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This study examines the nature of web-based homework (WBH) by identifying the various factors inherent in the WBH learning environment and their impact on the performance of students. A primary contribution of this study is the longitudinal nature of the research to investigate how student perceptions change during the course of an academic semester. Our working definition of WBH is *a web-based learning environment where students solve homework problems and receive instantaneous feedback on their progress and performance*. Current research does not know the answer to critical questions such as: *What are the factors in a WBH learning environment? What is its impact on student learning? How does this impact change during the course of an academic term?* Based on the literature review, several theories from four disciplines, including education, psychology, technology and sociology were used to develop a theory-driven view of the WBH learning environment. The data suggest that mastery motives, engagement, locus of control, performance goals, self-efficacy, technical-efficacy, usefulness, lazy user, frustration, cooperative learning, perceived ability and GPA are relevant factors in a WBH learning environment and they impact student performance through the course of an academic semester. This study also found that the strength of these relationships change over the course of the semester. Future research will extend the study across disciplines and student bodies to extend the generalizability of the study.

A LONGITUDINAL STUDY OF WEB-BASED HOMEWORK

by

CYNTHIA J. KHANLARIAN

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TABLE OF CONTENTS

Page

LIST OF TABLES v

LIST OF FIGURES vii

CHAPTER

I. INTRODUCTION 4

Theory Driven View of WBH Learning 4
Research Questions 9
Research Design 9
Organization 10

II. THEORETICAL FOUNDATIONS 12

Theories of Learning 12
Web-Based Homework 31
Factors That Impact the Efficacy of WBH 33
Psychological Theories of Achievement 39
Modern Social Learning Theories 47

III. RESEARCH DESIGN AND METHODOLOGY 49

Construct Development 49
Instrument Development 50

IV. ANALYSIS OF DATA 72

Hypotheses Testing 118
Results 122
Results of Hypotheses Testing 127
Summary of Chapter 130

V. LONGITUDINAL ANALYSIS 132

Question Analysis 132
Path Coefficient Analysis 145
Hypotheses Testing 162
Summary 167

VI. CONCLUSIONS 168

Summary 168
Findings 169
Discussion 174
Limitations 179
Future Research 180

REFERENCES 181

APPENDIX A. SURVEY 193

APPENDIX B. COVARIANCE MATRIX 201

LIST OF TABLES

Page

Table 1: Learning Theories ... 6

Table 2: Mayer and Moreno: Multimedia Learning (2003) ... 21

Table 3: Based on Knowles (1968) Assumptions of Andragogy ... 24

Table 4: Selected Educational Technology Literature Review ... 26

Table 5: Liedner's Educational Method Research Variables ... 30

Table 6: Construct Reliability Table:
Cronbach's Alpha at Times T1, T2 and T3 ... 74

Table 7: Component Matrix with All Questions at Time T2 ... 76

Table 8: Component Matrix with All Questions at Time T1 ... 80

Table 9: Component Matrix with All Questions at Time T3 ... 82

Table 10: P Values for Correlations at Time T2 ... 87

Table 11: P-values for Correlations at Time T1 ... 89

Table 12: P-values for Correlations at Time T3 ... 91

Table 13: Significant Paths to the Y Variable ... 92

Table 14: Component Matrix at Time T2
(Dropping Items with Low Reliability) ... 93

