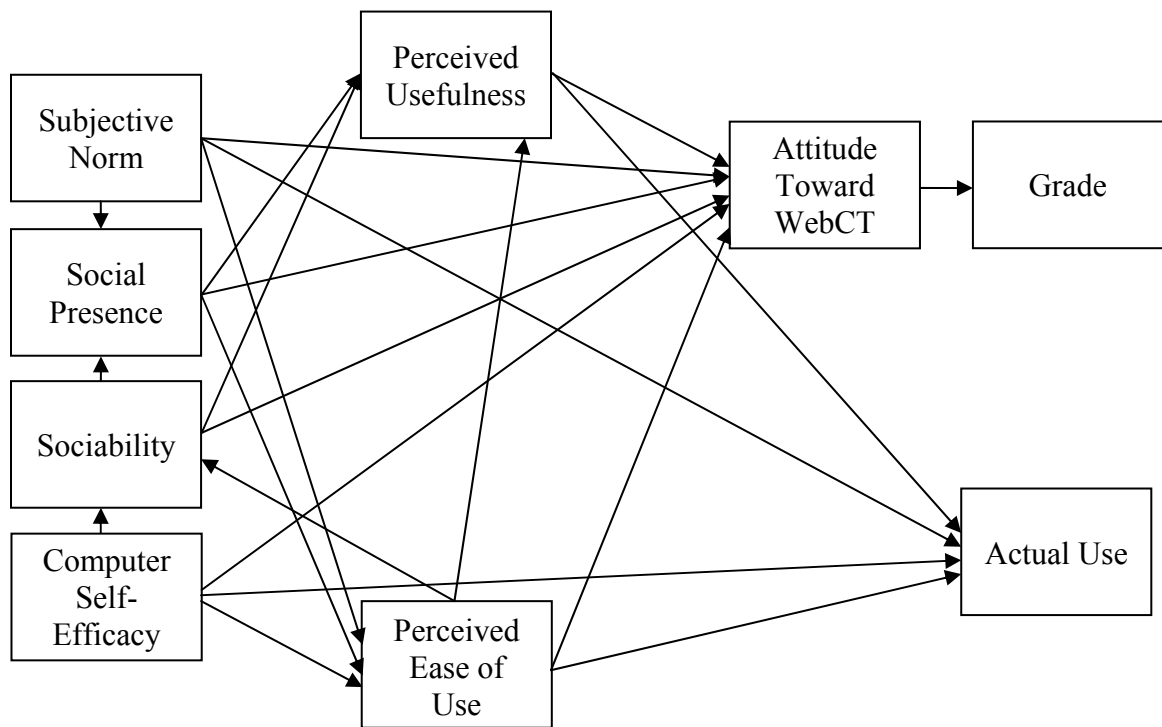


Figure 2-8 The Extended Technology Acceptance Model with Subjective Norm, Social Presence, Sociability, and Computer Self-Efficacy by Yang (2007)

The other study regarding the WebCT system at a large southeastern public university was conducted by Yang (Yang, 2007). Yang proposed subjective norm, social

presence, sociability, and computer self-efficacy as the extra determinants in addition to the constructs of TAM (Figure 2-8). In addition, students' grades of the WebCT course were also adopted in the research. A total of 79 college level students participated in this survey research on three different points of time. The results show the significant model fit on the collected data regarding all their points of time. Apart from the significant findings of the original constructs of TAM, this study also suggests that subjective norm, social presence, sociability, and computer self-efficacy could provide extra explanations for students' acceptance of the web-based online learning system.

#### *2.4.4 Extended Technology Acceptance Model with Perceived Enjoyment and attractiveness*

In order to address the individual's motivation toward the acceptance of websites, van der Heijden (2003) expanded the constructs of TAM with the constructs of perceived enjoyment and perceived attractiveness. Table 2-9 shows the constructs of this extended TAM. While perceived enjoyment is defined as "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated", perceived attractiveness is defined as "the degree to which a person believes that the website is aesthetically pleasing to the eye" (van der Heijden, 2003). Based on the constructs of TAM, perceived enjoyment is proposed to have a direct effect on both the attitude toward using and the intention to use; perceived attractiveness is proposed to have a direct effect on perceived usefulness, perceived ease

of use, and perceived enjoyment. In addition, perceived enjoyment is also assumed to be influenced by perceived ease of use.

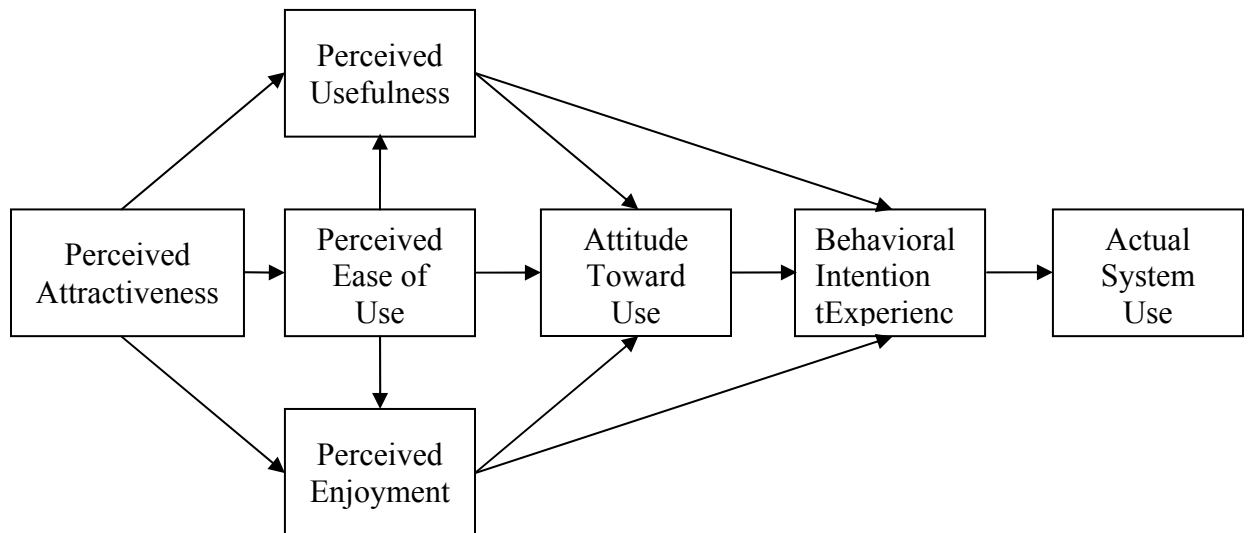


Figure 2-9 Extended Technology Acceptance Model (TAM) by van der Heijden (2003)

Based on this extended TAM, this research surveyed a total of 825 users of a portal website. The results significantly supported the constructs of the perceived enjoyment extended TAM. All of the proposed paths between the factors showed significant coefficient beta and the results explained around 30% of variance on those factors. Overall, the inclusion of perceived enjoyment and perceived attractiveness provided the extra explanation power in addition to the original TAM, and the research suggested that these two additional constructs could be essential belief aspects toward the usage of a web-based system.

#### *2.4.5 Extended Technology Acceptance Model with Perceived Resources and Support*

Researchers have found that resources are a key determination toward learning and adopting information systems (Ajzen, 1991; Ajzen & Madden, 1986; Gable, 1991; Guimaraes, et al., 1999; Igarria, et al., 1997; Y.-C. Lee, 2008; Mathieson, 1991; Mathieson, et al., 2001; Thong, et al., 1996). The factor of resources can be defined as the personal and organizational resources that users need to use in an information system (Mathieson, et al., 2001). Kwon and Zmud (1987) suggested that the sufficient organizational resources, such as developer and user time, funding, and technical skills, can directly motivate and sustain the implementation of an information system.

Perceived resources are the external belief variables that have been examined by several researchers (Ajzen, 1991; Igarria, et al., 1997; Y.-C. Lee, 2008; Mathieson, 1991; Mathieson, et al., 2001; Ngai, et al., 2007; Taylor & Todd, 1995a, 1995b, 1995c) on the influences toward users' motivation regarding the information system. Perceived resources are the individual's belief of personal and organizational resources that he or she needed to use in an information system (IS) (Mathieson, et al., 2001). The concept of perceived resources first came from the perceived behavioral control in the Theory of Planned Behavior (TPB) (Ajzen, 1985). After comparing TAM to TPB, Mathieson (1991) found that both models sufficiently explained the variances with just slight differences, but TAM had the advantage on the generalized instruments which can be easily applied to many situations. However, TAM only partially covered the perceived behavioral control on skill, the internal control factor. The other control factors were not

considered in TAM (Mathieson, 1991). Taylor and Todd's study (1995c) confirmed that the perceived behavioral control only minimally overlapped in TAM's constructs. In addition, researchers found TAM assumes that the use of the information system is volitional, which means, if an individual decides to use the information system, there are no barriers that would prevent the individual from doing so (Mathieson, et al., 2001).

This assumption might limit the implementations of TAM in practicality where individuals often face resource constraints (Oh, et al., 2003). Mathieson et al. (2001) further argued that the overlooking of the resource barriers such as lack of time, money, and equipment might prevent an individual from using the technology. Furthermore, since TAM was built on the idea that it "readily generalizes to different computer systems and user populations" (Davis, et al., 1989), the context specific beliefs were not identified in the construct of TAM and the beliefs other than ease of use and usefulness won't be available under this construct (Mathieson, 1991).

Mathieson et al. (2001) therefore proposed an extended TAM with the constant "Perceived Resources" (Figure 2-10) to examine the voluntary use of the Institute for Management Accountants (IMA) bulletin board system (BBS) by its 1172 members. Based on the constructs of the TAM, Mathieson et al. (2001) defined perceived resources as the objective measurements of the belief of the resources toward a specific task which is the bulletin board system (BBS) at the same single point of time as perceived ease of use and perceived usefulness.

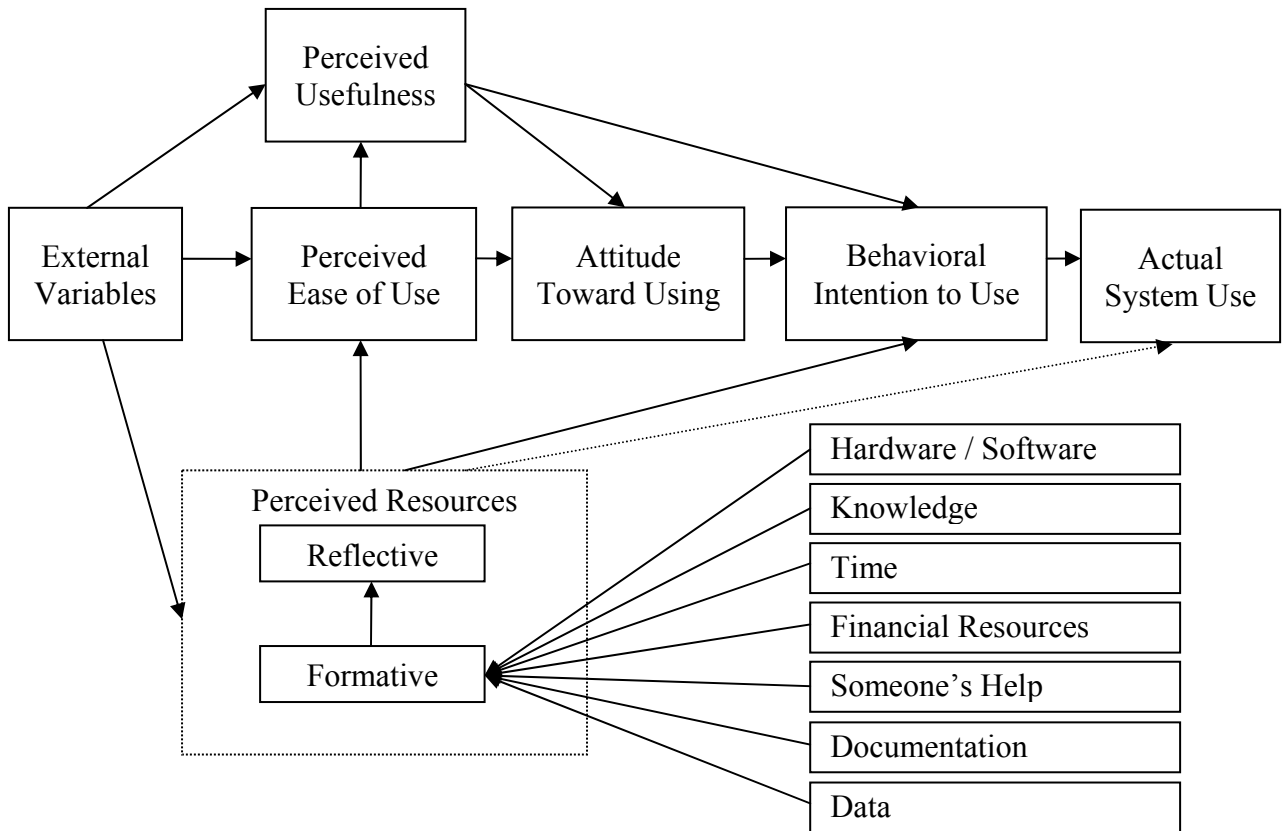


Figure 2-10 Extended Technology Acceptance Model (TAM) by Mathieson et al. (2001)

The concept of perceived resources can further be divided into reflective resources and formative resources. Reflective resources measure at the same level of abstraction as other constructs of the TAM, like the overall perception of resource availability. Formative resources measure specific barriers factors such as the expertise, the hardware, the software, and the financial support of using the system (Mathieson, et al., 2001). The results of the Mathieson et al. (2001) research indicates that the perceived resources affect an individual's behavioral intention, perceived ease of use, and have a minor effect on perceived usefulness. The findings commented that the perceived resources contributed not only an alternative way to estimate the beliefs of the resources,



but also the itemized information which may be valuable for administrators in the future by promoting this perception or even the acceptance of the technology system (Mathieson, et al., 2001).

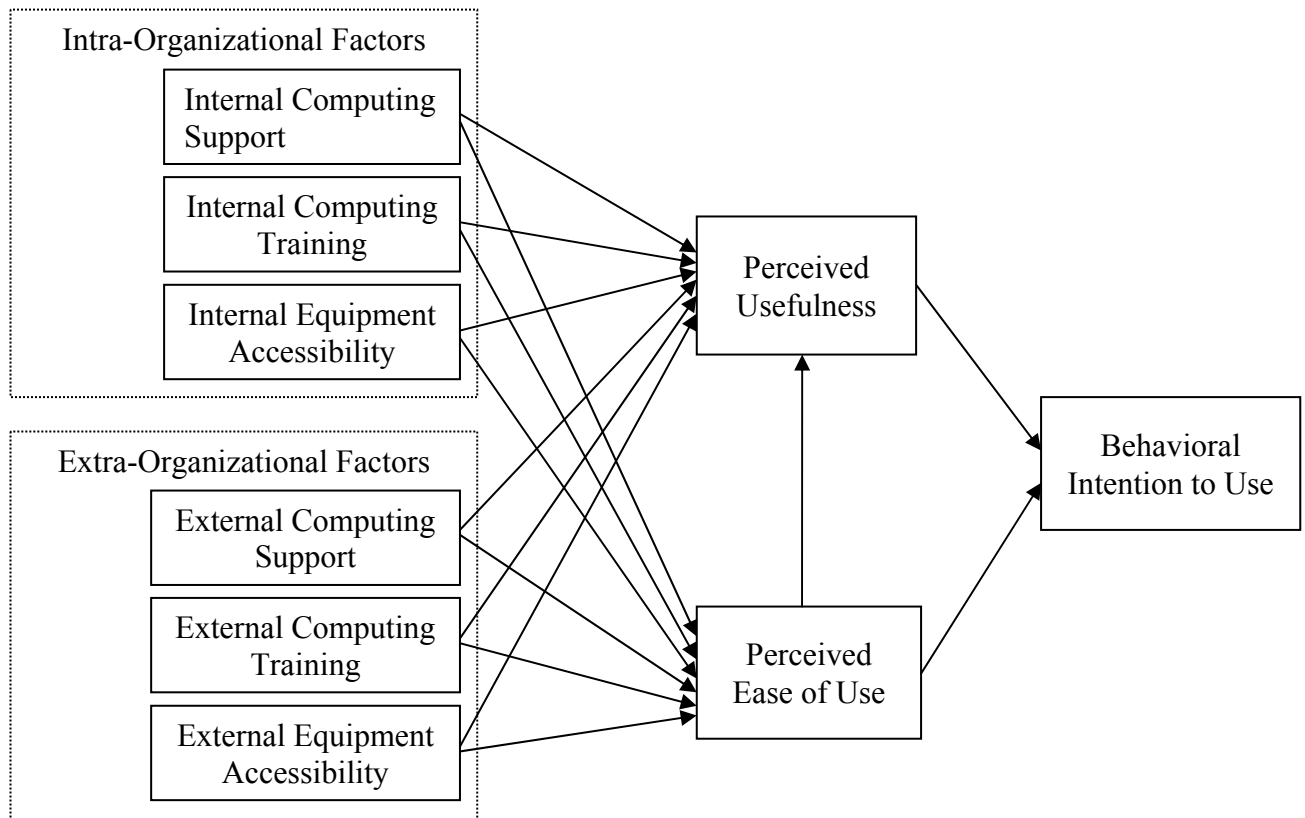


Figure 2-11 Extended Technology Acceptance Model (TAM) by Lee (2008)

While Mathieson et al. (2001) found that time, documentation, and knowledge are the most important individual resource factors in the study, they also commented that future researchers should adopt different resource factors according to the requirements of the specific technology. In terms of acceptance of the online learning systems, Lee

(2008) conducted a study of 1125 college students who had web-based learning systems in their universities to examine the influence of the perceptions of the needed resources toward students' adoption of an online learning system. Inheriting the perceived resources concept from Mathieson et al., (2001), Lee developed the Intra-Organizational and Extra-Organizational factors of support, training, and equipment accessibility of the online learning system that students can acquire internally and externally from the institutions. Lee also proposed a model that employed those internal and external organizational factors to represent perceived resources (Figure 2-11).

The results of Lee's study indicated that perceived ease of use, internal computing support, internal computing training, and external computing support have direct effects on perceived usefulness, while the internal computing support, internal computing training, external computing support, external computing training, and external equipment accessibility also have direct effects on perceived ease of use. The findings not only confirmed the constructs of the original TAM, but also commented on the considerable influences of perceived usefulness and perceived ease of use from perceived resources. Lee (2008) further suggested that perceived resources could lead to better online learning adoption.

In terms of the research conducted at a large southeastern public university, Siegel (2008) conducted a research to examine the acceptance behaviors toward LiveText for the faculty members at a large southeastern public university. LiveText© is a web-based online learning assessment management system, however, the issues of resistance and motivation regarding the new technology was also raised during the adoption. Siegel

(2008) proposed the motivation and acceptance model (MAM; Figure 2-12) to measure the user's motivation and technology resistance. The factor of perceived organizational support was introduced to represent the individual's perception on the support from the organization.

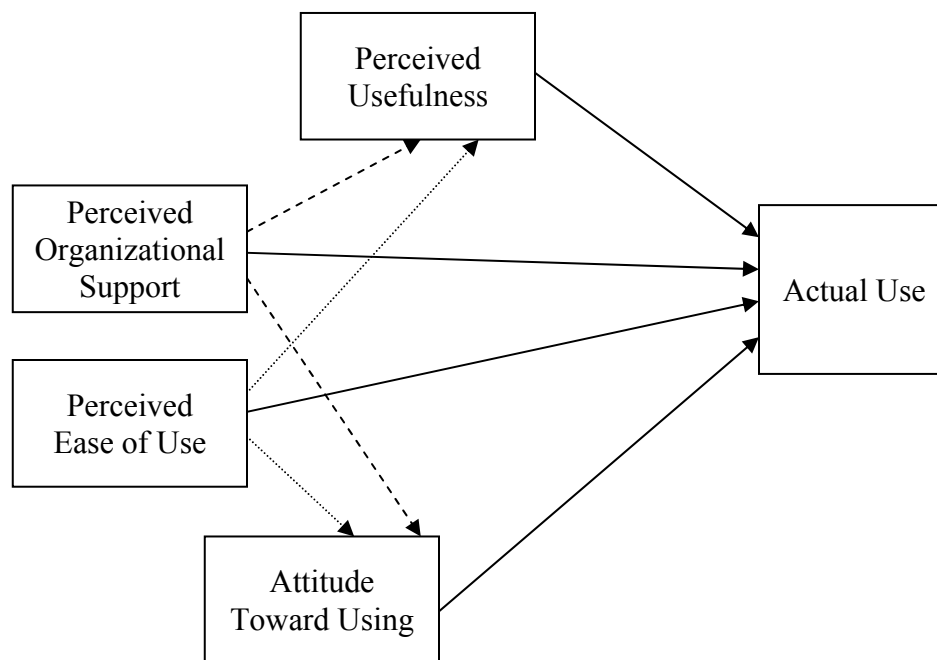


Figure 2-12 Motivation and Acceptance Model (MAM) by Siegel (2008)

Based on TAM, MAM adopted perceived organizational support as the additional determinant of perceived usefulness, attitude toward LiveText, and actual use. MAM assumes the actual usage behaviors will be determined by perceived organizational support, perceived ease of use, perceived usefulness, and attitude toward using. In addition, both perceived usefulness, and attitude toward using will also be affected by perceived organizational support and perceived ease of use. A total of 59 faculty

members participated in this research and the results indicated mixed findings regarding MAM. As expected in MAM, perceived ease of use, perceived usefulness, and attitude toward using have a direct effect on the actual use. Perceived usefulness is also influenced by perceived ease of use. However, perceived organizational support did not show the significant effects on actual use, perceived usefulness, and attitude toward LiveText.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 Introduction**

The current research was based on the non-experimental research design. The quantitative longitudinal survey instruments were used to examine the Perceived Resources and Technology Acceptance Model (PRATAM) on the students' beliefs, attitude toward, behavioral intention, and the actual use behavior of the web-based WebCT courses in a higher education campus. This chapter was divided into the following five major sections: (1) participants for the study; (2) research designs; (3) research instruments; (4) data collection; and (5) data analyses. The first section on the beginning of the chapter reveals the constructions and the sources of the participant's population. The next section describes the designs and compositions of the current research model. The following section describes the theoretically based instruments used in the current research. The last two sections of this chapter specify the procedures on the data collections and analyses.