Table 15: WarpPLS Report on Linear or Warped Relationship ... 95

Table 16: Regression Results ... 96

Table 17: Cronbach's Alpha ... 98

Table 18: Confirmatory Factor Analysis ... 99

Table 19: Construct Descriptions ... 101

Table 20: Literature Review of Construct Relationships 103

Table 21: WarpPLS Report on Warped or Linear Relationships 115

Table 22: Hypotheses Testing 120

Table 23: Item Loadings 123

Table 24: Composite Reliability and Average Variance Explained 124

Table 25: Fornell-Larcker Criterion to Test Discriminant Validity 126

Table 26: Results of Hypotheses Testing 127

Table 27: Question Analysis 133

Table 28: Total Effects 146

Table 29: Significance of Direct and Indirect Effects 148

Table 30: Summary of Changes in Relationships
Over Times T1, T2 and T3 150

Table 31: Frustration and Cooperative Learning Questions 152

Table 32: Cross Tabulation of Frustration2 and Coop2 at Time T2 154

Table 33: Cross Tabulation of Frustration2 and Coop2 at Time T2 155

Table 34: Cross Tabulation of Frustration2 and Coop3 at Time T2 156

Table 35: Cross Tabulation of Frustration4 and Coop1 at Time T2 157

Table 36: Cross Tabulation of Frustration4 and Coop3 at Time T2 158

Table 37: Cross Tabulation of Frustration4 and Coop2 at Time T2 159

Table 38: Cross Tabulation of Frustration4 and Coop3 at Time T2 160

Table 39: Results of Hypotheses Testing 163

Table 40: Significant Factors in the WBH Learning Environment 172

Table 41: Showing the Relationships Between the Factors in the
WBH Learning Environment 173

LIST OF FIGURES

Page

Figure 1: Wiley.com: 2009 Annual Report:
Higher Education Division Revenue by Source 3

Figure.2: Learning Continuum within the WBH Environment 5

Figure 3: Three Stages of Attribution (Weiner, 1972) 18

Figure 4: Achievement Can Be Attributed To: (Weiner, 1994) 19

Figure 5: Frustration! 35

Figure 6: Virtual Learning Environment Framework
(Piccoli et al., MISQ, 2001) 37

Figure 7: Bandura: Main Sources of Efficacy Information (1977) 42

Figure 8: Lazy User Theory of Solution Selection (Collan, 2007) 45

Figure 9:TTF and TAM, (Dishaw and Strong, 1999) 46

Figure 10: Schematic of Data Collection 71

Figure 11: Model Based on SPSS Factor Analysis 79

Figure 12: Model at Time T1 Based on Factor Analysis 81

Figure 13: Model at Time T3 Based on Factor Analysis 84

Figure 14: WarpPLS Model at Time T2 Based on Theory-Driven View 86

Figure 15: WarpPLS Model at Time T1 Based on Theory-Driven View 88

Figure 16: WarpPLS Model at Time T3 Based on Theory-Driven View 90

Figure 17: WarpPLS Model at Time T2 Based on PCA 94

Figure 18: WarpPLS Model at Time T1 Based on PCA 94

Figure 19: WarpPLS Model at Time T3 Based on PCA 95

Figure 20: WarpPLS Model at Time T2 Adding GPA 100

Figure 21: Mastery Leads Engagement ... 104

Figure 22: Engagement Affects Locus of Control ... 104

Figure 23: Engagement Affects Useful and Technical Efficiency ... 104

Figure 24: Performance Goals Affect Self-Efficacy ... 105

Figure 25: Self-Efficacy Affects Locus of Control
and Perceived Ability ... 105

Figure 26: Mastery Motives Affect Usefulness,
Self-Efficacy and Technical Efficiency ... 106

Figure 27: Self-Efficacy Affects Usefulness,
Technical-Efficay and Student Performance ... 106

Figure 28: Technical-Efficacy Affects Usefulness and Frustration ... 107

Figure 29: Lazy User Affects Usefulness ... 107

Figure 30: Cooperative Learning Affects Frustration ... 107

Figure 31: Usefulness Affects Student Performance ... 108

Figure 32: Locus of Control is Related to Homework and Test Grades ... 108

Figure 33: GPA is Related to Student Performance ... 109

Figure 34: Exploratory Research Model with All Constructs at Time T2 ... 110

Figure 35: Exploratory Research Model with All Constructs at Time T1 ... 111

Figure 36: Exploratory Research Model with All Constructs at Time T3 ... 112

Figure 37: Model using Jackknifing at Time T2 ... 113

Figure 38: Model using Jackknifing at Time T1 ... 114

Figure 39: Model using Jackknifing at Time T3 ... 115

Figure 40: Research Model at Time T1 Showing Significance ... 116

Figure 41: Research Model at Time T2 Showing Significance ... 117

Figure 42: Research Model at Time T3 Showing Significance ... 118

Figure 43: Research Model Hypotheses 119

Figure 44: Research Model Hypotheses Revisited 146

Figure 45: Cooperative Learning Moderates Frustration 151

Figure 46: Frustration Moderates Cooperative Learning 152

Figure 47: Research Model Relationships at Times T1, T2 and T3 161

Figure 48: Research Model Depicting Significant Changes Over Time 162

Figure 49: Research Model Revisited 170

Figure 50: Research Model Path Coefficients at Times T1, T2 and T3 171

Figure 51: Research Model Path Coefficients at Times T1, T2 and T3 174

CHAPTER I

INTRODUCTION

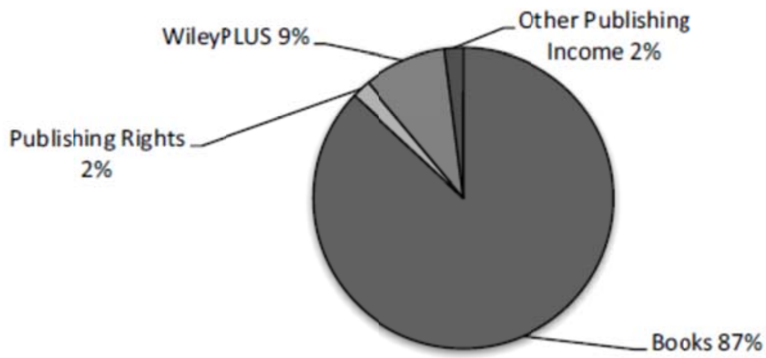
This study examines the nature of web-based homework (WBH) by identifying the various factors inherent in the WBH learning environment and their impact on the performance of students. A primary contribution of this study is the longitudinal nature of the research to investigate how student perceptions change during the course of an academic semester. Technology is widely used in education to support learning. Assessment mechanisms such as homework assignments and exams are increasingly completed online using WBH software (Dillard-Eggers et al., 2008). The growth in WBH suggests that research into its efficacy is both timely and important.

WBH has been explained in many different ways. *Computer-Assisted Instruction* applications involve an interactive computer program used for practice and test taking (Alavi, 1994). It has been called *web-based practice* (Nguyen and Gulm, 2005), *adaptive media* (Jones, 2008); and, recently, Palocsay and Stevens (2008) applied the term *Web-based homework* to Blackboard (a web-based platform technology), ALEKS (an intelligent diagnostic learning tool) and other web-based diagnostic and tutoring software packages. This study views WBH software as technology that allows students to solve homework problems and submit answers to questions presented online and to receive feedback. The working definition of WBH is *a web-based learning environment where students solve homework problems and receive instantaneous feedback on their progress and performance*.

The pervasive use of IT in the business sector and the technochanges (Bruque, Moyano, Eisenberg, 2008) that result from IT-induced change have had an impact in the classroom. In many places, the organization adopts IT and transforms the workplace, but at today's universities, the professor adopts the IT and transforms the learning environment. Now, millions of university students complete homework assignments online, using web-based homework (WBH) software provided by textbook publishers. WBH is based on the belief that practice is necessary for achievement and homework is assigned for practice, and the faster the students receive the feedback, the more they will learn (Pascarella, 2004). It is not free. Students must pay a fee to access the website and their work becomes the basis for part of their final grade in the course. WBH software often accompanies a course textbook. Students log into the website, read a question, submit an answer and receive immediate feedback.

Thousands of students currently use WBH, and this number will continue to grow as class sizes increase and distance learning evolves (Dillard-Eggers et al., 2008). In their 2009 Annual Report, (Figure 1) textbook publisher John Wiley and Sons wrote that their higher education division sales totaled $230 million with 9% of their sales attributed to WileyPLUS, their version of web-based homework solutions.

Figure 1: Wiley.com: 2009 Annual Report: Higher Education Division Revenue by Source



In 2009, McGraw-Hill launched Connect, an exchange that supports their web-based homework product. The McGraw-Hill Annual Report states, "The U.S. college new textbook market is approximately $4.3 billion and is expected to grow about 5% - 7% in 2010… As technology continues to be the key trend in higher education for course management and content delivery [we] will aggressively pursue a variety of e-initiatives, including electronic books, homework support for students and online faculty training (2009, 39)." McGraw-Hill offers web-based homework products in 38 different disciplines including foreign language, public speaking, philosophy and religion. For example, in the accounting discipline, Connect offers 24 different accounting textbooks, each with an associated homework web site.