### 3.2 Participants

The empirical data for this study was collected from two questionnaire surveys over the period of the Fall 2008 semester at University of Central Florida (UCF). The participant population in this study was the students enrolled in the EME 2040 “Introduction to Educational Technology” and RED 5147 “Foundation of Developmental Reading” courses of UCF College of Education. EME 2040 was held on two W-Type and three M-Type WebCT sessions and the total enrolment numbers in Fall 2008 was one hundred and sixty-eight students. On the other hand, RED 5147 was taught only by W-Type sessions and the total enrolment in Fall 2008 was eighty-four students (As shown in Table 3-1).

Table 3-1 Participated WebCT Courses Summary

		Course Type		Enrolled Students
		W-Type	M-Type	
Course	EME 2040 - Introduction to Educational Technology	2	3	163
	RED 5147 - Foundation of Developmental Reading	1	0	84
Total		3	3	247

### 3.3 Design of the Study

The purpose of this current empirical research was to use the Perceived Resources and Technology Acceptance Model (PRATAM) to observe and measure the student’s

beliefs on using WebCT online learning system. Based on the research question: How does PRATAM explain the students' usage behaviors of WebCT? The following research hypotheses were analyzed in the current research:

- H1. Perceived resources will have a positive direct effect on perceived usefulness.
- H2. Perceived resources will have a positive direct effect on perceived ease of use.
- H3. Perceived resources will have a positive direct effect on attitude toward using WebCT.
- H4. Perceived resources will have a positive direct effect on behavioral intention to use WebCT.
- H5. Perceived ease of use will have a positive direct effect on perceived usefulness.
- H6. Perceived ease of use will have a positive direct effect on attitude toward using WebCT.
- H7. Perceived usefulness will have a positive direct effect on attitude toward using WebCT.
- H8. Perceived usefulness will have a positive direct effect on behavioral intention to use WebCT.
- H9. Attitude toward using will have a positive direct effect on behavioral intention to use WebCT.

H10. Behavioral intention to use will have a positive direct effect on actual WebCT usage.

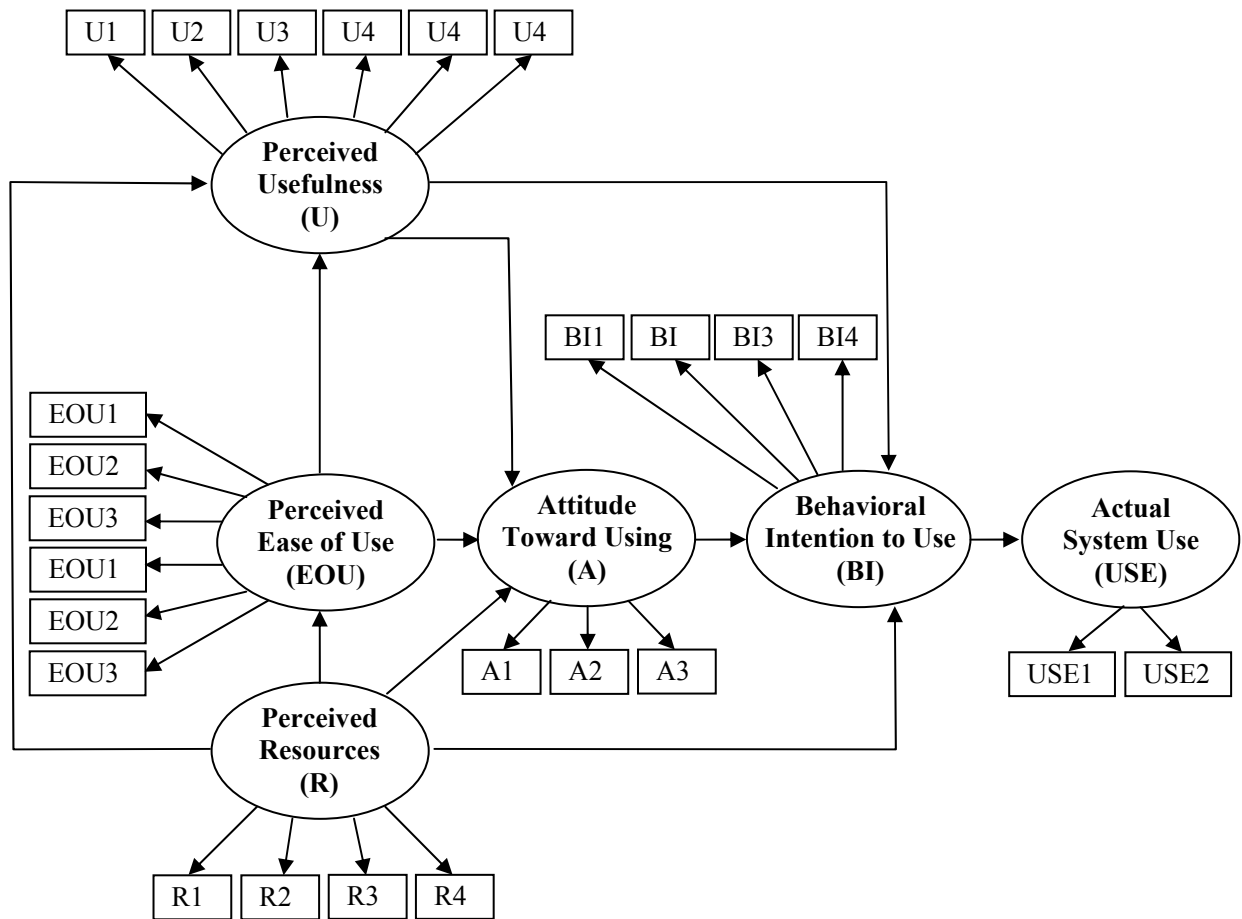


Figure 3-1 Measurement Model of the Perceived Resources and Technology Acceptance Model (PRATAM)

Therefore, this current research focused on the relationships between perceived usefulness, perceived ease of use, perceived resources, attitude toward using, behavioral intention to use and the actual system use of WebCT in higher education online learning courses. The causal constructs based on the belief-attitude-intention-behavior relationships in the technology acceptance model was adapted in PRATAM. As



illustrated in Figure 3-1, the six manifest variables (i.e., perceived usefulness, perceived ease of use, perceived resources, attitude toward using, behavioral intention to use, and actual system use) were measured as a scale based on the sum of corresponding measurement items. For example, behavioral intention to use was the total of the sum of four measurement items (i.e., BI1, BI2, BI3, and BI4).

### 3.4 Instrument

The survey instruments was adopted from previous research studies (Davis, 1993; Davis, et al., 1989; Y.-C. Lee, 2008; Mathieson, et al., 2001; Moon & Kim, 2001; Pan, 2003; Siegel, 2008) that have shown reliability and validity evidence. A total of thirty question items that used in the questionnaire included: (1) perceived resources instrument; (2) perceived usefulness instrument; (3) perceived ease of use instrument; (4) attitude toward using instrument; (5) behavioral intention to use instrument; (6) actual system use instrument; and (7) demographics instrument. Each of the seven instrument categories is illustrated in the following sections.

#### *3.4.1 Perceived Resources (R) Instrument*

The following four measurement items for perceived resources were modified from the perceived resources instrument provided by Mathieson et al. (2001) which claimed to have a 0.92 Cronbach's alpha reliability. All those items were a brief

statement followed by a seven-point Likert scale ranging from “extremely likely” (7), “quite likely” (6), “slightly likely” (5), “neither” (4), “slightly unlikely” (3), “quite unlikely” (2), to “extremely unlikely” (1) as well as “not applicable” (N/A). Table 3-2 shows the questionnaires for perceived resources instrument:

Table 3-2 Perceived Resources (R) Instrument

Variable	Questionnaires
R1	I have the resources I would need to use WebCT in my course.
R2	There are no barriers to my using WebCT in my course.
R3	I would be able to use WebCT in my course if I wanted to.
R4	I have access to the resources I would need to use WebCT in my course.

#### 3.4.2 Perceived Usefulness (U) Instrument

Pan (2003) conducted a research on student perspective to WebCT usage and concluded 0.91 and 0.946 Cronbach’s alpha reliability from the two points of the questionnaire times. Therefore, the six perceived usefulness instrument items were modified from Pan (2003) usability instrument. All those items were a brief statement followed by a seven-point Likert scale ranging from “extremely likely” (7), “quite likely” (6), “slightly likely” (5), “neither” (4), “slightly unlikely” (3), “quite unlikely” (2), to “extremely unlikely” (1) as well as “not applicable” (N/A). Table 3-3 shows the questionnaires for perceived usefulness instrument:

Table 3-3 Perceived Usefulness (U) Instrument

Variable	Questionnaires
U1	Using WebCT in my class would enable me to accomplish tasks more quickly.
U2	Using WebCT would improve my class performance.
U3	Using WebCT in my class would increase my productivity.
U4	Using WebCT would enhance my effectiveness in my course work.
U5	Using WebCT would make it easier to do my course work.
U6	I would find WebCT useful in my course work.

### 3.4.3 Perceived Ease of Use (EOU) Instrument

The six perceived ease of use instrument items were also modified from Pan (2003) usability instrument, which claimed the Cronbach’s alpha reliability from the two questionnaire of 0.942 and 0.954. All those items (as shown in Table 3-4) were a brief statement followed by a seven-point Likert scale ranging from “extremely likely” (7), “quite likely” (6), “slightly likely” (5), “neither” (4), “slightly unlikely” (3), “quite unlikely” (2), to “extremely unlikely” (1) as well as “not applicable” (N/A).

Table 3-4 Perceived Ease of Use (EOU) Instrument

Variable	Questionnaires
EOU1	Learning to use WebCT would be easy for me.
EOU2	I would find it easy to get WebCT to do what I want it to do.
EOU3	My interaction with WebCT would be clear.
EOU4	I would find WebCT to be flexible to interact with.
EOU5	It would be easy for me to become skillful at using WebCT.
EOU6	I would find WebCT easy to use.

#### 3.4.4 Attitude Toward Using (A) Instrument

The three attitude toward using instrument items were modified from Siegel (2008) instruments, which claimed to have a 0.99 reliability in the research on the acceptance of LiveText system in UCF. All those items were a brief statement followed by a seven-point Likert scale ranging from “extremely likely” (7), “quite likely” (6), “slightly likely” (5), “neither” (4), “slightly unlikely” (3), “quite unlikely” (2), to “extremely unlikely” (1) as well as “not applicable” (N/A). Table 3-5 shows the questionnaires for attitude toward instrument:

Table 3-5 Attitude Toward Using (A) Instrument

Variable	Questionnaires
A1	WebCT is beneficial.
A2	WebCT is positive.
A3	I would find WebCT easy to use.

#### 3.4.5 Behavioral Intention to Use (BI) Instrument

The four behavioral intention to use instrument items were modified from Lee (2008) instruments, which claimed to have a 0.81 reliability on behavioral intention to use in the study on student acceptance of online learning system. All those items were a brief statement followed by a seven-point Likert scale ranging from “extremely likely” (7), “quite likely” (6), “slightly likely” (5), “neither” (4), “slightly unlikely” (3), “quite

unlikely” (2), to “extremely unlikely” (1) as well as “not applicable” (N/A). Table 3-6 shows the questionnaires for behavioral intention instrument:

Table 3-6 Behavioral Intention to Use (BI) Instrument

Variable	Questionnaires
BI1	Assuming I have access to WebCT, I intend to use it.
BI2	Given that I have access to WebCT, I plan to use it.
BI3	It is worth it to use WebCT.
BI4	I will frequently use WebCT in the future.

#### 3.4.6 Actual System Use (USE) Instrument

Researchers suggested that frequency of use and amount of time spent are the typical metric to measure the usage (Davis, 1993). Pan (2003) and Yang (2007) applied these concepts in the instruments and successfully represented students’ WebCT usage in UCF. Therefore, the data of actual system use of WebCT in the current study was collected by these two aspects to measure the students’ frequency and length on using WebCT. Both questionnaires were measured on a six-point nominal scale. Table 3-7 shows the questionnaires for behavioral intention instrument:

Table 3-7 Actual Use Behavior (USE) Instrument

Variable	Questionnaires
USE1	On the average, the frequency I login on WebCT:
USE2	On the average, the length of time I spent every time I login on WebCT?

### 3.4.7 *Demographics Instrument*

The five demographics items are modified from Pan (2003) and Siegel (2008) instruments to evaluate students' basic demographic information. The questionnaires included: (1) gender; (2) age; (3) racial / ethnic groups; (4) academics status; and (5) occupation status.

## 3.5 Data Collections

The participation of this study was voluntary and was not affect any grade or status in the classes. Based on a pre-test and post-test method, students who participated in the current study were asked to complete the same identical questionnaire two times in a six-weeks interval. One month after the beginning of Fall 2008 semester, the students enrolled in the EME 2040 and RED 5147 courses were be given a brief announcement by the instructors regarding the research theme, procedure, and confidential concerns. Right after the announcement, the pre-test survey linkage was sent to students from the instructors. Students had two weeks of time (September 22<sup>nd</sup> to October 5<sup>th</sup>, 2008) to complete the survey. The identical post-test survey was then administered again two week before the end of the Fall 2008 semester, which students had the same amount of time to finish the survey (November 17<sup>th</sup> to 30<sup>th</sup>, 2008). A secured website with the 128-bit encryption technology was used to host the web-based survey instrument. The data were stored in UCF Form Manager System which also protected by the 128-bit

encryption technology and password. The survey linkage was provided by instructors which students was directed to the web page with the informed consent letter (Appendix B). Upon student's decision on attending this research, student will be directed to the web-based survey questionnaire (Appendix C).

### 3.6 Data Analyses

The causal relationships between the six manifest variables (i.e., perceived usefulness, perceived ease of use, perceived resources, attitude toward using, behavioral intention to use, and actual system use) in Perceived Resources and Technology Acceptance Model (PRATAM) were explored and analyzed in the current research. The data analyses in this current research was consisted of two sections: (1) validity and reliability of the instruments and (2) structural equation modeling (SEM) on the model fit and weights of constructs of PRATAM. In additional, the demographics results was also conducted by a simple explore of the collected data. The data analysis procedures were conducted via statistic software packages SPSS® for Windows® 17.0.1 and SAS® for Windows® 9.2.

First, even though the instruments used in this research were adapted from the previous studies with acceptable validity and reliability, this current research still conducted a data exploration to review the validity, reliability, and normality for the collected. In order to validate the constructs of PRATAM, an exploratory factor analysis were adopted to both pre-test and post-test data to examine the validity between the

measurement items and manifest variables. At the same time, an internal consistency analysis for the Cronbach's alpha value was also conducted base on the manifest variables to re-examine the reliability of the constructs of PRATAM. A repeated-measures analysis of variance (ANOVA) was then used to test the consistency between pre-test and post-test data. In the end, the normality analysis examined the descriptive statistics (i.e., mean, median, mode, standard deviation, variance, skewness, kurtosis, and range,), Shapiro-Wilk normality test (Shapiro & Wilk, 1965), the standardized  $Z$  score for skewness and kurtosis, histogram, box plot (Box-and-whiskers Plot), and Q-Q plot (Quantile-Quantile Plot) to verify the normal distribution assumption.

Secondly, the proposed PRATAM was examined via path analysis, the multivariate procedure of structural equation modeling (SEM). Path analysis examine “a set of relationships between one or more independent variables, either continuous or discrete, and one or more dependent variables, either continuous or discrete” (Tabachnick & Fidell, 1996), which fulfilled the causal relations and constructs of PRATAM. Both the pre-test and post-data were inspected on the covariance structure with the maximum likelihood parameter estimation by SAS Windows 9.2 PROC CALIS (i.e., Covariance Analysis of Linear Structural Equations). The standardized coefficient beta ( $\beta$ ) and the significant  $t$  value were generated to analyze the weight and significance of the research hypotheses. At the same time, the coefficient of determination  $R^2$  value and fit indexes such as chi-square, root mean square error of approximation (RMSEA), Bentler's (1989) comparative fit index (CFI), McDonald's Centrality Index (MC), and Bentler and



Bonett's (1980) Normed-fit Index (NFI) and Non-normed Index (NNFI) were generated to inspect the manifest variables constructs and the overall goodness of fit for PRATAM.

## **CHAPTER 4: RESEARCH RESULTS**

### 4.1 Introduction

This chapter adopted the outputs from both statistic software packages SPSS® for Windows® 17.0.1 and SAS® for Windows® 9.2 to present the analysis reports for the current research. The first section provided the basic statistic descriptions of the participants' demographics information (i.e., gender; age; racial; academics status; and occupation status). The following section discussed the issues of validity, reliability, homogeneity, and normality regarding the instruments and the collected data. The last section endeavored to analyze the research hypotheses and the two points of test time (pre-test and post-test) through path analysis (structural equation modeling, SEM). A summary section in the end of this chapter provided a brief overall recap of the findings in the current research.

This current research was intended to analyze the beliefs, attitude, intention, and the actual system use behavior on the higher education web-based online learning courses. Perceived Resources and Technology Acceptance Model (PRATAM) was introduced in the study to answer the research question of how does PRATAM explain the students' WebCT usage behaviors in the higher education web-based online learning

courses. The following nine research hypotheses were adapted to analysis the collected data:

- H1. Perceived resources will have a positive direct effect on perceived usefulness.
- H2. Perceived resources will have a positive direct effect on perceived ease of use.
- H3. Perceived resources will have a positive direct effect on attitude toward using WebCT.
- H4. Perceived resources will have a positive direct effect on behavioral intention to use WebCT.
- H5. Perceived ease of use will have a positive direct effect on perceived usefulness.
- H6. Perceived ease of use will have a positive direct effect on attitude toward using WebCT.
- H7. Perceived usefulness will have a positive direct effect on attitude toward using WebCT.
- H8. Perceived usefulness will have a positive direct effect on behavioral intention to use WebCT.
- H9. Attitude toward using will have a positive direct effect on behavioral intention to use WebCT.
- H10. Behavioral intention to use will have a positive direct effect on actual WebCT usage.

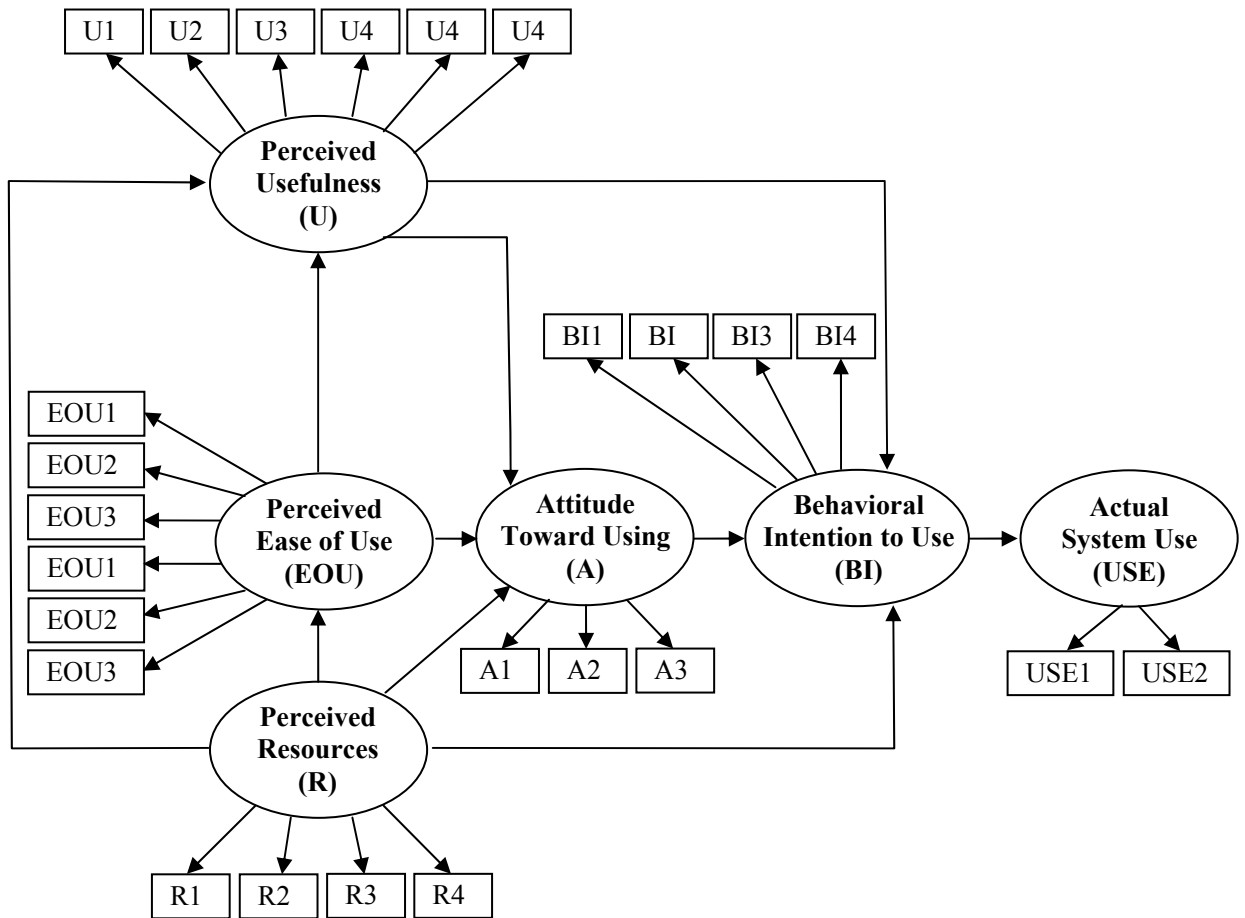


Figure 4-1 Measurement Model of Perceived Resources and Technology Acceptance Model (PRATAM)

This current research incorporated a total of twenty-five measurement items to measure PRATAM's six manifest variables (i.e., four items for perceived resources, six items for perceived usefulness, six items for perceived ease of use, three items for attitude toward using, four items for behavioral intention to use, and two items for actual system use). The manifest variable was manipulated at a scale level, which meant the scores of the manifest variables were calculated as the sum of its corresponding measurement items. For example, the score of the manifest variable "Perceived Resources" was the

sum of its four measurement items R1, R2, R3, and R4. The measurement model of PRATAM in Figure 4-1 shows the relationships and the measurement items for each manifest variable.

#### 4.2 Participant Demographics

A total of 115 (as shown in Table 4-1) valid participants were assessed in two University of Central Florida (UCF) Fall 2008 semester courses (i.e., EME 2040 Introduction to Educational Technology and RED 5147 Foundation of Developmental Reading). The initial enrollments were 163 for EME 2040 and 84 for RED 5147.