WBH has become a very important phenomenon and yet scholars know very little about it, its character, its composition, the nature of its impact on students and how that impact evolves over an academic term. Current research does not know the answer to critical questions such as: *What are the factors in a WBH learning environment? What is its impact on student learning? How does this impact change during the course of an academic term?* These questions are at the center of the research study presented here.

This chapter introduces the study by presenting existing, relevant research in learning, education and educational technology. The chapter will then introduce the various factors that may influence student learning in the WBH environment and provide an outline of this study, including the primary areas of investigation and the expected contributions.

Theory Driven View of WBH Learning

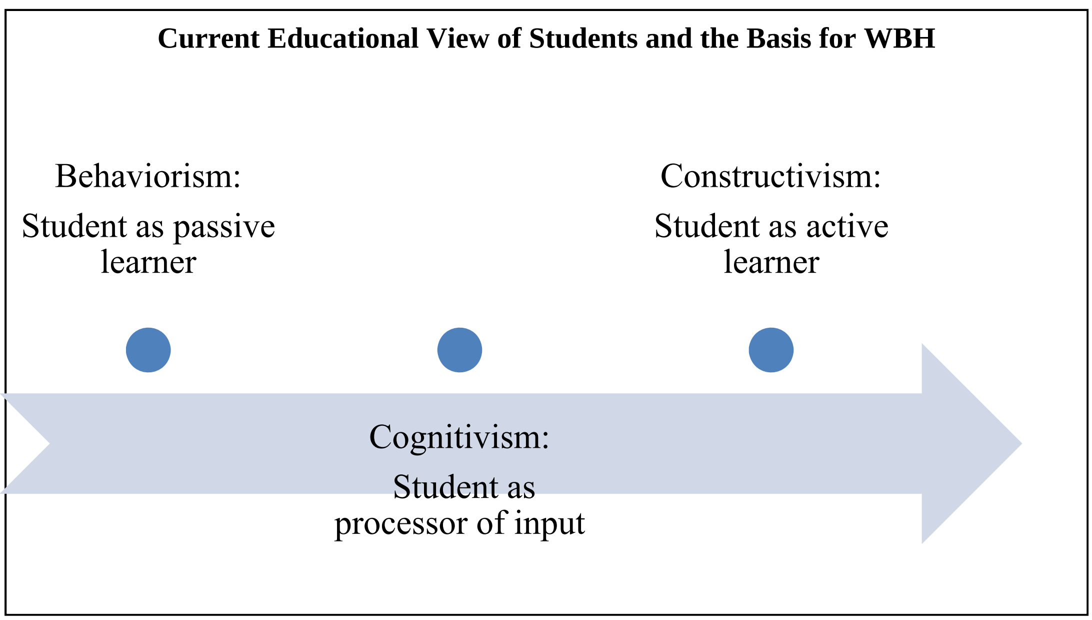
Piccoli (2000) wrote that the traditional definition of a learning environment involved a set time, a set place and a space where students met with a teacher to learn. He examined the modern learning environment and added that it could also include technology, interaction and student control. In light of his findings, it suggests that perhaps there are other significant factors in the WBH learning environment.

Theories of Learning

Through the years, scholars have identified many methods that enhance learning. The history of contemporary educational theory recognizes behaviorism as the beginning of a development of learning theory (Mowrer, 1960) followed by theories of cognitivism and constructivism (Mowrer and Klein, 2001). Contemporary theories of learning view the student in a variety of modes, including the student as a passive learner, the student as a thinker and the student as an active learner (Bower and Hilgard, 1981).

B.F. Skinner defined learning as "a change in probability of response" (Skinner, 1950, 193). As seen in his work, behaviorism presents an environment that trains the student to perform. Cognitivism holds the student as a unique organism who views the world differently from all others and processes input from his or her distinct perspective. Constructivism is based on the belief that people learn by finding relationships between new concepts and their current understanding of a topic. The three major areas of behaviorism, cognitivism and constructivism portray learning along a continuum based on how actively involved the learner is. In the WBH learning environment, behaviorism's feedback is presented, cognitivism's thought processes are encouraged and constructivism's active problem solving skills are nurtured. This continuum is depicted in Figure 2.

Figure.2: Learning Continuum within the WBH Environment



Aspects of each learning theory appear relevant to the WBH environment. This is summarized in Table 1.

Table 1: Learning Theories

	Behaviorism	Cognitivism	Constructivism
Associated theory:	Bandura's Social Learning Theory	Mayer's Theory of Multimedia Learning	Bruner's Discovery Learning
The Learner:	Passive (waiting for a stimulus)	Thinking (brain as a black box: input is processed)	Doing (based on experience)
Learning is seen:	In the change in behavior	In the change in the mental model	In the process of learning
Function of Teacher:	Applies positive or negative reinforcement	Provides active participation	As coach and analyzer
To teach:	Present stimulus	Provide ideas and offer possibilities	Present tasks

Psychological Theories of Achievement

Herbert Simon wrote that "motive and emotion are major influences on the course of cognitive behavior" (Simon, 1967, 29). Dowson and McInterney (2004) suggest that a range of achievement goals could possibly affect a student's learning outcomes. Elliott and Dweck (1988) reported students generally exhibited either a performance goal (generally extrinsic) or a learning goal (generally intrinsic). When a learning goal was highlighted, students choose learning at the risk of displaying mistakes to increase their competence. But when a performance goal was selected, students tended to sacrifice learning and choose a moderately difficult task to display their competence or an easy task to avoid looking incompetent. Psychological theories of achievement have an impact on the learning environment in WBH.

Technology and Education

Thorndike believed that it served no good purpose to pose a question on one page and the solution on the next page. Students would look at the solution before they tried to solve the problem. He wrote, "*If, by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print*" (Thorndike, 1912, 165). Skinner wrote,

> The public school was intended to bring the services of a private tutor to more than one student at a time. As the number of students increased, however, each student necessarily received less attention. By the time the number had reached 25 or 30, personal attention had become sporadic. Textbooks were invented to take over some of the work of the tutor, but two problems remained unsolved. What is done simultaneously by every member of a large group cannot be evaluated immediately, and what is taught to a large group cannot be precisely what each student is ready just at the moment to learn. Teaching machines were invented to restore these important features of personal instruction (Skinner, 1986, 103).

In both quotes, scholars turned to technology to solve teaching problems. Skinner's machine provided a series of questions formulated to present material that the student had never seen before. Answering a question correctly led to the next question in the series. He called this "programmed instruction" on a "teaching machine". These teaching machines became the precursors of the WBH learning environments of today.

Theories of Technology

Theories of technology are based on human development, adoption and use of a particular tool. Technology is defined as: "the branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment" (Random House Dictionary, 2009). Technicism refers to a sense of optimism associated with technology and the hope that future technology will be able to solve social problems that exist today (Mowshowitz, 1981). This attitude is prevalent in modern education and makes new uses of technology such as web-based homework software more likely.

Modern Social Learning Theories

Learning theories have changed over the past fifty years. Teachers now recognize that learning can occur without any visible outward sign as opposed to Skinner's "probability of response," and more scholars recognize that being part of a group can assist learning. Simon and Feigenbaum (1964) presented an information-processing theory of effects of similarity, familiarization, and meaningfulness in verbal learning that tested human memory using different methods to present information. This theory holds that learning is a process of building on previous knowledge and is enhanced through verbal cues (and verbal cues can only come from other people). Working on a task such as completing homework problems using web-based software should help students learn after listening to the lecture in class.

Therapist Carl Rogers' facilitation theory, also known as humanistic theory which led to student-centered learning (Rogers, 1951), stated that learning relied on human relationships. Rogers also believed that people are not happy unless they are productive and constantly improving. From this perspective, the benefits of WBH seem ambiguous. The teacher becomes more of a facilitator than instructor when the software is used, and there is very little contact between teacher and student. If learning is a function of personal relationships, then WBH would not be beneficial since there is no personal contact. Additionally, Rogers believed that learning could only occur when the student was in a nurturing environment. Although WBH should be non-threatening, repeated failed attempts can be emasculating to the student.