Table 4-1 Summary of the Participants by Course Name

Course		Enrolled Students	Pre-Test		Post-Test		Valid for Study	
			Participant	%	Participant	%	Participant	%
EME 2040	Introduction to Educational Technology	163	104	63.80	110	67.48	89	54.60
RED 5147	Foundation of Developmental Reading	84	41	48.81	45	53.57	26	30.95
Total		247	145	58.70	155	62.75	115	46.56

A total of 145 students (104 from EME 2040 and 41 from RED 5147) participated in the pre-test from October 13<sup>th</sup> 2008 to October 26<sup>th</sup> 2008. The post-test held from November 17<sup>th</sup> 2008 to November 30<sup>th</sup> 2008 acquired a total of 155 students (110 from

EME 2040 and 45 from RED 5147). The valid participants were selected from the students who answered both the pre-test and the post-test. The valid participant rates were 54.60% for EME 2040, 30.95% for RED 5147, and 46.56% of overall target students. In addition, table 4-2 displays the participants by the course type. Overall, the valid participants included 67 (46.53%) students from W-Type courses, 48 (46.60%) from the M-Type courses.

Table 4-2 Summary of the Participants by Course Type

Course Type		Enrolled		Pre-Test		Post-Test		Valid for Study	
		Students	Participant	%	Participant	%	Participant	%	
W-Type		144	85	59.03	89	61.81	67	46.53	
	M-Type	103	60	58.25	66	64.08	48	46.60	
Total		247	145	58.70	155	62.75	115	46.56	

#### 4.2.1 Gender

The majority of valid participants in the current research were female. The females presented 89.6% (a total of 103) of the participants, while the males only counted 10.4% (a total of 12) of the data. Figure 4-2 shows the gender distribution in a pie chart.

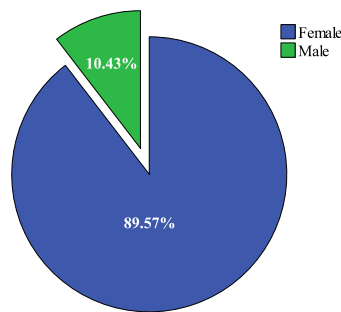


Figure 4-2 Pie Chart for Participants' Gender

#### 4.2.2 Age

The age of the valid participants is displayed in Table 4-3. The range of the participants' age was between 18 to 52 and two participants' data were missing. The average age was around 23 years old. Figure 4-3 shows the participants' age distribution in a box plot.

Table 4-3 Description of Participants' Age

	Participant	Range	Minimum	Maximum	Mean	Std. Deviation
Age	113	34	18	52	22.96	7.095
Missing	2					
Total	115					

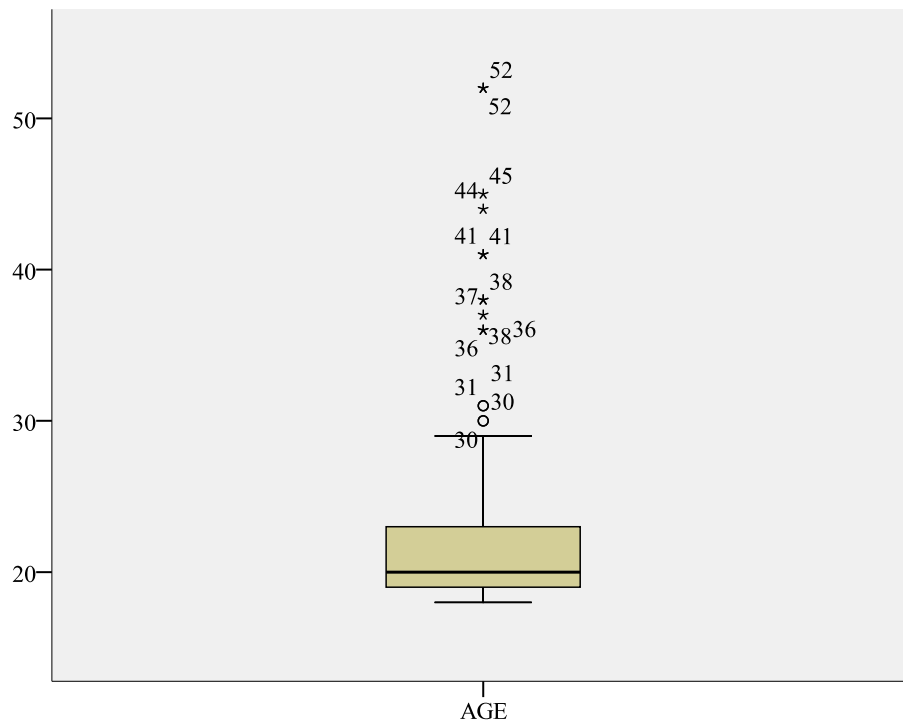


Figure 4-3 Boxplot for Participants' Age

### 4.2.3 Ethnicity

Table 4-4 discloses the participants' racial and ethnic groups. The majority of valid participants were white (93% or 93 out of 115). The other relatively minor groups were 10 for Hispanic (8.7%), 4 for Black (3.5%), and 2 for Asian (1.7%). None of the participants came from the group of American Indian and Non-resident Alien. Five participants chose not to respond this question and one participant's data was missing. Figure 4-4 displays the racial groups in a bar chart.

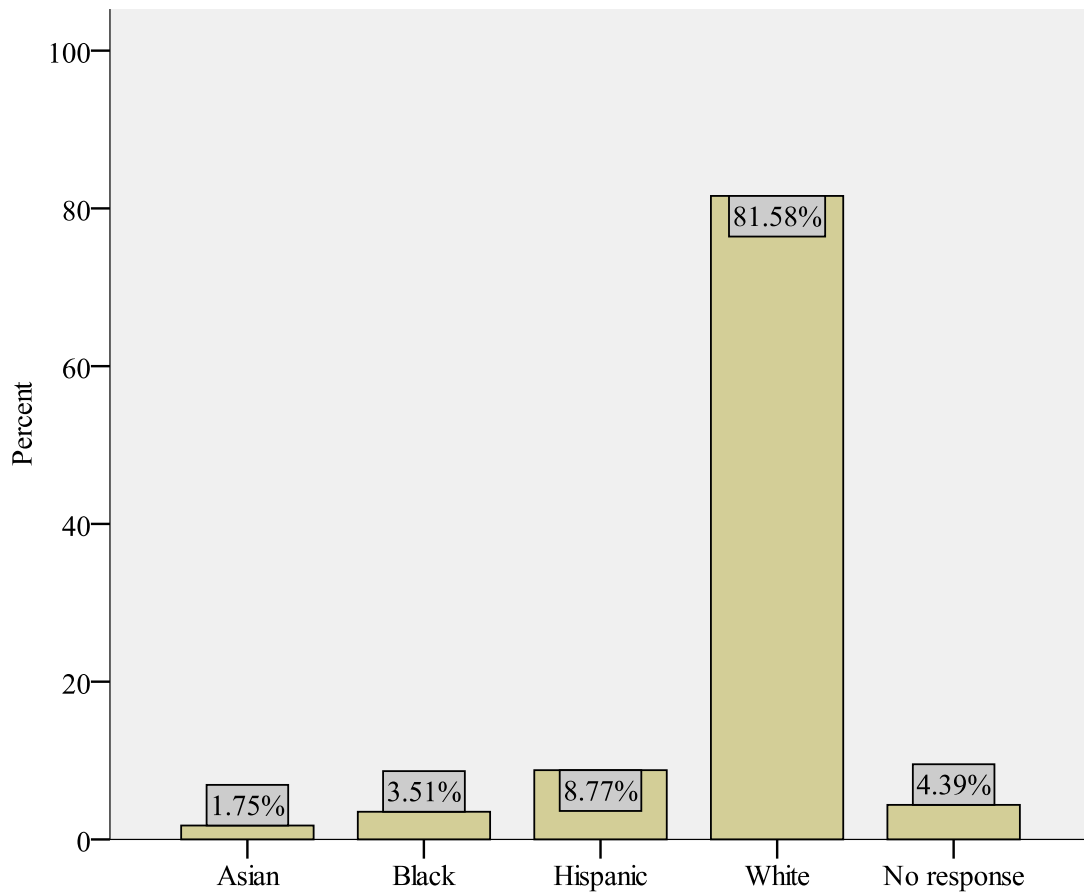


Figure 4-4 Bar Chart for Participants' Ethnicity



Table 4-4 Description of Participants' Racial

		Participant	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Valid	Asian	2	1.7	1.8	1.8
	Black	4	3.5	3.5	5.3
	Hispanic	10	8.7	8.8	14.0
	White	93	80.9	81.6	95.6
	No response	5	4.3	4.4	100.0
	Total	114	99.1	100.0	
Missing	System	1	.9		
Total		115	100.0		

#### 4.2.4 Academic Status

The academic status is described as followed in Table 4-5. The top three groups were 50 sophomores (43.5%), 32 juniors (27.8%), and 21 graduate students (18.3%). The distribution is displayed in a bar chart in Figure 4-5.

Table 4-5 Description of Participants' Academic Status

		Participant	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Valid	Freshman	2	1.7	1.7	1.7
	Sophomore	50	43.5	43.5	45.2
	Junior	32	27.8	27.8	73.0
	Senior	5	4.3	4.3	77.4
	Graduate	21	18.3	18.3	95.7
	Non Degree Seeking	4	3.5	3.5	99.1
	Other	1	.9	.9	100.0
	Total	115	100.0	100.0	

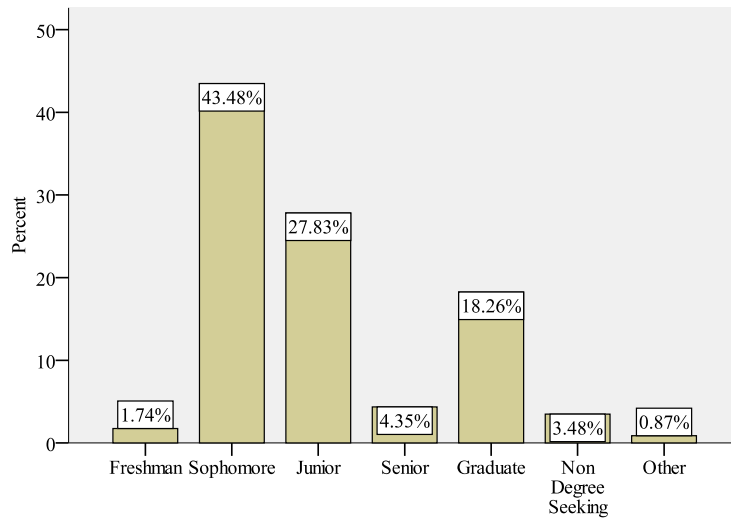


Figure 4-5 Bar Chart for Participants' Academic Status

#### 4.2.5 Occupation Status

Table 4-6 shows the occupation status of the valid participants. 26 of the participants had a full-time job (22.6%) and 48 of the participants were part-time worker (41.7%). The other 39 of the participants had no current job (33.95%) while one chose not to respond and one datum was missing. Figure 4-6 displays the occupation status in a bar chart.

Table 4-6 Description of Participants' Occupation Status

		Participant	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Valid	Full-time worker	26	22.6	22.8	22.8
	Part-time worker	48	41.7	42.1	64.9
	No current employment	39	33.9	34.2	99.1
	No response	1	.9	.9	100.0
	Total	114	99.1	100.0	
Missing	System	1	.9		
Total		115	100.0		

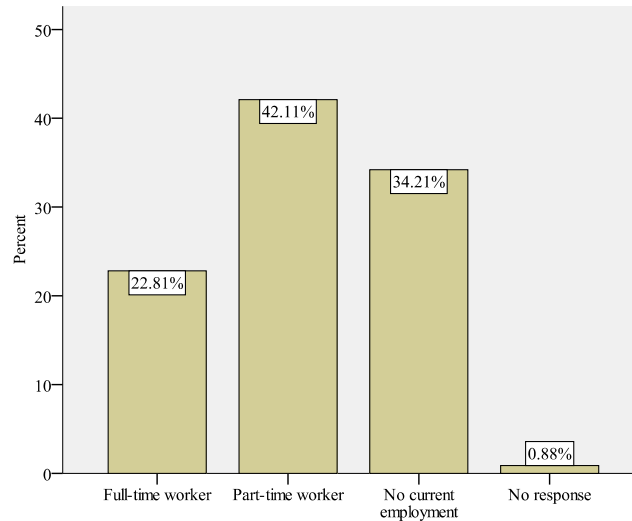


Figure 4-6 Bar Chart for Participants' Occupation Status

### 4.3 Data Exploration

#### 4.3.1 Validity

The instruments for the six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use) in the current research were modified from the previous researchers' instruments. An exploratory factor analysis was first conducted to validate the structures and the measurement items for Perceived Resources and Technology Acceptance Model (PRATAM). Excluding the demographic instruments, a total of twenty-five measurement items (i.e., four items for perceived resources, six items for perceived usefulness, six items for perceived ease of use, three items for attitude toward using, four items for

behavioral intention to use, and two items for actual system use) were analyzed through SPSS 17 “Dimension Reduction” function on both pre-test and post-test data. Table 4-7 displays the results of Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity tests from pre-test and post-test data.

Table 4-7 KMO and Bartlett's Test for Pre-Test Data

		Pre-Test	Post-Test
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.875	.916
Bartlett's Test of Sphericity	Approx. Chi-Square	2773.763	2981.211
	Df	300	300
	Sig.	.000	.000

According to the comments from Kaiser (1974), Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy test in the pre-test (.875) and the post-test (.916) revealed a meritorious (range from 0.80 to 0.89) and a marvelous (range from 0.90 to 1.00) compact pattern of correlations respectively. These results suggested that factory analysis could be assumed to provide distinct and reliable factors (Field, 2005).

In addition, Bartlett's Test of Sphericity in both pre-test and post-test results rejected (Sig. < .05) the null hypothesis that the original correlation matrix is an identity matrix (Field, 2005), which further suggested that factor analysis was suitable for the current research. Based on the assumptions of the causal relationships between the manifest variables, the Promax rotation method (Hendrickson & White, 1964) was used to conduct the exploratory factory analysis with oblique rotations. Table 4-8 and 4-9 presents the results of the exploratory factory analysis.

Table 4-8 Rotated Factor Component Matrix for Pre-Test Data

	Factor				
	1	2	3	4	5
R1				.850	
R2				.886	
R3				.791	
R4				.669	
U1			.958		
U2			.835		
U3			.887		
U4			.947		
U5			.742		
U6			.668		
EOU1		.946			
EOU2		.893			
EOU3		.946			
EOU4		.845			
EOU5		.829			
EOU6		.909			
A1	.693				
A2	.855				
A3	.966				
BI1	.702				
BI2	.800				
BI3	.894				
BI4	.821				
USE1					-.498
USE2					.896

Extraction Method: Principal Component Analysis. Rotation Method: Promax with Kaiser Normalization.

The pre-test factor component matrix indicated that the initial instrument items provided adequate measurements on the manifest variables such as perceived resources (i.e., R1, R2, R3, and R4), perceived usefulness (i.e., U1, U2, U3, U4, U5, and U6),

perceived ease of use (i.e., EOU1, EOU2, EOU3, EOU4, EOU5, and EOU6), and actual system use (USE1 and USE2). However, the manifest variables attitude toward using (i.e., A1, A2, and A3) and behavioral intention to use (i.e., BI1, BI2, BI3, and BI4) fell into the same factor. These results suggested that the measurement items for attitude toward and behavioral intention might be interrelated.

The post-test factor component matrix also indicated that the measurement items for perceived resources (i.e., R1\_PST, R2\_PST, R3\_PST, and R4\_PST), perceived ease of use (i.e., EOU1\_PST, EOU2\_PST, EOU3\_PST, EOU4\_PST, EOU5\_PST, and EOU6\_PST), and actual system use (USE1\_PST and USE2\_PST) showed adequacy independence with their own group of factors. However, a problem was raised on the measurement items for perceived usefulness (i.e., U1\_PST, U2\_PST, U3\_PST, U4\_PST, U5\_PST, and U6\_PST), attitude toward using (i.e., A1\_PST, A2\_PST, and A3\_PST), and behavioral intention to use (i.e., BI1\_PST, BI2\_PST, BI3\_PST, and BI4\_PST). These three manifest variables fell into the same factor, which failed to support the independence between the manifest variables. The other issue that needed to be recognized was that the first measurement item for actual system use (USE1\_PST, the frequency of WebCT usage). This measurement item presented a factor individually while it still accompanied the second measurement item for actual system use (USE2\_PST, the length of WebCT usage) on the other factor.

Table 4-9 Rotated Factor Component Matrix for Post-Test Data

	Factor				
	1	2	3	4	5
R1_PST			.890		
R2_PST			.995		
R3_PST			.758		
R4_PST			.932		
U1_PST	.918				
U2_PST	.995				
U3_PST	.994				
U4_PST	1.014				
U5_PST	.960				
U6_PST	.800				
EOU1_PST		.530			
EOU2_PST		.658			
EOU3_PST		.630			
EOU4_PST		.655			
EOU5_PST		1.092			
EOU6_PST		1.027			
A1_PST	.816				
A2_PST	.816				
A3_PST	.698				
B11_PST	.624				
B12_PST	.691				
B13_PST	.669				
B14_PST	.699				
USE1_PST				.828	-.631
USE2_PST					1.008

Extraction Method: Principal Component Analysis. Rotation Method: Promax with Kaiser Normalization.

The possible reasons of the interrelated problem on the measurement items might include the following situations. The first situation is the instruments failed to capture the theme it expected to measure; for example, the behavioral intention instrument did not

measure the students' behavioral intention correctly. The other situation is the target theme of the instruments was not formed at the time the survey questionnaire was given; for example, the behavioral intention to use WebCT had not formed when the students took the survey. While recognizing the issues on the interrelated measurement items for some manifest variables, the current research, however, still used the initial measurement items for all six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use) to maintain the same construct of PRATAM through the whole study.

#### *4.3.2 Reliability*

The value of the six manifest variables were summed from its' measurement items (i.e., four items for perceived resources, six items for perceived usefulness, six items for perceived ease of use, three items for attitude toward using, four items for behavioral intention to use, and two items for actual system use). The measurement items were inspected the same dimension on its' manifest variables. The only exception was the measurement items for actual system use, which measured the two different dimensions (i.e., frequency and length) of the WebCT usage behavioral. In spite of the high reliability suggested by previous literatures on those measurement items, this current research conducted a reliability analysis to validate the internal consistency on the five sets of measurement items (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use) from the collected data. Table 4-



10 shows Cronbach's alpha (Cronbach, 1951) for the five manifest variables that generated via SPSS "Reliability Analysis" on both pre-test and post-test data.

Table 4-10 Cronbach's Reliability Analysis

	Cronbach's Alpha ( $\alpha$ )	
	Pre-Test	Post-Test
Perceived Resources (R1-R4)	.818	.908
Perceived Usefulness (U1-U6)	.951	.956
Perceived Ease of Use (EOU1-EOU6)	.956	.922
Attitude Toward Using (A1-A3)	.945	.953
Behavioral Intention to Use (BI1-BI4)	.914	.961

As suggested by Carmines and Zeller (1979), Cronbach's alpha over 0.8 is considered acceptable reliability. The results from Table 4-10 shows that most measurement sets were exceeding the 0.9 level, which indicated good internal consistency on the test results. The only exception was the scale set of perceived resources in pre-test data that was just slightly (.818) over the 0.8 level. This current research also investigated the possible improvement of the results from dropping the measurement items. However, the greatest improvement of the alpha would be the removal of the third measurement item of perceived resources (R3) in the post-test data, which would increase the alpha of perceived resources by only 0.025 (increase to .933 from .908). Therefore, the measurement items of the five manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use) appeared to be worthy and reliable to keep its' initial measurement sets.

### 4.3.3 Repeated Measurement

In order to identify the differences on students' pre-test and post-test scores within PRATAM's six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use), this current research adopted the repeated-measures analysis of variance (ANOVA) to test the assumption of the homogeneity of variance. Based on the assumption of the perfect sphericity (Field, 2005) from the two condition level test (i.e., pre-test and post-test), the  $F$  value and its significance ( $\alpha$ ) along with the pre-test and the post-test mean for the six manifest variables are showed in Table 4-11.

Table 4-11 Test of Repeated-Measures Analysis of Variance (ANOVA)

	Mean		$F$	Sig. ( $\alpha$ )
	Pre-Test	Post-Test		
Perceived Resources (R1-R4)	25.87	25.59	.844	.36
Perceived Usefulness (U1-U6)	32.86	33.93	3.380	.07
Perceived Ease of Use (EOU1-EOU6)	36.31	36.82	.930	.34
Attitude Toward Using (A1-A3)	18.45	18.43	.004	.95
Behavioral Intention to Use (BI1-BI4)	24.68	24.74	.031	.86
Actual System Use (USE1-USE2)	9.01	8.86	2.039	.16

The results showed that the mean score of perceived resources in the pre-test ( $M = 25.87$ ) was not significantly different than the mean score in the post-test ( $M = 25.59$ ),  $F(1, 111) = .844$ ,  $p = .36 > .05$ . The insignificant difference between pre-test and post-test data also showed on perceived usefulness,  $F(1, 112) = 3.380$ ,  $p = .07 > .05$ ; perceived ease of use,  $F(1, 112) = .930$ ,  $p = .34 > .05$ ; attitude toward using,

$F(1, 111) = .004$ ,  $p = .95 > .05$ ; behavioral intention to use,  $F(1, 112) = .031$ ,  $p = .86 > .05$ ; and actual system use,  $F(1, 113) = 2.039$ ,  $p = .16 > .05$ . Therefore, the results suggested that none of the scores for PRATAM's manifest variables was significantly different between pre-test and post-test data.

#### 4.3.4 Normality

This section examined the normal distribution assumption of the parametric statistic approach (Field, 2005) on PRATAM's six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use). The manifest variables were calculated as the sum of its corresponding measurement items. For example, the score for the manifest variables "Perceived Resources" is the sum total of the four perceived resource questions (i.e., R1, R2, R3, and R4). SPSS was used to generate the reports (as shown in Table 4-13) of the descriptive statistics (i.e., mean, median, mode, standard deviation, variance, skewness, kurtosis, and range,) and Shapiro-Wilk normality test (Shapiro & Wilk, 1965). In addition, the standardized  $Z$  score for skewness and kurtosis were also calculated by the assumption of the standard normal distribution; both have a mean of 0 and a standard deviation of 1 (Field, 2005). Histogram, box plot (Box-and-whiskers Plot), and Q-Q plot (Quantile-Quantile Plot) for each manifest variable were also generated by SPSS to further analyze the normality of the manifest variables in both pre-test and post-test data.

Table 4-12 Statistic Results Table for Manifest Variables in Pre-Test and Post-Test

	Pre-Test						Post-Test					
	R	U	EOU	A	BI	USE	R	U	EOU	A	BI	USE
Valid Data	113	114	115	112	114	115	114	114	113	115	114	114
Missing Data	2	1	0	3	1	0	1	1	2	0	1	1
Mean	25.88	32.68	36.20	18.45	24.70	9.01	25.58	33.90	36.82	18.38	24.77	8.86
Median	27.00	35.00	37.00	20.00	26.00	9.00	27.00	35.00	39.00	19.00	27.00	9.00
Mode	28	42	42	21	28	10	28	42	42	21	28	9
Std. Deviation	2.60	8.23	6.12	3.58	4.54	1.39	3.27	7.19	5.94	3.34	4.79	1.37
Variance	6.75	67.79	37.46	12.81	20.58	1.94	10.71	51.75	35.33	11.17	22.97	1.87
Skewness	-1.69	-1.04	-1.74	-2.03	-1.90	0.02	-2.40	-1.23	-1.44	-1.96	-2.16	-0.40
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	-7.43	-4.60	-7.68	-8.91	-8.42	0.11	-10.58	-5.42	-6.35	-8.70	-9.53	-1.74
Kurtosis	3.62	0.89	4.69	4.62	3.69	0.00	8.59	1.70	2.14	4.25	4.48	0.54
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	8.03	1.99	10.50	10.20	8.21	0.00	19.12	3.79	4.75	9.51	9.97	1.20
Range	13	36	35	18	21	7	20	34	28	17	21	7
Minimum	15	6	7	3	7	5	8	8	14	4	7	5
Maximum	28	42	42	21	28	12	28	42	42	21	28	12
Shapiro-Wilk ( $W$ )	0.79	0.91	0.84	0.73	0.75	0.95	0.74	0.89	0.83	0.75	0.70	0.94
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward using; BI: behavioral intention to use; USE: actual system use;

The table above (Table 4-13) shows the statistical reports for all the manifest variables in both pre-test and post-test data. Except for the results of actual system use (USE) in the pre-test, most of the manifest variables showed a larger median value than the mean, which indicated a possible left skew on the distribution of the data. Even though most of the manifest variables (except attitude toward using in the pre-test, and

perceived resources and behavioral intention to use in the post-test) fell in that range for a reasonable normal distribution range of the skewness and the kurtosis (i.e., *skewness* < 2, and *kurtosis* < 7) suggested by Curran, West, and Finch (1996). The majority of the manifest variables posted a *Z* score larger than 1.96 (i.e.,  $p < 0.05$ ), 2.58 (i.e.,  $p < 0.01$ ), or even 3.29 (i.e.,  $p < 0.001$ ) on both skewness and kurtosis, which means that most of the manifest variables were significantly different than a normal distribution.

In addition, the value from Shapiro-Wilk normality test further suggested that all of the manifest variables in both the pre-test and post-test were significant ( $p < 0.05$ ). Those manifest variables failed to accept the null hypothesis that the distribution of the manifest variable is not significantly different from a normal distribution, in other words, the distribution of the manifest variables might not be normal. The results from the charts (as shown in Figure 4-7 to Figure 4-18) also supported the abnormal distribution on the manifest variables. Most of the manifest variables show a visible abnormal distribution on both the pre-test and post-test data except for actual system use (USE). The histograms of the perceived resources, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use show distinct distribution skewness to the left; the box plots indicated the notable negative skewed and outliers on those manifest variables; the Q-Q plots further revealed the deviations away from the expected normal distribution value and the left skew. Those observations confirmed the earlier statistic results that the data for the manifest variables were abnormal distribution data.

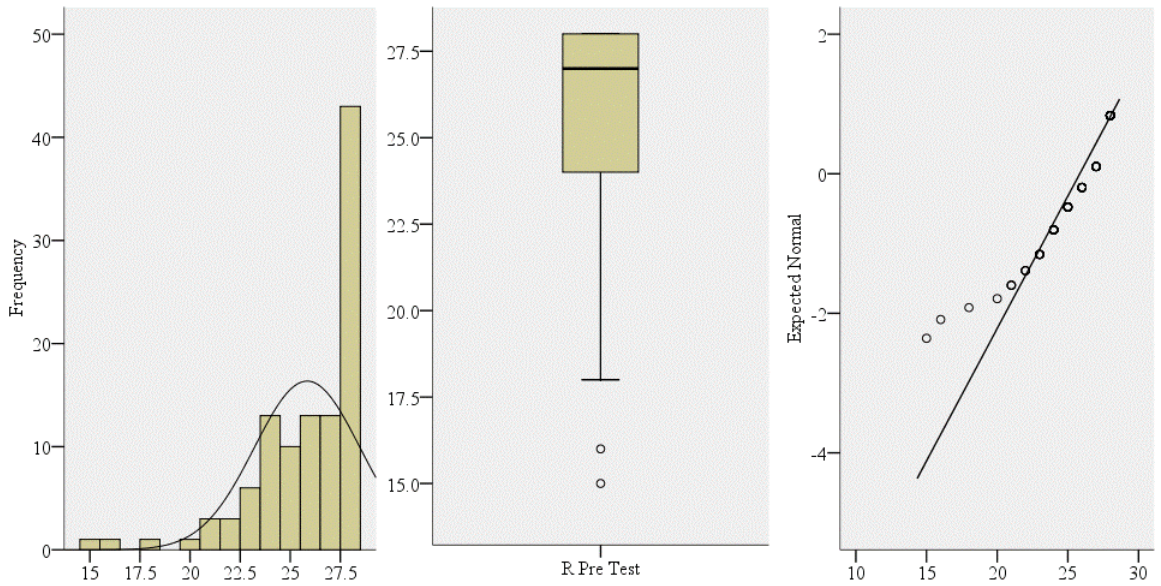


Figure 4-7 Histogram, Box Plot, and Q-Q Plot for Pre-Test Perceived Resources (R)

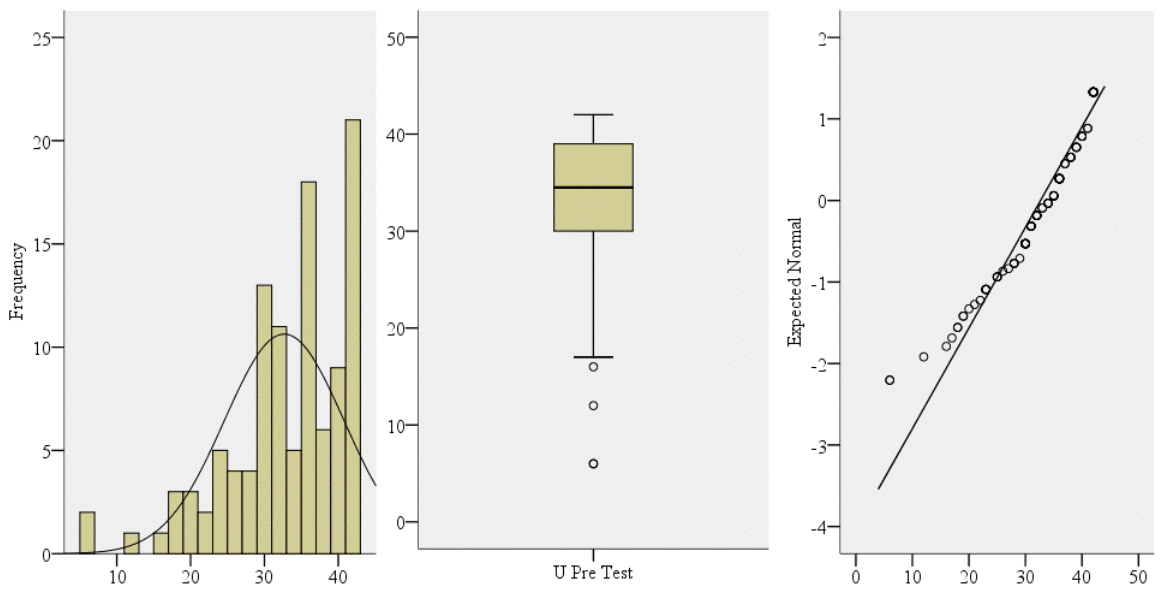


Figure 4-8 Histogram, Box Plot, and Q-Q Plot for Pre-Test Perceived Usefulness (U)

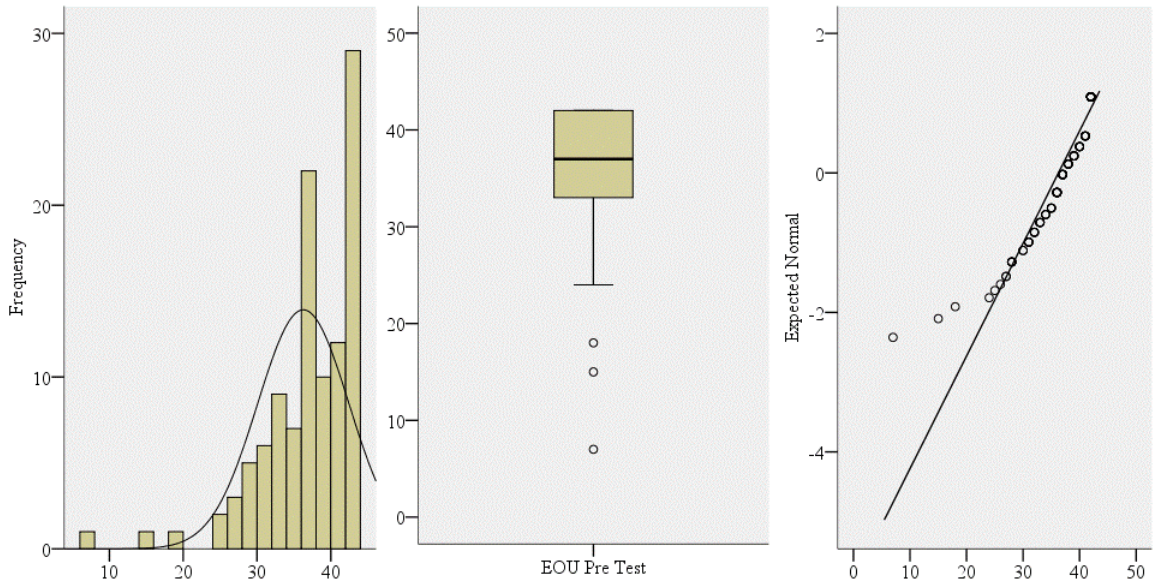


Figure 4-9 Histogram, Box Plot, and Q-Q Plot for Pre-Test Perceived Ease of Use (EOU)

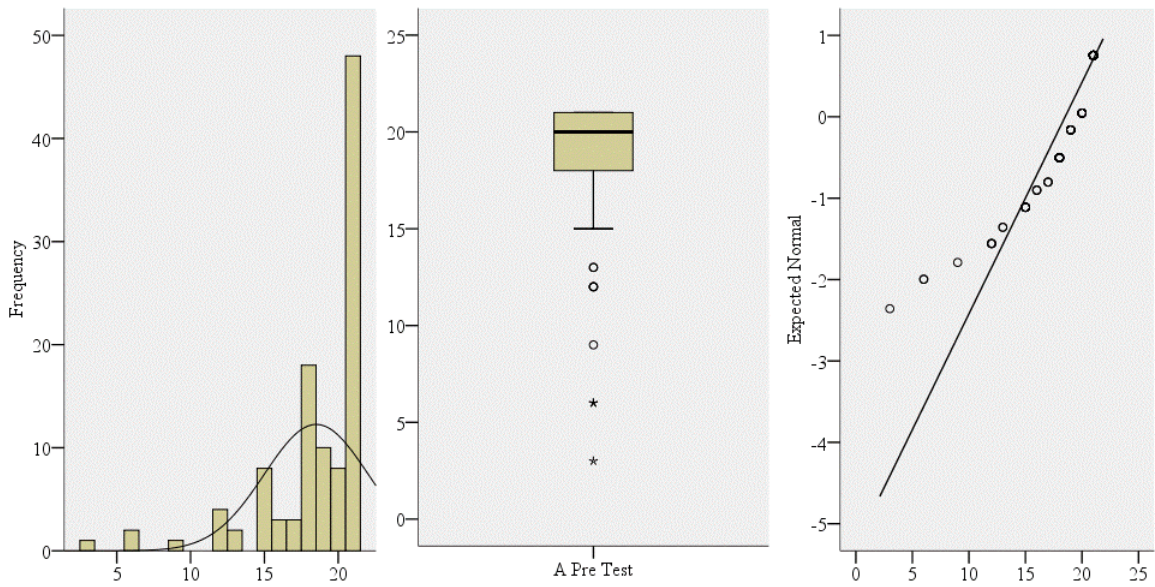


Figure 4-10 Histogram, Box Plot, and Q-Q Plot for Pre-Test Attitude Toward Using (A)

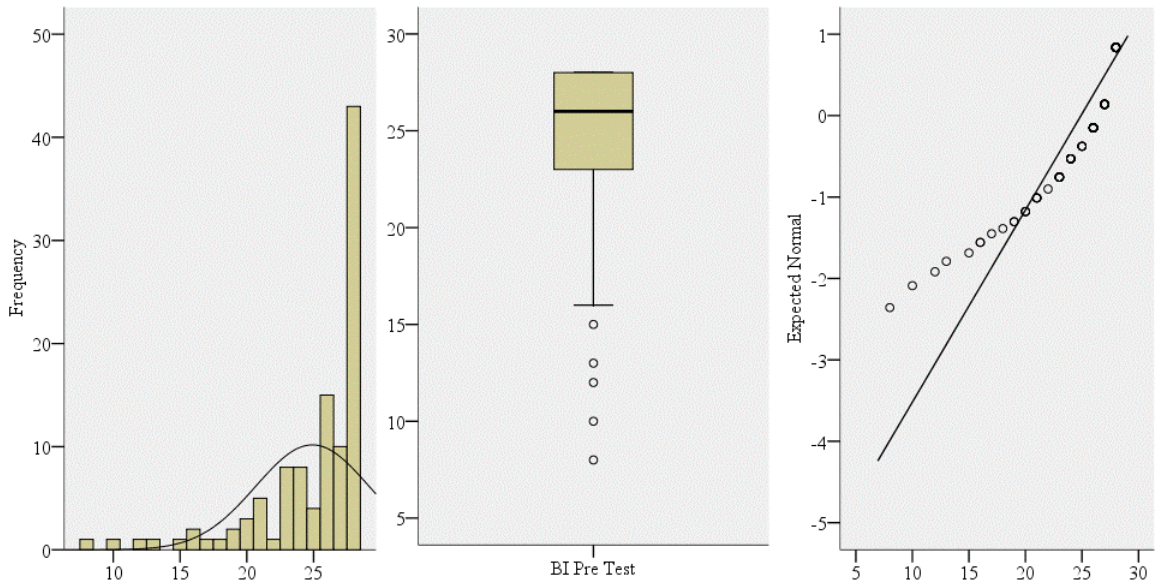


Figure 4-11 Histogram, Box Plot, and Q-Q Plot for Pre-Test Behavioral Intention to Use (BI)

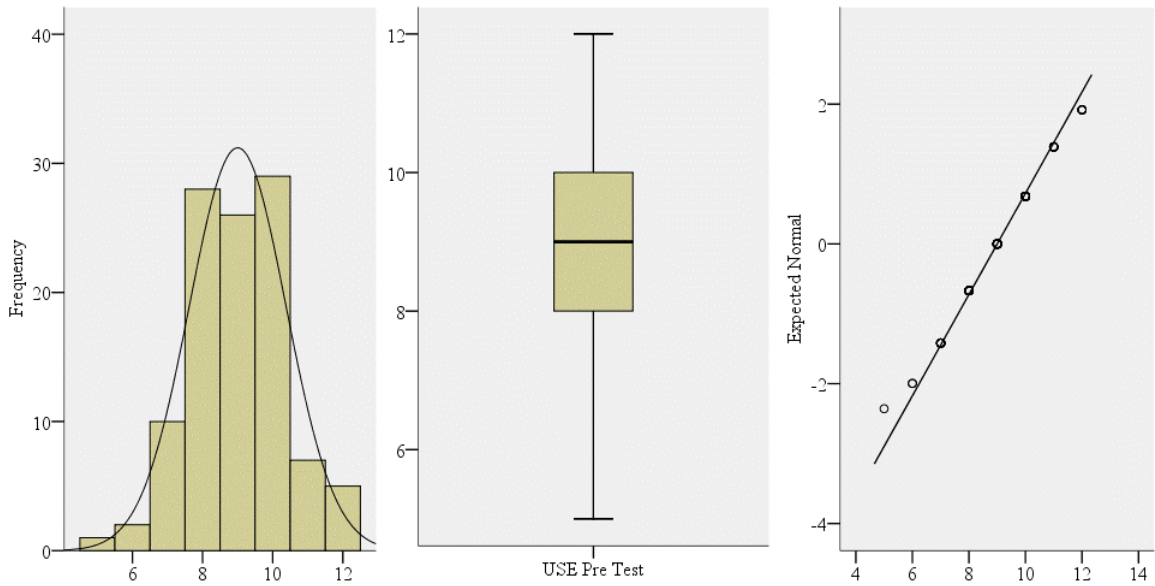


Figure 4-12 Histogram, Box Plot, and Q-Q Plot for Pre-Test Actual System Use (USE)



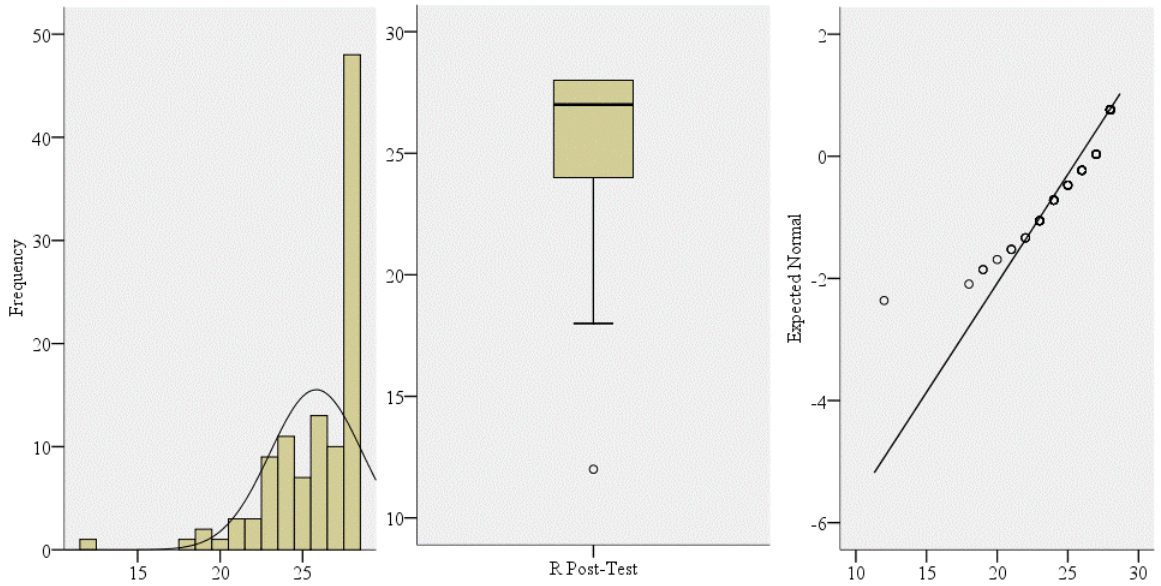


Figure 4-13 Histogram, Box Plot, and Q-Q Plot for Post-Test Perceived Resources (R)

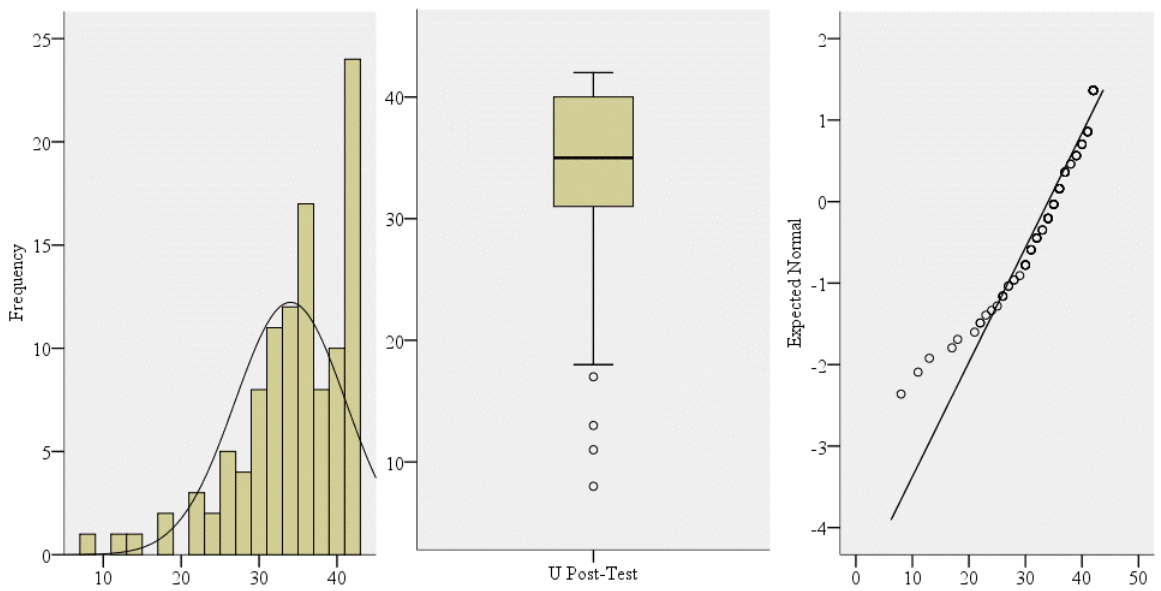


Figure 4-14 Histogram, Box Plot, and Q-Q Plot for Post-Test Perceived Usefulness (U)