These technical, social and psychological learning theories serve as the basis for the development of the theory-driven view of the WBH learning environment presented in detail in Chapter Two. This theory-driven view guides the development of the research model to answer the research questions.

Research Questions

This study will examine the following three research questions:

1. What are the factors in the WBH learning environment?
2. How do these factors relate to each other?
3. Do these relationships change significantly over time?

Research Design

Trautwein and Köller (2003) propose that further study is needed to examine the relationship between homework and the manner in which students exert control over their own lives. Trautwein and Köller suggest the use of longitudinal data and structured equation modeling as an appropriate research design to conduct the study. Longitudinal studies are co-relational as they involve repeated measures of the same items over time. A cohort study involves observations of people who share a characteristic. This research will conduct an in-depth, longitudinal study of accounting students using WBH software. A longitudinal study of students' use of software to complete course requirements is appropriate since learning is a process that involves perception, experiences, cognition and behavior (Kolb, 1984). Experience changes one's perceptions, future experiences, and understanding of future events as well as one's future behavior (Dewey, 1913). Thus, "learning is the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, 38). A longitudinal study can provide some answers that are not available through cross-sectional studies. This study will provide insight into factors that affect student performance on a longitudinal basis.

This design will allow an examination of several major factors. The relationships between the WBH environment and student performance as measured by homework grades and test scores will be examined. Changes in the student's perception of the usefulness of the WBH environment over time will be evaluated.

This study will use existing scheduled classes. Roughly 100 accounting majors will be using Wiley Plus WBH for financial accounting, sixty non-majors will be using Connect by McGraw Hill for financial accounting, and the remaining 200 students taking managerial accounting, a mix of majors and non-majors, will be using Cengage Now. The students will be required to work all homework problems using the WBH software. The assignments will be composed so that some problems will be required and others will be optional. Data will be collected about three weeks into the term. Eight weeks into the term, which will be after the mid-term exam, a second data collection will commence. At the end of the semester, fifteen weeks later when the final exam is taken, data will be collected a third time. A confirmatory factor analysis will be performed and multiple models will be created using appropriate SEM tools. T-tests will be performed to examine response and performance differences between T-1 and T-2, between T-2 and T-3, and between T-1 and T-3.

Organization

Chapter One has introduced the overall context of the study. Chapter Two will further develop the theory driven view of the WBH learning environment by reviewing the literature. Chapter Three will present the construct development and the creation of the instrument. Chapter

Four presents the results of the exploratory study to determine the significant factors in the WBH learning environment. Additionally, Chapter Four will present hypotheses to test the impact of significant factors in the WBH learning environment on student performance. In this respect, Chapter Four will address the first and second research questions. Chapter Five will present the result of the longitudinal examination of how the impact of the significant factors in a WBH learning environment on student performance changes over time. Chapter Six will conclude the study and present limitations and directions for future research.

CHAPTER II

THEORETICAL FOUNDATIONS

A significant assumption behind WBH is that learning is technologically facilitated. The various qualities of the medium impact the learning and motivation of the learner. But each student is also affected by a variety of psychological and sociological factors which are part of the student's learning environment. This chapter will examine the various theories surrounding such individual aspects. In particular, this study will build on previous research that explains students' behaviors in technologically mediated learning in order to develop a theoretical foundation for an integrated and holistic examination of student learning in a WBH environment. A unique aspect of this research is the longitudinal nature of the study which attempts to assess the pervasiveness of the relationships between the learning theories, psychological factors and social factors on student performance in a WBH environment. In particular, this study attempts to determine if these relationships change over time. This understanding currently does not exist and would be useful to form instructional strategies in this emergent environment.

Theories of Learning

Thousands of students currently use WBH software in math, chemistry, physics, information systems and accounting, but it is not the number of students or the amount of money spent on it that makes it worthy of study. It is important because it is an attempt to improve student learning based on two hundred years' worth of theory, speculation and research by people who cared passionately about understanding how people learn.