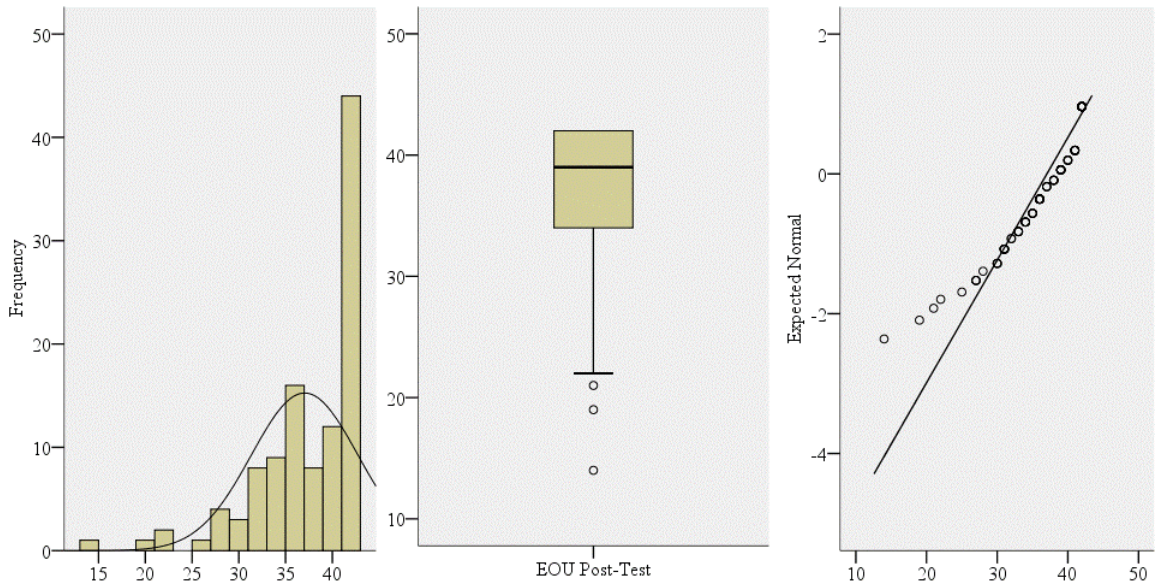


Figure 4-15 Histogram, Box Plot, and Q-Q Plot for Post-Test Perceived Ease of Use (EOU)

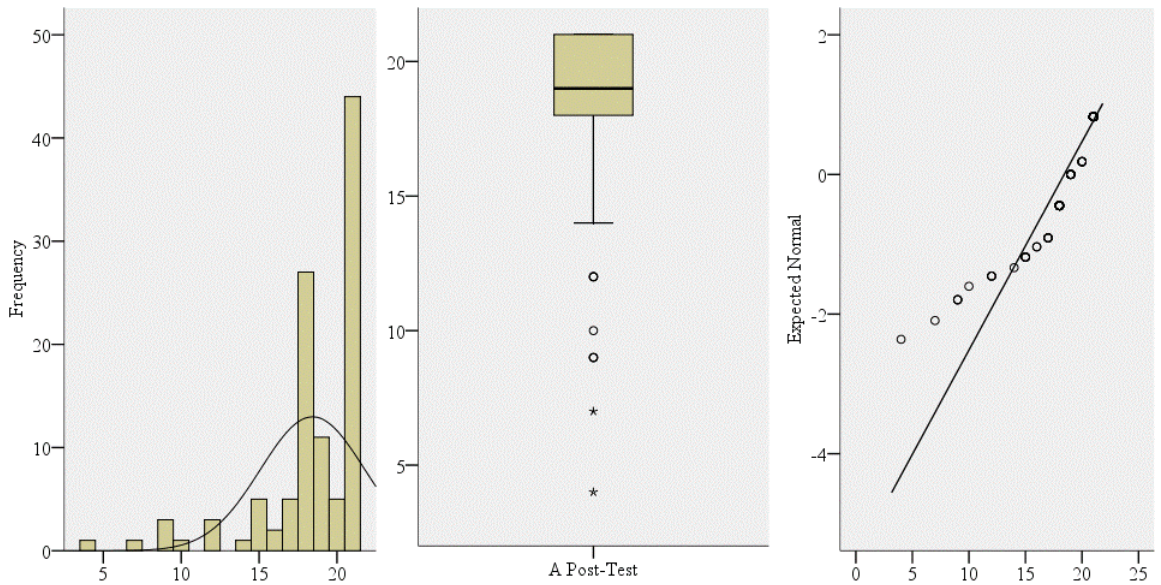


Figure 4-16 Histogram, Box Plot, and Q-Q Plot for Post-Test Attitude Toward Using (A)

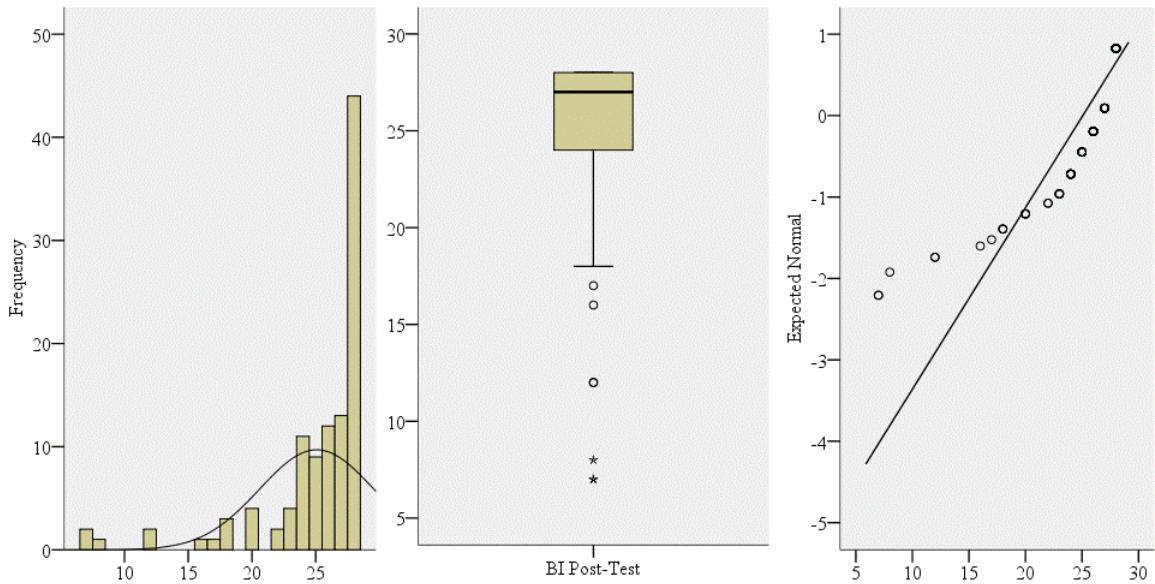


Figure 4-17 Histogram, Box Plot, and Q-Q Plot for Post-Test Behavioral Intention to Use (BI)

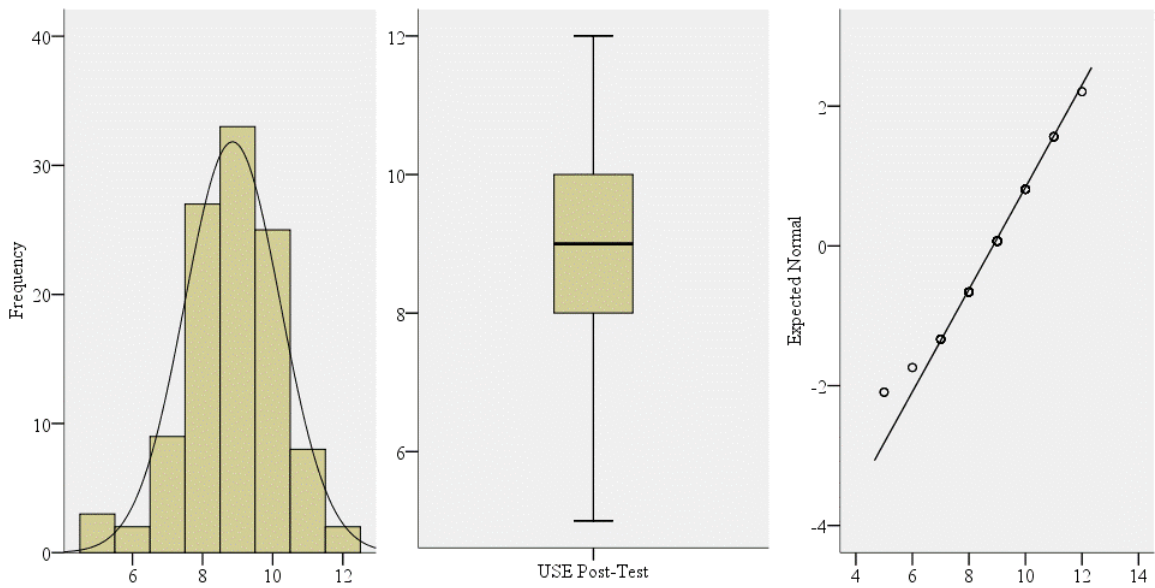


Figure 4-18 Histogram, Box Plot, and Q-Q Plot for Post-Test Actual System Use (USE)

In order to pursue a better normality of the data to fulfill the normal distributed data assumption of a parametric analysis, this current research attempted to apply the data transforming technique to correct the normality problem. The three transformation techniques adopted by the current research were: (1) the logarithmic transformation or the log transformation; (2) the natural logarithm transformation or the natural log transformation; and (3) the square root transformation. The tables below (Table 4-13 to 4-18) show the comparisons of the statistic values for each manifest variable from the original (raw) data, log transformed data, natural log transformed data, and square root transformed data, applied to the data of all manifest variables.

Table 4-13 Statistic Comparison of Perceived Resources with Data Transformation

	Pre-Test R				Post-Test R			
	Raw	Log	LogN	SQRT	Raw	Log	LogN	SQRT
Mean	25.88	1.41	3.25	5.08	25.58	1.40	3.23	5.04
Median	27.00	1.43	3.30	5.20	27.00	1.43	3.30	5.20
Std. Deviation	2.60	0.05	0.11	0.27	3.27	0.07	0.17	0.36
Variance	6.75	0.00	0.01	0.07	10.71	0.01	0.03	0.13
Skewness	-1.69	-2.23	-2.23	-1.94	-2.40	-4.01	-4.01	-3.10
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	-7.43	-9.78	-9.78	-8.52	-10.58	-17.70	-17.70	-13.68
Kurtosis	3.62	6.77	6.77	5.02	8.59	22.71	22.71	14.23
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	8.03	15.02	15.02	11.14	19.12	50.54	50.54	31.68
Shapiro-Wilk ( $W$ )	0.79	0.75	0.75	0.77	0.74	0.60	0.60	0.68
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

R: Perceived Resources; LogN: Nature Log; SQRT: Square Root

Table 4-14 Statistic Comparison of Perceived Usefulness with Data Transformation

	Pre-Test U				Post-Test U			
	Raw	Log	LogN	SQRT	Raw	Log	LogN	SQRT
Mean	32.68	1.49	3.44	5.66	33.90	1.52	3.49	5.78
Median	35.00	1.54	3.56	5.92	35.00	1.54	3.56	5.92
Std. Deviation	8.23	0.15	0.34	0.81	7.19	0.12	0.28	0.69
Variance	67.79	0.02	0.12	0.66	51.75	0.01	0.08	0.47
Skewness	-1.04	-2.47	-2.47	-1.61	-1.23	-2.44	-2.44	-1.75
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	-4.60	-10.92	-10.92	-7.10	-5.42	-10.79	-10.79	-7.72
Kurtosis	0.89	8.34	8.34	3.30	1.70	8.02	8.02	3.99
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	1.99	18.57	18.57	7.35	3.79	17.86	17.86	8.89
Shapiro-Wilk ( $W$ )	0.91	0.76	0.76	0.75	0.89	0.76	0.76	0.84
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

U: Perceived Usefulness; LogN: Nature Log; SQRT: Square Root

Table 4-15 Statistic Comparison of Perceived Ease of Use with Data Transformation

	Pre-Test EOU				Post-Test EOU			
	Raw	Log	LogN	SQRT	Raw	Log	LogN	SQRT
Mean	36.20	1.55	3.57	5.99	36.82	1.56	3.59	6.05
Median	37.00	1.57	3.61	6.08	39.00	1.59	3.66	6.24
Std. Deviation	6.12	0.10	0.23	0.58	5.94	0.08	0.19	0.53
Variance	37.46	0.01	0.05	0.33	35.33	0.01	0.04	0.28
Skewness	-1.74	-3.84	-3.84	-2.56	-1.44	-2.20	-2.20	-1.78
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	-7.68	-17.01	-17.01	-11.35	-6.35	-9.69	-9.69	-7.83
Kurtosis	4.69	22.07	22.07	10.49	2.14	6.26	6.26	3.80
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	10.50	49.33	49.33	23.44	4.75	13.87	13.87	8.42
Shapiro-Wilk ( $W$ )	0.84	0.65	0.65	0.76	0.83	0.75	0.75	0.80
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

EOU: Perceived Ease of Use; LogN: Nature Log; SQRT: Square Root

Table 4-16 Statistic Comparison of Attitude Toward Using with Data Transformation

	Pre-Test A				Post-Test A			
	Raw	Log	LogN	SQRT	Raw	Log	LogN	SQRT
Mean	18.45	1.25	2.88	4.27	18.38	1.25	2.89	4.26
Median	20.00	1.30	3.00	4.47	19.00	1.28	2.94	4.36
Std. Deviation	3.58	0.12	0.29	0.49	3.34	0.11	0.25	0.45
Variance	12.81	0.02	0.08	0.24	11.17	0.01	0.06	0.20
Skewness	-2.03	-3.58	-3.58	-2.66	-1.96	-3.20	-3.20	-2.47
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	-8.91	-15.68	-15.68	-11.63	-8.70	-14.18	-14.18	-10.96
Kurtosis	4.62	16.36	16.36	8.69	4.25	13.17	13.17	7.39
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	10.20	36.11	36.11	19.19	9.51	29.43	29.43	16.52
Shapiro-Wilk ( $W$ )	0.73	0.58	0.58	0.67	0.75	0.62	0.62	0.70
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

A: Attitude Toward; LogN: Nature Log; SQRT: Square Root

Table 4-17 Statistic Comparison of Behavioral Intention to Use with Data Transformation

	Pre-Test BI				Post-Test BI			
	Raw	Log	LogN	SQRT	Raw	Log	LogN	SQRT
Mean	24.70	1.38	3.18	4.94	24.77	1.38	3.18	4.95
Median	26.00	1.41	3.26	5.10	27.00	1.43	3.30	5.20
Std. Deviation	4.54	0.11	0.25	0.52	4.79	0.12	0.27	0.56
Variance	20.58	0.01	0.06	0.27	22.97	0.01	0.08	0.32
Skewness	-1.90	-2.85	-2.85	-2.32	-2.16	-2.97	-2.97	-2.53
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	-8.42	-12.61	-12.61	-10.26	-9.53	-13.10	-13.10	-11.18
Kurtosis	3.69	9.56	9.56	6.06	4.48	9.24	9.24	6.53
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	8.21	21.27	21.27	13.48	9.97	20.56	20.56	14.52
Shapiro-Wilk ( $W$ )	0.75	0.64	0.64	0.70	0.70	0.58	0.58	0.64
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

BI: Behavioral Intention; LogN: Nature Log; SQRT: Square Root

Table 4-18 Statistic Comparison of Actual System Use with Data Transformation

	Pre-Test USE				Post-Test USE			
	Raw	Log	LogN	SQRT	Raw	Log	LogN	SQRT
Mean	9.01	0.95	2.19	2.99	8.86	0.94	2.17	2.97
Median	9.00	0.95	2.20	3.00	9.00	0.95	2.20	3.00
Std. Deviation	1.39	0.07	0.16	0.23	1.37	0.07	0.17	0.24
Variance	1.94	0.00	0.03	0.05	1.87	0.01	0.03	0.06
Skewness	0.02	-0.50	-0.50	-0.22	-0.40	-1.04	-1.04	-0.70
Std. Error of Skewness	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
$Z_{skewness}$	0.11	-2.21	-2.21	-0.99	-1.74	-4.59	-4.59	-3.10
Kurtosis	0.00	0.75	0.75	0.24	0.54	2.02	2.02	1.12
Std. Error of Kurtosis	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$Z_{kurtosis}$	0.00	1.68	1.68	0.54	1.20	4.49	4.49	2.48
Shapiro-Wilk ( $W$ )	0.95	0.94	0.94	0.94	0.94	0.90	0.90	0.93
Shapiro-Wilk ( $p$ )	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

USE: Actual System Use; LogN: Nature Log; SQRT: Square Root

The results from the transformed data showed three consistent patterns. First, the mean, median, mode, standard deviation, variance, and range decreased after the transformation. Those were expected because the idea behind those transformation methods is to lower the value of each case within the data. Second, none of the manifest variables showed a decreased skewness, kurtosis, and  $Z$  scores for skewness and kurtosis after transformations. The results suggested that the data distribution became worse than a normal distribution after the transformations. Third, the Shapiro-Wilk normality test did not post any improvement after the transformations. None of the manifest variables could reach the  $p > .05$  level, which meant the distributions of the transformed data remain significantly different than a normal distribution.

This current research, therefore, recognized the issue of the abnormal distribution on both pre-test and post-test data. Since the data transformation did not provide any improvement on the data distribution, the original un-transformed data was to be used in the following analysis.

#### 4.4 Path Analysis of Perceived Resources and Technology Acceptance Model

The current research used path analysis, a subset of structural equation modeling (SEM) to examine the causal relationships between the manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use) of Perceived Resources and Technology Acceptance Model (PRATAM). SAS Windows 9.2 PROC CALIS (i.e., Covariance Analysis of Linear Structural Equations) procedure was used to perform the analysis of the causal relationships of PRATAM. The analysis procedures adopted by the covariance structure analysis using the maximum likelihood parameter estimation method. The following two sections present the analytic results of PRATAM from the two time points of the pre-test and the post-test.

##### *4.4.1 Perceived Resources and Technology Acceptance Model in Pre-Test*

The pre-test analysis was based on a total of 108 observations (i.e., the valid participants who answered all measurement items in pre-test) to examine the six manifest



variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use) in PRATAM. PRATAM followed the overidentified model assumption (Hatcher, 1994) to estimate 16 parameters from a total of 21 data points. The satisfaction of the convergence criterion also indicated that the model did converge.

The significance tests of the hypotheses of PRATAM are presented in Table 4-19. Hatcher (1994) suggested the path coefficient  $t$  value should exceed 1.96 at the  $p < .05$  level, exceed 2.58 at the  $p < .01$  level, and exceed 3.30 at the  $p < .001$  level. The result showed that the  $t$  value of hypothesis 3 (H3), hypothesis 4 (H4) and hypothesis 10 (H10) were below the cut-off level of 1.96. Which indicated that the proposed hypothesis 3, hypothesis 4, and hypothesis 9 failed to reach statistical significance from pre-test data.

Table 4-19 Hypotheses Significance Test for PRATAM in Pre-Test Data

Hypotheses Path		$\beta$	Std Err	$t$
H1 Perceived Resources to Perceived Usefulness	R→U	0.208	0.10	2.19
H2 Perceived Resources to Perceived Ease of Use	R→EOU	0.347	0.09	3.83
H4 Perceived Resources to Attitude Toward Using	R→A	0.047	0.07	0.65
H4 Perceived Resources to Behavioral Intention to Use	R→BI	0.024	0.06	0.41
H5 Perceived Ease of Use to Perceived Usefulness	EOU→U	0.262	0.10	2.76
H6 Perceived Ease of Use to Attitude Toward Using	EOU→A	0.211	0.07	2.90
H7 Perceived Usefulness to Attitude Toward Using	U→A	0.614	0.07	8.58
H8 Perceived Usefulness to Behavioral Intention to Use	U→BI	0.202	0.08	2.62
H9 Attitude Toward Using to Behavioral Intention to Use	A→BI	0.663	0.08	8.59
H10 Behavioral Intention to Use to Actual System Use	BI→USE	0.169	0.10	1.78

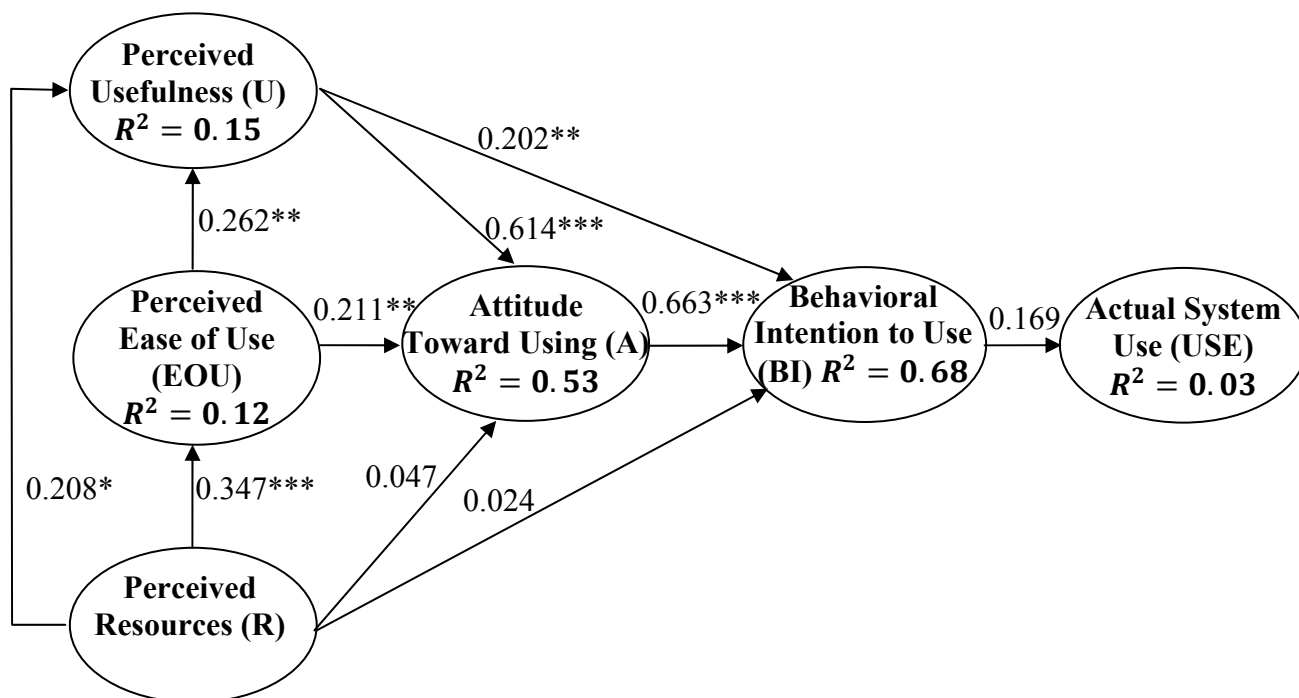
R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward Using; BI: behavioral intention to Use; USE: actual system use;  $\beta$ : standardized path coefficients; Std Err: Standard Error

Table 4-20 shows the equations with standardized path coefficients for PRATAM in the pre-test data as well as the residual terms (i.e., E1, E2, E3, E4, and E5). The residual terms represented the manifest variable's variability that came from the factors other than the antecedent manifest variables. The same path coefficients display in Figure 4-19 again with the  $R^2$  value for PRATAM. The  $R^2$  displayed underneath the endogenous variables (i.e., perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use) represents the percent of variance that can be explained by the antecedent manifest variables. Therefore, the result suggested that perceived resources accounted for 12% of the variance of perceived ease of use; perceived resources and perceived ease of use accounted for 15% of the variance of perceived usefulness; perceived usefulness and perceived ease of use accounted for 53% of the variance of attitude toward using; and perceived resources, perceived usefulness, and attitude toward accounted for 68% of the variance of behavioral intention to use. However, behavioral intention to use only accounted for 3 % of the variance of actual system use.

Table 4-20 Equations with Standardized Coefficients of PRATAM in Pre-Test Data

U	=	0.262**	EOU	+ 0.208*	R	+ 0.922	E1
EOU	=	0.347***	R	+ 0.938	E2		
A	=	0.614***	U	+ 0.211**	EOU	+ 0.047	R + 0.683 E3
BI	=	0.202**	U	+ 0.663***	A	+ 0.024	R + 0.566 E4
USE	=	0.169	BI	+ 0.986	E5		

R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward using; BI: behavioral intention to use; USE: actual system use; E1-E5: Residual Terms; \*  $t > 1.96$  (the level of  $p < .05$ ); \*\*  $t > 2.58$  (the level of  $p < .01$ ); \*\*\*  $t > 3.30$  (the level of  $p < .001$ )



\*  $t > 1.96$  (the level of  $p < .05$ );  
 \*\*  $t > 2.58$  (the level of  $p < .01$ );  
 \*\*\*  $t > 3.30$  (the level of  $p < .001$ )

Figure 4-19 Path Diagram of PRATAM in Pre-Test Data

In order to inspect the goodness of fit, the current research adopted chi-square, root mean square error of approximation (RMSEA), Bentler's (1989) comparative fit index (CFI), McDonald's Centrality Index (MC), and Bentler and Bonett's (1980) Normed-fit Index (NFI) and Non-normed Index (NNFI) as the fit indexes to analyze the model fit of PRATAM. Chi-square test focused on "test the specified model versus the alternative that the data are from a multivariate normal distribution with unconstrained covariance matrix" (SAS Institute., 1999). Chi-square value indicates "the amount of difference between expected and observed covariance matrices" (Suhr, 2008), which the

smaller value represented the smaller differences between the matrices. Chi-square probability value ( $p$ ) revealed the acceptance of the null hypothesis that the model fits the data. Therefore,  $p < .01$  or  $.05$  indicated that the data rejected the null hypothesis of a good model fit. Root mean square error of approximation (RMSEA), Bentler's (1989) comparative fit index (CFI), McDonald's Centrality Index (MC), and Bentler and Bonett's (1980) Normed-fit Index (NFI) and Non-normed Index (NNFI) are the alternative goodness of fit indexes to the chi-square test. All these alternative indexes are valued from 0 to 1. While RMSEA desires a value lower than 0.08 for a good model fit (Fan & Sivo, 2005; Sivo, Fan, Witt, & Willse, 2006), the other values require 0.9 or larger to indicate an acceptable fit of the model (Peter M Bentler, 1989; P. M. Bentler & Bonett, 1980; Hatcher, 1994; Hu & Bentler, 1999; McDonald & Marsh, 1990; Sivo, Pan, & Hahs-Vaughn, 2007).

According to the fit statistics report (as shown in Table 4-21), the pre-test data revealed a significant chi-square value  $\chi^2 (5, N = 108) = 16.77, p < .01$ . The result rejected the null hypothesis that the goodness of fit between PRATAM and the pre-test data. In addition, although Bentler's (1989) comparative fit index (CFI), McDonald's Centrality Index (MC), and Bentler and Bonett's (1980) Non-normed Index (NNFI) exceeded 0.9, root mean square error of approximation (RMSEA) and Bentler and Bonett's (1980) Normed-fit Index (NFI) didn't reach the cut-off level ( $RMSEA = 0.1483 > 0.08$  and  $NFI = 0.8023 < 0.90$ ). The result also suggested the problematic model fit on PRATAM and the pre-test data. Therefore, this current research also tried to identify and revise the causal structure of PRATAM.

Table 4-21 Fit Statistics Report for PRATAM in Pre-Test Data

	Fit Index
Chi-Square	16.7740
Chi-Square Degree of Freedom (df)	5
Chi-Square Probability value ( <i>p</i> )	0.0049
Root Mean Square Error of Approximation (RMSEA) Estimate	0.1483
Bentler's Comparative Fit Index (CFI)	0.9509
McDonald's (1989) Centrality (MC)	0.9469
Bentler & Bonett's (1980) Normed-fit Index (NFI)	0.8023
Bentler & Bonett's (1980) Non-normed Index (NNFI)	0.9528

Hatcher (1994) suggested that the standardized residual exceeds 2 which may be consider problematic in the model. According to the standardized residual matrix (as shown in Table 4-22), the residual between perceived ease of use and behavioral intention was 3.441 ( $> 2$ ) which may indicate a possible problem between those two manifest variables in the hypothesized PRATAM. In addition, Wald modification beta matrix also showed the connection between the perceived ease of use and the behavioral intention as was the top rank, which suggested a significant ( $p=0.0006<0.001$ ) decrease in chi-square by 11.82.

Table 4-22 Standardized Residual Matrix of PRATAM in Pre-Test Data

		R	U	EOU	A	BI	USE
Perceived Resources	R	0.00					
Perceived Usefulness	U	0.00	0.00				
Perceived Ease of Use	EOU	0.00	0.00	0.00			
Attitude Toward Using	A	0.00	0.00	0.00	0.00		
Behavioral Intention to Use	BI	0.00	0.00	3.44	0.00	0.00	
Actual System Use	USE	0.40	0.94	-0.41	-1.12	0.00	0.00

Therefore, this current research tried to add the casual link from perceived ease of use to behavioral intention, which was showed in the hypothesis 11 as follows:

H11. Perceived ease of use will have a positive direct effect on behavioral intention to use.

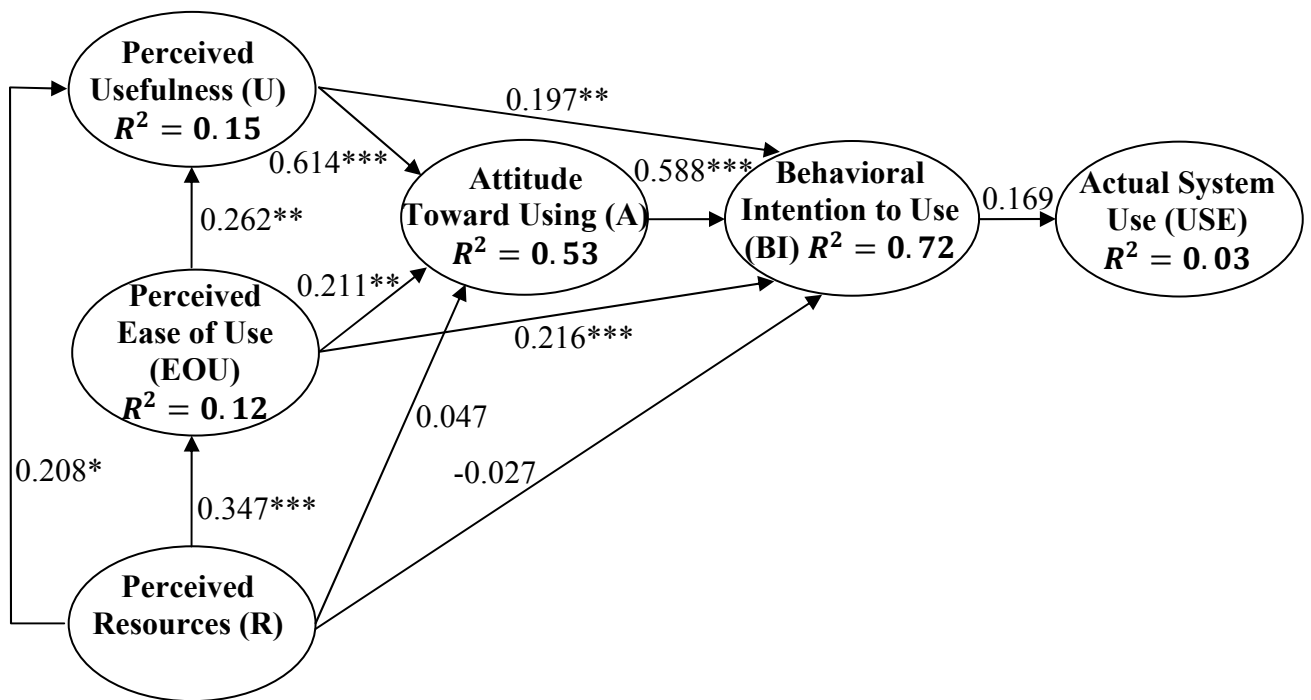
The revised PRATAM used the same pre-test 108 observations to examine the six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward, behavioral intention, and actual system use). The revised PRATAM still followed the overidentified model assumption (Hatcher, 1994) to estimate 17 parameters out of the total of 21 data points and the convergence criterion were also satisfied.

Table 4-23 Hypotheses Significance Test for Revised PRATAM in Pre-Test Data

Hypotheses Path		$\beta$	Std Err	<i>t</i>
H1 Perceived Resources to Perceived Usefulness	R→U	0.208	0.10	2.19
H2 Perceived Resources to Perceived Ease of Use	R→EOU	0.347	0.09	3.83
H3 Perceived Resources to Attitude Toward Using	R→A	0.047	0.07	0.65
H4 Perceived Resources to Behavioral Intention to Use	R→BI	-0.027	0.05	-0.48
H5 Perceived Ease of Use to Perceived Usefulness	EOU→U	0.262	0.10	2.76
H6 Perceived Ease of Use to Attitude Toward Using	EOU→A	0.211	0.07	2.89
H7 Perceived Usefulness to Attitude Toward Using	U→A	0.614	0.07	8.58
H8 Perceived Usefulness to Behavioral Intention to Use	U→BI	0.197	0.07	2.71
H9 Attitude Toward Using to Behavioral Intention to Use	A→BI	0.588	0.08	7.78
H10 Behavioral Intention to Use to Actual System Use	BI→USE	0.169	0.10	1.78
H11 Perceived Ease of Use to Behavioral Intention to Use	EOU→BI	0.216	0.06	3.64

R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward Using; BI: behavioral intention to Use; USE: actual system use;  $\beta$ : standardized path coefficients; Std Err: Standard Error

The significance tests of the hypotheses of the revised PRATAM are presented in Table 4-23. The result still showed that the  $t$  value of perceived resources on behavioral intention and behavioral intention on actual system use were below the cut-off level of 1.96, while the hypothesis 11 (H11) revealed statistical significance at the  $p < .001$  level. As a result, the hypothesis 3 (H3), hypothesis 4 (H4), and the hypothesis 9 (H9) remained as insignificant in the revised PRATAM from the pre-test data.



\*  $t > 1.96$  (the level of  $p < .05$ );  
 \*\*  $t > 2.58$  (the level of  $p < .01$ );  
 \*\*\*  $t > 3.30$  (the level of  $p < .001$ )

Figure 4-20 Path Diagram of Revised PRATAM in Pre-Test Data

Table 4-24 Equations with Standardized Coefficients of Revised PRATAM in Pre-Test Data

U	=	0.262**	EOU	+ 0.208*	R	+ 0.922	E1
EOU	=	0.347***	R	+ 0.938	E2		
A	=	0.614***	U	+ 0.211**	EOU	+ 0.047	R + 0.682 E3
BI	=	0.197**	U	+ 0.588***	A	- 0.027	R + 0.216*** EOU + 0.534 E4
USE	=	0.169	BI	+ 0.986	E5		

R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward using; BI: behavioral intention to use; USE: actual system use; E1-E5: Residual Terms; \*  $t > 1.96$  (the level of  $p < .05$ ); \*\*  $t > 2.58$  (the level of  $p < .01$ ); \*\*\*  $t > 3.30$  (the level of  $p < .001$ )

Table 4-24 shows the equations with standardized path coefficients and the residual terms (i.e., E1, E2, E3, E4, and E5) for the revised PRATAM in the pre-test data. The same path coefficients were displayed in Figure 4-20 again with the  $R^2$  value for the revised PRATAM. After adding the new causal relationship between perceived ease of use to behavioral intention to use, most  $R^2$  remained the same. The only exception was behavioral intention to use accounted for 4% more to 72 % of the variance by the new causal relationships from perceived ease of use.

According to the fit statistics report (as shown in Table 4-25), the revised PRATAM in the pre-test data revealed an insignificant chi-square value  $\chi^2(4, N = 108) = 4.25, p = .37 > .05$ . The result failed to reject the null hypothesis that the goodness of fit between PRATAM and the pre-test data. In other word, the chi-square result supported that the revise PRATAM fit the pre-test data. In addition, root mean square error of approximation (RMSEA) equal to 0.0243, which meant the minimal lack of fit for PRATAM compared to a perfect model. Along with Bentler's (1989) comparative fit index (CFI), McDonald's Centrality Index (MC), and Bentler and



Bonett's (1980) Normed-fit Index (NFI) and Non-normed Index (NNFI) were all exceeded the 0.9 level. Since researches suggested that the value closer to 1 represented the better model fit (Hatcher, 1994; Sivo, et al., 2007). Compared to the fit indexes from the hypothesized PRATAM, the result further supported that the revised PRATAM fitted better with the pre-test data.

**Table 4-25 Fit Statistics Report for the Revised PRATAM in the Pre-Test Data**

	Fit Index
Chi-Square	4.2523
Chi-Square Degree of Freedom (df)	4
Chi-Square Probability value ( <i>p</i> )	0.3729
Root Mean Square Error of Approximation (RMSEA) Estimate	0.0243
Bentler's Comparative Fit Index (CFI)	0.9989
McDonald's (1989) Centrality (MC)	0.9988
Bentler & Bonett's (1980) Normed-fit Index (NFI)	0.9374
Bentler & Bonett's (1980) Non-normed Index (NNFI)	0.9990

Since none of residual value in the standardized residual matrix (as shown in Table 4-26) exceed 2, the results also confirmed the previous conclusion on the goodness of fit of the revised PRATAM.

**Table 4-26 Standardized Residual Matrix of the Revised PRATAM in the Pre-Test Data**

		R	U	EOU	A	BI	USE
Perceived Resources	R	0.00					
Perceived Usefulness	U	0.00	0.00				
Perceived Ease of Use	EOU	0.00	0.00	0.00			
Attitude Toward Using	A	0.00	0.00	0.00	0.00		
Behavioral Intention to Use	BI	0.00	0.00	0.00	0.00	0.00	
Actual System Use	USE	0.48	0.94	-0.79	-1.12	0.00	0.00

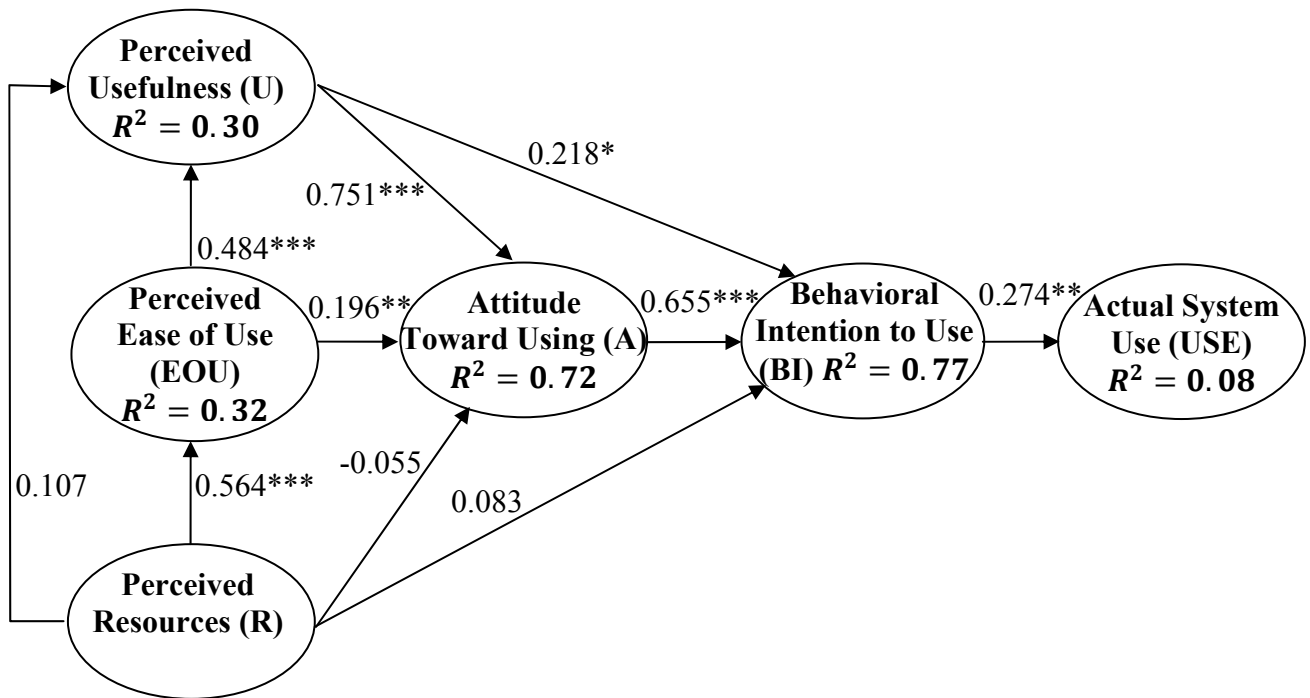
#### 4.4.2 Perceived Resources and Technology Acceptance Model in Post-Test

A total of 109 observations from the post-test data was used to examine the six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use) in the hypothesized PRATAM. As showed in the pre-test results, SAS reported that the hypothesized PRATAM estimates 16 parameters out of a total of 21 data points, which met the assumption of the overidentified model (Hatcher, 1994). In addition, the post-data also satisfied the convergence criterion.

Table 4-27 Hypotheses Significance Test for PRATAM in Post-Test Data

Hypotheses Path		$\beta$	Std Err	$t$
H1 Perceived Resources to Perceived Usefulness	R→U	0.107	0.10	1.11
H2 Perceived Resources to Perceived Ease of Use	R→EOU	0.564	0.08	7.10
H3 Perceived Resources to Attitude Toward Using	R→A	-0.055	0.06	-0.89
H4 Perceived Resources to Behavioral Intention to Use	R→BI	0.083	0.05	1.67
H5 Perceived Ease of Use to Perceived Usefulness	EOU→U	0.484	0.10	4.98
H6 Perceived Ease of Use to Attitude Toward Using	EOU→A	0.196	0.06	2.87
H7 Perceived Usefulness to Attitude Toward Using	U→A	0.751	0.06	12.33
H8 Perceived Usefulness to Behavioral Intention to Use	U→BI	0.218	0.08	2.57
H9 Attitude Toward Using to Behavioral Intention to Use	A→BI	0.655	0.08	7.85
H10 Behavioral Intention to Use to Actual System Use	BI→USE	0.274	0.09	2.96

R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward using; BI: behavioral intention to use; USE: actual system use;  $\beta$ : standardized path coefficients; Std Err: Standard Error



\*  $t > 1.96$  (the level of  $p < .05$ );  
 \*\*  $t > 2.58$  (the level of  $p < .01$ );  
 \*\*\*  $t > 3.30$  (the level of  $p < .001$ )

Figure 4-21 Path Diagram of PRATAM in Post-Test Data

Table 4-28 Equations with Standardized Coefficients of PRATAM in Post-Test Data

U	=	0.484***	EOU	+ 0.107	R	+ 0.834	E1
EOU	=	0.564***	R	+ 0.826	E2		
A	=	0.751***	U	+ 0.196**	EOU	- 0.055	R + 0.528 E3
BI	=	0.218*	U	+ 0.654***	A	+ 0.082	R + 0.475 E4
USE	=	0.274**	BI	+ 0.962	E5		

R: perceived resources; U: perceived usefulness; EOU: perceived ease of use; A: attitude toward using; BI: behavioral intention to use; USE: actual system use; E1-E5: Residual Terms; \*  $t > 1.96$  (the level of  $p < .05$ ); \*\*  $t > 2.58$  (the level of  $p < .01$ ); \*\*\*  $t > 3.30$  (the level of  $p < .001$ )

The significance tests of PRATAM hypotheses of the post-test data are presented in Table 4-27. The result showed that the  $t$  value of the perceived resources on the

perceived usefulness and the perceived resources on the behavioral intention to use were both below the cut-off level of 1.96. Therefore, the hypothesis 1 (H1), hypothesis 3 (H3), and hypothesis 4 (H4) showed insignificant in PRATAM from the post-test data.

Table 4-28 shows the equations with standardized path coefficients and the residual terms (i.e., E1, E2, E3, E4, and E5) for PRATAM in the post-test data. The same path coefficients also displayed in Figure 4-21 with the  $R^2$  value displayed underneath the endogenous variables of PRATAM. The result indicated that perceived resources accounted for 32% of the variance of perceived ease of use, and perceived resources and perceived ease of use accounted for 30% of the variance of perceived usefulness. Perceived usefulness and perceived ease of use also accounted for 72% of the variance of attitude toward using, and perceived resources, perceived usefulness, and attitude toward using accounted for 77% of the variance of behavioral intention to use. However, behavioral intention only accounted for 27% of the variance of actual system use.

Table 4-29 Fit Statistics Report for PRATAM in Post-Test Data

	Fit Index
Chi-Square	1.5856
Chi-Square Degree of Freedom (df)	5
Chi-Square Probability value ( $p$ )	0.9030
Root Mean Square Error of Approximation (RMSEA) Estimate	0.0000
Bentler's Comparative Fit Index (CFI)	1.0000
McDonald's (1989) Centrality (MC)	1.0158
Bentler & Bonett's (1980) Normed-fit Index (NFI)	0.9878
Bentler & Bonett's (1980) Non-normed Index (NNFI)	1.0089

According to the fit statistics report (as shown in Table 4-29), PRATAM in the post-test data revealed an insignificant chi-square value,  $\chi^2 (5, N = 109) = 1.59, p = .90 > .05$ . The result failed to reject the null hypothesis that the goodness of fit between PRATAM and the pre-test data and suggested that PRATAM fit well with the post-test data. The other fit indexes also supported that PRATAM fitted with the post-test data. Root mean square error of approximation (RMSEA) equal to 0 which meant the minimal lack of fit for PRATAM compared to a perfect model. Along with Bentler's (1989) comparative fit index (CFI), McDonald's Centrality Index (MC), and Bentler and Bonett's (1980) Normed-fit Index (NFI) and Non-normed Index (NNFI) were all exceeded the 0.9 level.

Table 4-30 Standardized Residual Matrix of PRATAM in Post-Test Data

		R	U	EOU	A	BI	USE
Perceived Resources	R	0.00					
Perceived Usefulness	U	0.00	0.00				
Perceived Ease of Use	EOU	0.00	0.00	0.00			
Attitude Toward	A	0.00	0.00	0.00	0.00		
Behavioral Intention	BI	0.00	0.00	0.94	0.00	0.00	
Actual System Use	USE	0.69	-0.38	0.42	-0.24	0.00	0.00

In addition, none of the residual value in the standardized residual matrix (as shown in Table 4-30) exceed 2, which further confirmed the goodness of fit for PRATAM in the post-test data.

## 4.5 Summary

This current research examined Perceived Resources and Technology Acceptance Model (PRATAM) in two higher education WebCT courses. SPSS and SAS were used to analyze PRATAM and its six manifest variables (i.e., perceived resources, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use). These manifest variables were measured by a total of twenty-five measurement items in the instruments. The results in this chapter revealed several notable findings from the collected data.

First, the demographics result showed the characteristics of the participants. A little less than half (46.56%) of the target population finished both pre-test and post-test survey instruments, where around 60% (67 out of 115) were from W-Type WebCT courses and the other 40% were from M-Type courses. In addition, the majority of the participants were female (89.6%) and white (81.58%).

Second, the data exploration also found a couple restrictions from the collected data. The exploratory factor analysis test revealed the interrelated measurement items from attitude toward using and behavioral intention to use in the pre-test data. The same high-interrelated measurement issue repeated in the post-test data on perceived usefulness, attitude toward, and behavioral intention as well. The normality test suggested a non-normal distribution on all of the manifest variables in both the pre-test and post-test. An attempt on data transformation could not correct the distribution issue either. However, the reliability test provided convincing results on the Cronbach's alpha

reliability value for the manifest variables. The repeated-measures analysis of variance (ANOVA) tests also indicated the consistent means on those manifest variables between pre-test and post-test.

Third, the path analysis results tested the hypotheses and the construct of PRATAM from both pre-test and post-test data. An insignificant result on hypothesis 3 (i.e., perceived resources will have a significant positive effect on attitude toward using), hypothesis 4 (i.e., perceived resources will have a significant positive effect on behavioral intention to use), and hypothesis 10 (i.e., behavioral intention to use will have a significant positive effect on actual system use) were revealed in pre-test data. The post-test data also indicated that hypothesis 1 (i.e., Perceived resources will have a significant positive effect on perceived usefulness), hypothesis 3 (i.e., perceived resources will have a significant positive effect on attitude toward using), and hypothesis 4 (i.e., perceived resources will have a significant positive effect on behavioral intention to use) were statistically insignificant. In order to fit the data, the pre-test result suggested that a new causal relationship from perceived ease of use to behavioral intention was needed in addition to the initial PRATAM construct. However, the post-test data fitted well with PRATAM without any modification.

## **CHAPTER 5: CONCLUSIONS AND DISCUSSIONS**

### 5.1 Introduction

The purpose of the current research is to identify the factors and the causal relationships that influence students' behaviors of using WebCT online learning system at the University of Central Florida (UCF), a large southeastern public university. The research model- Perceived Resources and Technology Acceptance Model (PRATAM)- was introduced on a construct that based on Davis' (1986) Technology Acceptance Model (TAM) and the extended technology acceptance model by Mathieson et al. (2001). PRATAM proposed the causal relationships on students' perceived resources, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use as the predictors to students' actual system use of WebCT online learning system. This current research, therefore, was focusing on answering the research question of how PRATAM explains the students' WebCT usage behaviors in the higher education web-based online learning courses.

This chapter provided the overall conclusions and suggestions regarding the current research. First, a section reviews the participants for this study. A conclusion section then extends the results of the study based on the fit of the research model and the research hypotheses. The two sections after the conclusions discusses the significance, as



well as the limitations in the study. After all, a suggestion section describes some issues and directions for the future research.

## 5.2 Participants and Data Collection

The data in the current research was collected at the University of Central Florida (UCF) within the Fall 2008 semester. Two UCF WebCT courses (i.e., EME 2040 Introduction to Educational Technology and RED 5147 Foundation of Developmental Reading) were selected in this current research. The participants were assessed twice by an identical survey instrument in the manner of pre-test and post-test observations, which the pre-test was conducted in the middle of the semester and the post-test was conducted on the end of the semester. Since UCF WebCT courses utilize the web-based WebCT system as the main platform to deliver instructions and content through the Internet, those courses usually required a minimal face-to-face classroom time or even no actual classroom meeting. A web-based survey available for students to access over the Internet is the most accessible method to fit the same style of WebCT instructions. However, this voluntary web-based survey required students' extra effort and time in addition to their original course work. Furthermore, this current research adopted the pre-test and post-test design to investigate the changes on students' beliefs, attitudes, intentions, and behaviors over time, hence, students need to accomplish the survey twice to be claimed as a valid data.

This current research, however, claimed a total of 115 students that finished both the pre-test and post test survey instruments with a valid data, which indicated the final valid response rate for 46.56% of the total 247 enrolled students. Compared to the previous studies that based on UCF WebCT courses, Pan (2003) posted a response rate at 38.5% on a pre-test post-test style study with two undergraduate level courses; and Yang (2007) found only 79 out of 1,015 undergraduate level students finished the whole series of three assessments. Therefore, even the participants for the current research only yielded for a little bit less than half of the target population; it seems to be an acceptable response rate for the UCF WebCT courses.

In addition, two courses with two different WebCT instructions was adopted in the current research. RED 5147 was totally online or W-Type WebCT course while EME 2040 provided both M-Type (i.e., mixed mode) and W-Type WebCT sessions. Previous researchers have analyzed two different courses with only one single (E-Type) WebCT instruction method (Pan, 2003) or one single course with three different WebCT instruction methods (Yang, 2007). In this current research, however, regardless of the difference between these two different types of instruction, all participants were treated as a whole group. The valid participants, therefore, including around three out of five (58.26%) students from W-Type WebCT sessions and the other 41.74% students were from M-Type sessions.

### 5.3 Conclusions

Based on the Perceived Resources and Technology Acceptance Model (PRATAM) and the research hypotheses, the following sections concludes the results in the model fit, explained variation, and all ten research hypotheses.

#### 5.3.1 Model Fit

In the pre-test data, PRATAM missed several fit indexes' cut-off level and chi-square  $\chi^2 (5, N = 108) = 16.77, p < .01$  failed to support a goodness of fit for PRATAM. However, a revised with an addition causal relationship from perceived ease of use to behavioral intention showed a moderate model fit with chi-square  $\chi^2 (4, N = 108) = 4.25, p = 0.37 > .05$ . The post-test data, On the other hand, showed a great model fit-Chi-square  $\chi^2 (5, N = 109) = 1.59, p = 0.90 > .05$ -with PRATAM without any modification.

While Mathieson et al. (2001) created the extended technology acceptance model, the research did not supply the model fit indexes due to the lack of fit metric by the partial least squares (PLS) analysis procedures. Even though Mathieson et al. (2001) analyzed the coefficient of determination  $R^2$  value and concluded a fit of the model, there were no direct statistics regarding the model fit. Since PRATAM replicated from the construct of Mathieson's et al. (2001) extended technology acceptance model, the result

of this current research could also provide the additional fit indexes to support the goodness of fit for the extended technology acceptance model.

In addition, the revised PRATAM in the pre-test data was modified by the causal relationship from perceived ease of use to behavioral intention. A possible reason for the need to modify PRATAM in pre-test might be the time required to form the behavioral intention on using WebCT. Davis (1986) suggested that the formation of the behavioral intention requires a period of time. Even the initial design of the current research arranged the pre-test in the middle of the semester so that students can have time to form the behavioral intention, this period of time might not be adequate for students to respond in the instrument. In addition, the causal relationship between perceived ease of use and behavioral intention further suggested that perceived ease of use played an important role in the forming of behavioral intention. In other words, the easier a student thought WebCT was, the higher behavioral intention was for this student on using WebCT. The higher fit indexes result in the post-test data, indicated that students' behavioral intention was well developed at the time of the post-test. Thus, the result suggested that the forming of the behavioral intention on using WebCT might require as long as a whole semester of time.

### *5.3.2 Explained Variation*

In pre-test, PRATAM accounted for approximately 15% of the variance in perceived usefulness, 12% in perceived ease of use, 53% in attitude toward, 68% in

behavioral intention, and 3% in actual system use. The revised PRATAM further added 4% more variance in behavioral intention by incorporating the extra causal relationships between perceived ease of use and behavioral intention. Meanwhile, PRATAM in post-test explained approximately 30% of the variance in perceived usefulness, 32% in perceived ease of use, 72% in attitude toward, 77% in behavioral intention, and 8% in actual system use. Overall, PRATAM explained more variance in post-test data than pre-test data in this current research. Compared to the pre-test data, the explained variation ( $R^2$ ) gained 5% to 20 % consistently in the post-test data. Therefore, the results indicated that the students' progress in a WebCT course might influence the abilities for PRATAM to interpret the students' beliefs, attitudes, intentions, and behaviors.

Since PRATAM was duplicated from Mathieson's et al. (2001) extended technology acceptance model, table 5-1 lists the comparison of  $R^2$  value in the condition of pre-test, pre-test with revised PRATAM, post-test, and the results posted by Mathieson et al. (2001). Compared to the  $R^2$  conducted by Mathieson et al. (2001), the  $R^2$  values generated by the current research showed a quite similar pattern. However, some exceptions in the results still need to be recognized.

Table 5-1 Proportion of Explained Variation Comparison Table

	Pre-Test		Post-Test	Mathieson et al. (2001)
	Original	Revised		
Perceived Usefulness (U)	0.15	0.15	0.30	0.22
Perceived Ease of Use (EOU)	0.12	0.12	0.32	0.26
Attitude Toward Using (A)	0.53	0.53	0.72	0.67
Behavioral Intention to Use (BI)	0.68	0.72	0.77	0.40
Actual System Use (USE)	0.03	0.03	0.08	0.30

The first thing worthy to note was the minor (8%) explained variance of actual system use in the current research. The results showed that behavioral intention to use did not significantly affect actual system use in this study. In other words, students may not change their behaviors in using WebCT even though they have substantial intention to use WebCT. Meanwhile, Mathieson et al. (2001) yielded a 30% variance explained on actual system use. The possible reason on the difference on explained variance might be caused by the different target populations and target information systems. Since the system accessed by Mathieson et al. was a bulletin board system (BBS) that provided the optional communications for a professional organization. Therefore, the users who used the system were mainly driven by the benefits that come with the system, which was a major intention. WebCT in the current research, however, was a mandatory content and instruction platform that required students to access it in order to acquire course content or get their grades. Hence, in addition to the behavioral intention to use WebCT, students might also be affected by some other variables such as grade or self-efficacy. The other possibility might be the way this study observed the students' actual system use. Since only two measurement items were adopted to measure the two dimensions of actual system use (i.e., frequency and length). There might be some other dimensions of usage behaviors that affected by students' behavioral intention. For example, students' with higher behavioral intention may improve their efficiency on using WebCT for their course works, which means that they can spend less time on WebCT and still finish the same amount of homework.

Second, perceived usefulness and perceived ease of use in this study only explained about 15% of variances in pre-test and 30% of variances in post-test, the results matched the limitation suggested in chapter one regarding the lack of external variables. The findings also consistently match the result generated by Mathieson et al. (2001). In addition, Davis et al. (1989) also noticed in the Technology Acceptance Model (TAM) that perceived usefulness and perceived ease of use can be affected by various external variables. The results in the current research, therefore, confirmed the comments from Davis et al. and found some external variables could explain perceived usefulness and perceived ease of use up to 85% in pre-test and 70% in post-test. The analysis of standardized path coefficient equations further supported these findings. Both pre-test and post-test posted a relatively high coefficients ( $\beta$ ) in the residual terms for perceived usefulness (0.92 in pre-test and 0.83 in post-test) and perceived ease of use (0.94 in pre-test and 0.83 in post-test). These results indicated that both perceived usefulness and perceived ease of use were significantly affected by the variables other than the manifest variables defined by PRATAM. Furthermore, the effect from the external variables decreased along with the time students using WebCT system, which also confirmed with the suggestions made by Mathieson et al. (2001) that perceived ease of use and perceived usefulness account more variables after the individual gained experiences with the system.

### 5.3.3 Hypothesis 1

*H1. Perceived resources will have a positive direct effect on perceived usefulness.*

Hypothesis 1 assumed that the personal and organizational resources students believe they could have for using WebCT will positive affect students' beliefs on using the WebCT system could improve their performance in the courses. The results of the path coefficient showed a significant coefficient beta 0.208 ( $p < .05$ ) for the relationship between perceived resources and perceived usefulness in pre-test, which means one unit of perceived resources increase will significantly increase about 0.208 unit of perceived usefulness. Therefore, students considered their accessible resources as one of the factors when they thought using WebCT is useful in the pre-test data. The post-test data, however, failed to duplicate this significant result ( $\beta = 0.107, p > .05$ ), students' perception of their available resources did not significantly affect their thought on whether WebCT is useful. Overall, the current research data only partially supported this hypothesis; more research is needed to clarify the link between perceived resources and perceived usefulness.

According to Mathieson's et al. (2001) extended TAM, perceived resources do not direct affect perceived usefulness. However, Mathieson's et al. (2001) noticed a significant link between perceived resources and perceived usefulness ( $\beta = 0.216, p < .05$ ) in their research. Mathieson et al. (2001) suggested that the possible reason could be certain formative items of perceived resources. For example, expertise could be a formative item for perceived resources. An individual with more expertise could also



have more knowledge on the capabilities and applications that the system can achieve, which also lead the higher perception on the system is useful. However, Mathieson et al. (2001) argued that this effect could be relatively small and should only explained a minimal of variances. The relatively small and unstable beta coefficient in this current research, validated Mathieson's et al. (2001) argument and suggested that perceived resources could only have direct effect on perceived usefulness on certain circumstance.

#### *5.3.4 Hypothesis 2*

*H2. Perceived resources will have a positive direct effect on perceived ease of use.*

Hypothesis 2 proposed that the personal and organizational resources students believe they could have for using WebCT will positive affect students' beliefs on whether the WebCT system is easy to use. The results of the path coefficient showed a significant coefficient beta on both pre-test ( $\beta = 0.347, p < .05$ ) and post-test ( $\beta = 0.564, p < .05$ ). Therefore, the current research supported the hypothesis 2 and found students' beliefs on their available resources on using WebCT had a direct effect on how easy students thought it was to use WebCT.

Overall, PRATAM showed a quite consistent finding on the link between perceived resources and perceived ease of use with previous studies. The study conducted by Mathieson et al. (2001) claimed a significant effect on this relationship ( $\beta = 0.510$ ,

$p < .05$ ) while Oh et al. (2003) also supported this relationship in the hypothesis ( $\beta = 0.356, p < .05$ ). As Davis et al. (1989) noticed the existing external variables that might affect the perceived ease of use in the Technology Acceptance Model (TAM), a suggestion has also been made on the need to assess the impact of the external variables (Davis, et al., 1989). This current research, accompanies the studies by Mathieson et al. (2001) and Oh et al. (2003), further confirming that perceived resources could be a key determinant for perceived ease of use.

In addition, as online learning system vendors and institutes are struggling on providing the products with better usability for the growing market, the finding of this current research confirmed the influence on perceived ease of use from perceived resources. Therefore, the improvements on the online learning resources such as the technology support and documentation might help institutes and designers to address the usability concern of the online learning system.

### 5.3.5 Hypothesis 3

*H3. Perceived resources will have a positive direct effect on attitude toward using WebCT.*

Hypothesis 3 proposed that the personal and organizational resources students believe they could have for using WebCT will positive affect students' attitude toward using WebCT. The results of the path coefficient showed an insignificant coefficient beta

consistently on either pre-test ( $\beta = 0.047, p > .05$ ), pre-test with revised PRATAM ( $\beta = 0.047, p > .05$ ), and post-test ( $\beta = -0.055, p > .05$ ). Therefore, this current research rejected hypothesis 3 and found that students' consideration on their available resources of using WebCT did not have a significant effect on their attitude toward using WebCT. This result is expected because Previous research (Mathieson, et al., 2001) also found perceived resources do not have the direct effect on attitude toward using. Mathieson et al. (2001) stated that an individual might have a positive attitude toward using the system, but still believe he or she do not have the important to perform the behaviors. In other words, one may desire to use WebCT but still found the computer hardware or software may not be able to run WebCT. In addition, consider that perceived resources is derived from the construct of perceived behavioral control from Ajzen's (1991) Theory of Planned Behavior (TPB). In TPB, Ajzen proposed attitude toward behavior and perceived behavioral control as two parallel factors that do not have any direct connection. Therefore, this current research confirmed that attitude toward using is not directly influenced by perceived resources.

#### *5.3.6 Hypothesis 4*

*H4. Perceived resources will have a positive direct effect on behavioral intention to use WebCT.*

Hypothesis 4 proposed that the personal and organizational resources students believe they could have for using WebCT will positive affect students' behavioral intentions to use WebCT. The results of the path coefficient showed an insignificant coefficient beta consistently on either pre-test ( $\beta = 0.024, p > .05$ ), pre-test with revised PRATAM ( $\beta = -0.027, p > .05$ ), and post-test ( $\beta = 0.083, p > .05$ ). Hence, this current research rejected hypothesis 4 and found that students' consideration on their available resources of using WebCT did not have a significant effect on the intentions student formed toward using WebCT.

These results were inconsistent with the findings from the previous study conducted by Mathieson et al. (2001), which posted a significant relationship ( $\beta = 0.291, p < .05$ ) on perceived resources to behavioral intention. In addition, while resources constraints also referred as the external construct of perceived behavioral control in the Theory of Planned Behavior (Ajzen, 1985, 1991), researchers also found that resources influenced behavioral intention (Mathieson, 1991; Taylor & Todd, 1995c). However, Taylor and Todd (1995b) also noted that the link between perceived behavioral control and behavioral intention could be tenuous and suggested the need to further examine the relationships. Furthermore, while Mathieson's et al. (2001) study required particular hardware and software equipments to connect to the bulletin board system (BBS). The resources for using WebCT are the same as those resources for using the Internet and personal computers, which is quite common in today's higher education campus. For example, instant messaging and e-mail are probably the most common activities for college students and they all required the resources of the Internet and

computer. Therefore, this current research had anticipated that the score of perceived resources would be relatively high. The mean scores ( $\underline{M} = 25.87$  in pre-test and  $\underline{M} = 25.59$  in post-test on a scale from 0 to 28) for perceived resources supported this anticipation with no surprise. As this current research used a conservative manner to duplicate Mathieson's et al. (2001) extended technology acceptance model, the insignificant results on the relationship between perceived resources and behavioral intention were understandable. A further investigation on the relationships between perceived resources and behavioral intention in a higher education online learning system setup will be needed to clarify this issue.

### 5.3.7 Hypothesis 5

*H5. Perceived ease of use will have a positive direct effect on perceived usefulness.*

Hypothesis 5 proposed that students' beliefs on whether the WebCT system is easy to use will positive affect students' beliefs on using the WebCT system could improve their performance in the courses. The results of the path coefficient showed a significant coefficient beta consistently  $\beta = 0.262$ ,  $p < .05$  in both pre-test and pre-test with the revised PRATAM, and  $\beta = 0.448$ ,  $p < .05$  in post-test. Therefore, the current research supported hypothesis 5 and found students' beliefs on the WebCT system is easy to use had a direct effect on how useful students thought WebCT was. The result from the

current research confirmed the findings by Mathieson et al. (2001), Pan (Pan, 2003), Taylor and Todd (Taylor & Todd, 1995c), and Yang (2007), whom all concluded that perceived usefulness is significantly influenced by perceived ease of use.

One thing worthy to note was the huge value changes in regression coefficients on the link of perceived ease of use and perceived usefulness overtime. The standard beta coefficients increased from 0.262 in pre-test to 0.448 in post-test. The same gap in the increasing beta scores overtime were also found in Davis' et al. (1989) study (i.e.,  $\beta = 0.10$ ,  $p > .05$  in time 1 and  $\beta = 0.23$ ,  $p < .01$  in time 2). This fluctuation indicated that weight on users' perceived ease of use in determining one perception of the usefulness of the system changed overtime. In this current study, students' might find the WebCT system is easy for them to operate after they have more time to use it, while they also dug out more functions and applications of WebCT overtime and considered WebCT could be helpfulness on their performance. However, some researchers (Pan, 2003; Yang, 2007) of the WebCT system found a relatively consistent results in the studies which also collected the data in more than one point of time. Hence, more efforts will be needed to diagnose the inconsistent relationship between perceived usefulness and perceived ease over time.

#### 5.3.8 Hypothesis 6

*H6. Perceived ease of use will have a positive direct effect on attitude toward using WebCT.*

Hypothesis 6 proposed that students' beliefs on whether the WebCT system is easy to use will positive affect their attitude toward using the WebCT system. The standardized path coefficient showed consistent significant results in pre-test ( $\beta = 0.214$ ,  $p < .05$ ), pre-test with the revised PRATAM ( $\beta = 0.214$ ,  $p < .05$ ), and post-test ( $\beta = 0.196$ ,  $p < .05$ ). The results in the current research supported the hypothesis 6 and found students' beliefs on using the WebCT system as easy to use, had a direct effect on their attitude toward using WebCT. The same results were found in the studies conducted by Mathieson et al. (2001), Taylor and Todd (Taylor & Todd, 1995c), and Yang (2007), whom also concluded that perceived ease of use is a significant determinant to attitude toward using.

An issue raised the attention to the researcher was the decreasing value on the causal relationship from perceived ease of use to attitude toward. Compared to the pre-test data, the standardized coefficient beta on the link showed a decreasing trend in the post-test data. Davis et al. (1989) found the link between perceived ease of use and attitude toward in a similar study was insignificant at the first assessment and significant at the second assessment, while Pan (Pan, 2003) in the other similar study found the link in a reversed way (i.e., significant at the first time and insignificant at the second time). Therefore, the linkage between perceived ease of use and attitude toward seems to fluctuate over time and may required further research to find out the influences during the progress of system using. Regardless, one possible reason for the decreasing weight on perceived ease of use explaining attitude toward might be the timing of the post-test survey. Since the post-test was held right before the final exam, instead of considering

whether the WebCT system was easy for them to use, their attitude might be affected more by the variables which might be beneficial for them to pass the exam. The same reason was also applied to the decreased standardized coefficient beta in the causal relationship between perceived usefulness and attitude toward in hypothesis 6.

#### *5.3.9 Hypothesis 7*

*H7. Perceived usefulness will have a positive direct effect on attitude toward using WebCT.*

Hypothesis 7 proposed that students' beliefs on using the WebCT system could improve their performance in the courses will positive affect students' attitude toward using the WebCT system. The standardized path coefficient showed consistent significant results in pre-test ( $\beta = 0.614$ ,  $p < .05$ ), pre-test with the revised PRATAM ( $\beta = 0.614$ ,  $p < .05$ ), and post-test ( $\beta = 0.751$ ,  $p < .05$ ). The results in the current research supported hypothesis 7 and concluded that students' beliefs that the WebCT system can improve their course performance, had a significant effect on their attitude toward using WebCT. Other researchers (Davis, et al., 1989; Mathieson, et al., 2001; Pan, 2003; Taylor & Todd, 1995c; Yang, 2007) also found the significant path between perceived usefulness and attitude toward in their research.

As Davis et al. (1989) argued that perceived usefulness is a major determinant over perceived ease of use in people's intention and attitude, this current research



confirmed this thought and posted a significantly lower standardized coefficient beta on perceived ease of use than perceived usefulness. For example, the standardized coefficient beta from perceived ease of use to attitude toward was 0.224, which is lower than the path from perceived usefulness to attitude toward ( $\beta = 0.624, p < .05$ ). Therefore, PRATAM explained students attitude toward using WebCT was quite similar with the attitude toward using in Davis et al. (1989) Technology Acceptance Model (TAM).

#### *5.3.10 Hypothesis 8*

*H8. Perceived usefulness will have a positive direct effect on behavioral intention to use WebCT.*

Hypothesis 8 proposed that students' beliefs on using the WebCT system could improve their performance in the courses will positive affect students' behavioral intention to use the WebCT system. The standardized path coefficient showed consistent significant results in pre-test ( $\beta = 0.202, p < .05$ ), pre-test with the revised PRATAM ( $\beta = 0.197, p < .05$ ), and post-test ( $\beta = 0.218, p < .05$ ). Hypothesis 8 was supported by the results in the current research. The finding suggested that students' behavioral intention on using WebCT was directly affected by students' beliefs on using the WebCT system could improve their course performance.

The causal relationship between perceived usefulness to behavioral intention to use was validated by several researchers (Davis, et al., 1989; Mathieson, 1991; Taylor & Todd, 1995c), for example, the previous research conducted by Davis et al. (1989) found a significant result ( $\beta = 0.48$ ,  $p < .001$  in time 1 and  $\beta = 0.61$ ,  $p < .001$  in time 2) in the path between perceived usefulness and behavioral intention. However, Mathieson et al. (2001) in the study of the extended technology acceptance model found an insignificant value ( $\beta = 0.003$ ,  $p > .05$ ) in the same link. The Theory of Reasoned Action (TRA) proposed by Fishbein and Ajzen (1975) also argued that the beliefs variables (e.g., perceived usefulness) should affect behavioral intention indirectly through attitude toward behavior. Mathieson et al. (2001) noted that the bulletin board system used in the study was voluntary and no immediate rewards, whereas Davis' et al. (1989) study conducted with a higher education word processing system which students could increase their job performance. Mathieson et al. (2001) suggested that this system differentia might be the reason for the insignificant results in the study. The WebCT system used in this current research was similar to the system examined in Davis et al. (1989) study, which students could receive direct rewards (i.e., grades) from using the WebCT system. Hence, the significant values in this study confirmed the comment by Mathieson et al. (2001) and validated the link between perceived usefulness and behavioral intention in a system with rewards.

### 5.3.11 Hypothesis 9

*H9. Attitude toward using will have a positive direct effect on behavioral intention to use WebCT.*

Hypothesis 9 proposed that the students' attitude toward using WebCT is the other determinant to their behavioral intention to use the WebCT system. The results in the standardized path coefficient showed significant values in pre-test ( $\beta = 0.663$ ,  $p < .05$ ), pre-test with the revised PRATAM ( $\beta = 0.588$ ,  $p < .05$ ), and post-test ( $\beta = 0.655$ ,  $p < .05$ ). The current research supported hypothesis 9 consistently and the finding confirmed that students' attitude toward using WebCT have direct impact to students' intention on using the WebCT system.

This linkage between attitude toward using and behavioral intention to use was validated in several studies regarding the technology acceptance model (Davis, et al., 1989; Mathieson, 1991; Mathieson, et al., 2001). In addition, the Theory of Reasoned Action (TRA) proposed by Fishbein and Ajzen (1975) also assumed the causal relationship between attitude toward and behavioral intention as one of the fundamental construct. Therefore, along with those previous studies, the findings of this current research further confirmed that an individual attitude toward a information system would be an important factor to influence an individual's users' behavioral intention.

### 5.3.12 Hypothesis 10

*H10. Behavioral intention to use will have a positive direct effect on actual WebCT usage.*

Hypothesis 10 proposed that the students' intention on using WebCT has a direct effect on their actual usage behaviors on the WebCT system. As Davis et al. (1989) found a significant result ( $\beta = 0.35$ ,  $p < .001$  in time 1 and  $\beta = 0.63$ ,  $p < .001$  in time 2) on this causal relationship between behavioral intention to use and actual system use in the Technology Acceptance Model (TAM), Mathieson et al. (2001) also found a significant relationship ( $\beta = 0.466$ ,  $p < .05$ ) on this linkage in the extended technology acceptance model. This current research, however, only found the significant result from the post-test data ( $\beta = 0.274$ ,  $p < .05$ ). The standardized path coefficient values in both pre-test ( $\beta = 0.169$ ,  $p > .05$ ) and pre-test with the revised PRATAM ( $\beta = 0.169$ ,  $p > .05$ ) failed to conclude significant influences on actual system use from behavioral intention. Therefore, the current research could only be partially supported by hypothesis 10 and the finding suggested that students' intention on using WebCT only showed a significant impact on students' actual WebCT usage at the second time of assessment (i.e., post-test).

One possible reason for the insignificant result in the pre-test data could be formation of behavioral intention. As mentioned in section 5.3.1 previously, the formation of an individual's behavioral intention requires a period of time (Davis, 1986). The students in the current study's pre-test assessment might not have proper time to

form the completed behavioral intention. Therefore, the behavioral intention in the pre-test data failed to display a significant path to actual system use. The exploratory factory analysis in section 4.3.1 indicated highly interrelated measurement scores in attitude toward and behavioral intention in the pre-test data. These interrelated results further supported the thought that the students' behavioral intention in pre-test was incomplete. If this thought is true, then the insignificant results of the link between behavioral intention and actual system use in the pre-test data is expected.

#### 5.4 Significant Findings of the Study

While Technology Acceptance Model (TAM) has been applied in assessing people's acceptance behaviors for more than two decades, Mathieson et al. (2001) extended the technology acceptance model by incorporating the perceived resources to address the essential resource issues caused by the modern system. On the other hand, even though researchers have investigated the online learning system by TAM and various modified TAM, the previous implementations that related to the resources issues in an online learning system only addressed the formative resource variables such as support and training. This current research introduced perceived resources as the new aspect of students' belief into a higher education WebCT online learning system and validated the influences toward other existing beliefs, attitudes, intentions, and behavior variables. The purpose of the current research, therefore, was to first adopt the perceived resources as the overall reflective resource measurement into a TAM. This new aspect of

belief could provide the additional knowledge in assessing the usage behavior in a higher education online learning system.

Based on the Perceived Resources and Technology Acceptance Model (PRATAM), the significant findings of this current research are listed below:

1. Based on the constructs of Mathieson et al. (2001) extended technology acceptance mode, PRATAM successfully replicated the extended technology acceptance model and implemented it into the higher education WebCT courses at the University of Central Florida (UCF). Overall, PRATAM demonstrated a significant fit with the collected data and explained the constructs and causal relationships from the aspects of students' belief, attitude, intention, and behavior.
2. Students' perceived resources on using WebCT was proved to be a statistically significant determinate of students' perceived ease of use toward WebCT.
3. Students' perceived ease of use toward WebCT was a statistically significant predictor that influenced students' perceived usefulness of WebCT.
4. Students' attitude toward using WebCT was jointly determined by students' perceived usefulness of WebCT and perceived ease of use toward WebCT, whereas perceived usefulness showed a more significant impact over perceived ease of use on students' attitude toward WebCT.
5. Students' behavioral intention to use WebCT was jointly determined by students' perceived usefulness of WebCT and attitudes toward using WebCT, whereas attitude toward using WebCT showed a more significant impact over perceived usefulness on students' behavioral intention to use WebCT.

6. Students' behavioral intention to use WebCT did not consistently influence students' actual usage behavior of WebCT at the two assessment times.
7. Students' perceived resources on using WebCT did not consistently affect students' perceived usefulness of WebCT on the two assessment times.
8. Students' perceived resources on using WebCT did not influence students' attitude toward using WebCT.
9. Students' perceived resources on using WebCT did not influence students' behavioral intention to use WebCT.
10. Student's perceived ease of use toward WebCT showed a statistic significant impact on students' behavioral intention to use WebCT at the pre-test.

The results of the current research also revealed only a small portion of perceived usefulness and perceived ease of use was explained within PRATAM, which indicated the existence of external variables. While Davis et al. (1989) suggested the influences by external variables in the original TAM, a similar finding has been made in a WebCT environment by Pan (2003), which found students' perceived ease of use and perceived usefulness was significantly affected by the external variables, such as computer self efficacy and subjective norms. Hence, the results in this study suggested that a further investigation on this possibility would be needed.

Furthermore, the current research found the fluctuation values on the causal relationships of PRATAM's construct variables in the two different assessment times. These fluctuation results suggested that the students' initial belief, attitude, intention, and behavior changed overtime during the progress of the WebCT courses. Davis et al.

(1989) also found the changes on the standardized coefficient beta over time. As a result, this study suggested a further examination on the changes over time.

### 5.5 Limitations of the Data

The limitations on the collected data in the current research are listed as the following points:

1. First, a convenience sample method was used to collect the data from two University of Central Florida College of Education WebCT courses, where the target population was mixed with two instruction types (i.e., W-Type and M-Type) and two academic levels (i.e., graduate and undergraduate). Hence, the participants in the current research would be considered as biased and might not be able to accurately represent other groups or populations such as the WebCT courses in the other colleges of UCF or students from other universities. Generalizing the findings from the current research to any population might not be appropriate and may require additional efforts.
2. Second, the response rate in the current research only accounted for merely 47% of the target population. While researchers (Visser, Krosnick, Marquette, & Curtin, 1996) suggested that the survey with lower response rate yielded a more accurate measurement than the survey with high response rate, Bradburn and Sudman (1988) argued that the lower response rate could lead to greater biases in the data, make the results meaningless. In addition, the total valid sample in this study only accounted



for a total of 115 students, where Hatcher (1994) suggested an acceptable sample for more than 150 observations to be estimated in a structural equation modeling analysis. Thus, the nature of the collected data size and response rate might bring biases to the results of the current study.

3. The other limitation from the data was the normality of the data distributions. The data showed a visible skew to the left on most manifest variables of PRATAM. Other normality indexes, such as the Shapiro-Wilk normality test and standardized  $Z$  score for skewness and kurtosis, were all failed to generate the results to prove the assumption of normal distribution. The researcher tried several data transforming methods but none of the methods generated an acceptable normality data. Schafer and Graham (2002) suggested that the real data is rarely conformed to normality while Yuan and Bentler (2003) further commented that the data for social and behavioral sciences are seldom distributed normally. This current research, however, violated the normal distribution assumption of a parametric statistic approach.
4. This current research focused on belief-attitude-intention-behavior relationships of the WebCT online learning system. Several factors that may affect students' usage behaviors such as the organization support and classroom requirement were not considered in this research.

## 5.6 Further Research Recommendations

The recommendations for further research from the current research are listed as the following points:

1. The instruments used in the current research to assess students' actual system use were based on the self-reported design. While one study (Barnett, et al., 2006) found strong correlation between the self-reported and computer-recorded usage, another study conducted by Straub et al. (1995) found a low relationship between self-reported and computer-recorded measurements. Therefore, the results of the actual use of WebCT in the current research could be limited by the self-reported data. Additional studies that address the actual system use in both self-reported and computer-recorded usage will bring more understanding to the students' actual usage behavior toward the WebCT system. In addition, UCF discontinued the older WebCT Campus Edition (CE) 4.1 system and moved to the newer BlackBoard WebCT Vista (or Webcourses@UCF for differentiation purpose) system in Spring 2009 semester (University of Central Florida Course Development & Web Services, 2008). Other than the students' total hits, read, and posted record in the old WebCT system, the newer Webcourses@UCF system provided the enhanced function when recording students' usage. For example, the separated hits records and average spending time for different course tools are available in the newer system. Hence, the computer recorded usage data can be used to analyze the acceptance on not only the overall WebCT system, but also the individual features and course tools.

2. The current research only assessed the perceived resources based on the reflective measures. Mathieson et al. (2001) stated the formative measures as the other aspect of the measurement for perceived resources. The formative measures approach identified the specific resources perceptions that should directly influence the reflective perceived resources (Mathieson, et al., 2001), for example, training, documentation, and technical support. Lee (2008) also found that the itemized formative resources could directly impact the perceived ease of use and perceived usefulness. In addition, Ajzen (Ajzen, 1991) commented that the factors of resources vary across situations and actions. Mathieson et al. (2001) also noted that the formative resource items should be re-considered when assessing a new system. Therefore, a further investigation on the formative resource items in a WebCT online learning system will help to find out the potential leverage points for students' usage behaviors toward the WebCT system.

**APPENDIX A: UCF INSTITUTION REVIEW BOARD PERMISSION  
LETTER**



University of Central Florida Institutional Review Board  
Office of Research & Commercialization  
12201 Research Parkway, Suite 501  
Orlando, Florida 32826-3246  
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276  
[www.research.ucf.edu/compliance/irb.html](http://www.research.ucf.edu/compliance/irb.html)

### Notice of Expedited Initial Review and Approval

From : **UCF Institutional Review Board**  
**FWA00000351, Exp. 6/24/11, IRB00001138**

To : **Cheng-Hsin Ku**

Date : **September 04, 2008**

IRB Number: **SBE-08-05788**

Study Title: **Extending the Technology Acceptance Model Using Perceived User Resources in Higher Education Web-based Courses**

Dear Researcher:

Your research protocol noted above was approved by **expedited** review by the UCF IRB Chair on 9/4/2008. **The expiration date is 9/3/2009.** Your study was determined to be minimal risk for human subjects and expeditable per federal regulations, 45 CFR 46.110. The category for which this study qualifies as expeditable research is as follows:

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

A **waiver of documentation of consent** has been approved for all subjects. Participants do not have to sign a consent form, but the IRB requires that you give participants a copy of the IRB-approved consent form, letter, information sheet, or statement of voluntary consent at the top of the survey.

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Advise the IRB if you receive a subpoena for the release of this information, or if a breach of confidentiality occurs. Also report any unanticipated problems or serious adverse events (within 5 working days). Do not make changes to the protocol methodology or consent form before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <http://iris.research.ucf.edu>.


**Failure to provide a continuing review report could lead to study suspension, a loss of funding and/or publication possibilities, or reporting of noncompliance to sponsors or funding agencies.** The IRB maintains the authority under 45 CFR 46.110(e) to observe or have a third party observe the consent process and the research.

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 09/04/2008 11:24:25 AM EDT

IRB Coordinator

**APPENDIX B: INFORMED CONSENT LETTER**

	<b>UCF College of Education</b> <b>Extended Technology Acceptance Model Survey</b> Cheng-hsin Ku
<b>Informed Consent</b>	
<p>Dear Student,</p> <p>This is Cheng Ku. I am a Ph.D. student at UCF College of Education. I am working on a research study (Extending the Technology Acceptance Model Using Perceived User Resources in Higher Education Web-based Courses) with UCF faculty members, Dr. Stephen Sivo. The study is mainly focused on the relationships between students' beliefs, attitudes, intentions, and the actual usage behavioral on WebCT courses. The purpose of this study is to identify the variables that affecting students' acceptance and usage of the web-based learning environment.</p> <p>Two surveys will be administered in the fall 2008 semester. Both surveys should take no more than 15 minutes. Your participation in this study is voluntary. You must be at least 18 years of age or older to participate. You do not have to answer any question that you do not wish to answer, and you may choose not to participate in this study or withdraw this survey at any time. There are no anticipated risks associated with participation.</p> <p>The "Access Code" attached in the email will be used as the identity to match you answer from first and second survey. The access code is randomly assigned to you and will be kept confidential in a locked cabinet in my research and development laboratory at UCF Teaching Academy Room 321 and will be destroyed soon after the research process is completed. Your responses will also remain confidential to the extent provided by law and will be stored under an encrypted and password protected data system that is administered and maintained by Computer Services &amp; Telecommunications, only myself have the access to these data. Confidentiality will be maintained to the degree permitted by the technology used. No absolute guarantees can be made regarding the confidentiality of electronic data. The potential risk of breaches of confidentiality may result in such as embarrassment or stress within one's social group.</p> <p>The analysis of this study will be in aggregate form therefore no individual answers will be published or presented. There are no direct benefits or compensation for participation. However, your participation in this study is critical for the future improvement of online learning environment as Web CT, Webcourses@UCF, and Blackboard in higher education such, and your assistance will lead instructors and courses designers to provide better web-based contents and learning environments. If you agree participate in this voluntarily study and you are 18 years of age or above, please check the box and click "Submit" button below. If you do not want to continue this survey study at this time, please close this window. Thank you so much for your time.</p> <p>If you have any questions or comments regarding to this survey study, please feel free to contact me (<a href="mailto:cku@mail.ucf.edu">cku@mail.ucf.edu</a>, 407-256-9760) or my advisor, Dr. Stephen Sivo, UCF College of Education (<a href="mailto:ssivo@mail.ucf.edu">ssivo@mail.ucf.edu</a>, 407-823-4147). Research at the University of Central Florida is conducted under the oversight of the UCF Institutional Review Board. Questions or concerns about research participants' right may be directed to the UCF IRB office:</p> <p>University of Central Florida, Office of Research &amp; Commercialization, 12201 Research Parkway, Suite 501</p>	



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Please click the following box to verify that you are at least 18 years old and that you understand and accept the Informed Consent Statement.

I am at least 18 years of age and completing this survey constitutes my informed consent.

Submit


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## **APPENDIX C: SURVEY INSTRUMENT**



**UCF College of Education**

**Extended Technology Acceptance Model Survey**

Cheng-hsin Ku

**Instructions: Please circle one answer for each statement below.**

Please enter your **Access Code:**

---

**Part I: Preceptions attitude and intention**

**Ratings:**

<b>7</b>	Extremely Likely
<b>6</b>	Quite Likely
<b>5</b>	Slightly Likely
<b>4</b>	Neither
<b>3</b>	Slightly Unlikely
<b>2</b>	Quite Unlikely
<b>1</b>	Extremely Unlikely
<b>0</b>	Not Applicable

	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>Perceived resources (R) instruments</b>								
<b>1.</b> I have the resources I would need to use WebCT courses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>2.</b> I have access to the resources I would need to use WebCT courses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>3.</b> There are no barriers to my using WebCT courses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>4.</b> I would be able to use WebCT courses if I wanted to.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Perceived usefulness (U) instruments</b>								
<b>5.</b> Using WebCT in my class would enable me to accomplish tasks more quickly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>6.</b> Using WebCT would improve my class performance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>7.</b> Using WebCT in my class would increase my productivity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>8.</b> Using WebCT would enhance my effectiveness in my course work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>9.</b> Using WebCT would make it easier to do my course work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>10.</b> I would find WebCT useful in my course Work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Perceived ease of use (EOU) instruments</b>								
<b>11.</b> Learning to use WebCT would be easy for me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>12.</b> I would find it easy to get WebCT to do what I want it to do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>13.</b> My interaction with WebCT would be clear.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>14.</b> I would find WebCT to be flexible to interact with.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>15.</b> It would be easy for me to become skillful at using WebCT.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>16.</b> I would find WebCT easy to use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Attitude (A) instruments</b>								
<b>17.</b> WebCT is beneficial.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>18.</b> WebCT is positive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>19.</b> All things considered, my using WebCT is good.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Behavioral intention (BI) instruments</b>								
<b>20.</b> Assuming I have access to WebCT, I intend to use it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>21.</b> Given that I have access to WebCT, I plan to use it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>22.</b> It is worth it to use WebCT.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>23.</b> I will frequently use WebCT in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



- Less than once a week
- Not applicable

**25.** On the average, the length of time I spent every time I login on WebCT?

- More than 60 minutes
- Between 46 and 60 minutes
- Between 31 and 45 minutes
- Between 15 and 30 minutes
- Less than 15 minutes
- Not applicable

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**PartIII: Demographic**

---

**26. Please indicate your gender:**

- Male
- Female

**27. Please indicate your age:**

**28. Racial / ethnic groups:**

- Asian
- Black
- Hispanic
- American Indian
- Non-Resident Alien
- White
- No response

**29. Academics status:**

- Freshman
- Sophomore
- Junior
- Senior
- Graduate
- Non Degree Seeking
- Other

**30. Occupation Status:**

- Full-time worker
- Part-time worker
- No current employment
- No response

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**End of survey. Thank you for your participation in this survey.**

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