Behaviorism

From the studies of Thorndike and Pavlov in the late 19th and early 20th centuries through the 1960s, behavior theorists developed "global" theories of learning, that is, theories that attempted to explain all aspects of the learning process (Mower and Klein, 2001, 2).

Edward Lee Thorndike (1912) studied animal behavior and the learning process. He experimented with cats in puzzle boxes, recording the amount of time it took for them to accidentally discover the way out. Every time the experiment was run the amount of time it took for the cat to escape decreased. This observation resulted in his "law of effect" which stated that the more satisfying an event was in response to a stimulus the more likely that response would be given in the future. He followed the "law of effect" with "the law of exercise" meaning that the more an activity is performed or exercised, the stronger the bond will be between the stimulus and response. However, Thorndike later revised his theories since he found that exercise alone will not produce results. He added the need for feedback in his law and supplemented it with the knowledge that reward and punishment were not equal as reinforcement. In further experiments he found that reward always strengthened a relationship while punishment weakened it a little or not at all. WBH, as well as computer based learning in general, can provide a stimulus in the form of a problem for the student to solve. Each time it is solved correctly, the student is rewarded with a feeling of satisfaction which will then strengthen the bond between homework and satisfaction.

Building on Thorndike's work, Sidney Pressey created a machine in 1925 to allow students to drill and practice. It had a design similar to that of a typewriter except it had four buttons. A question would be presented in a window, followed by four answers. The student would press the button corresponding to the correct answer. The machine would record the student's answer, and at the end it would tabulate a score. The device could be set up so the student must answer correctly before going to the next question. This option is still available in some current WBH software. In 1962, Pressey wrote about his "teaching machine":

> …the student first looked over a reading assignment, laboratory exercise, or other material, and only after some such first contact with the matter to be learned did the auto instructional procedure present carefully chosen questions on that matter, immediately appraise each answer, and if it was wrong indicate or guide to the correct answer. The auto-instruction thus functioned like a good teacher or tutor who, after a student is presumed to have made some effort to deal with an assigned task and as an adjunct to that effort, asks questions pointing up the important and possibly difficult issues, and explicates each if difficulty appears… (Pressey, 1962, 30).

Ivan Pavlov (1927) developed a well-known conditioning procedure where dogs were trained to salivate at the ringing of a bell. This involuntary response was called association; for teachers who dealt with students who did not care about learning, the involuntary response mechanism was seen as a way to teach. Teachers could present the material so often that it was "learned" in spite of the student.

In 1913, John B. Watson wrote, "Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior" (Watson, 1913, 158). Behaviorism is based on the premise that everything an organism does is a behavior, including thinking, acting and feeling. Watson even stated that thought was just an instance when a person talked to himself. Watson performed a series of experiments in which he conditioned a baby to cry when shown a mouse. Watson called it a conditioned response. Conditioned responses in education include the use of flash cards for multiplication tables. Repeated use of the cards over time should stimulate the correct response.

B. F. Skinner (1904-1990) also studied the stimulus response and found that the rate at which an animal pressed a bar for food did not rely so much on what preceded the action – it depended more on what followed. He called this operant conditioning and began investigating behavior-consequence relationships (as opposed to stimulus- response) by experimenting with positive and negative reinforcement and observing how behaviors were strengthened or weakened by time lapses between behavior and consequence. Contiguity or the amount of time that passed between stimulus and response was an important factor in determining the strength of the response. Operant conditioning relies on reinforcement to make it more likely to occur again. "A positive reinforcer strengthens any behavior that produces it, such as being rewarded with food for pressing a bar. A negative reinforcer strengthens any behavior that reduces or terminates it" (Skinner, 1976, 51) such as removing a shoe that was too tight. He continued,

> When a given act is almost always reinforced, a person is said to have a feeling of confidence**.** A tennis player reports that he practices a particular shot 'until he feels confident'; the basic fact is that he practices until a certain proportion of his shots are good. Frequent reinforcement also builds faith. …. When reinforcement is no longer forthcoming, behavior undergoes 'extinction' and appears rarely, if at all. (Skinner, 1976, 64).

From this, it appears that practice is necessary in order to master a skill and build faith in one's ability to perform said behavior on command. Skinner believed that education was simply a matter of reinforcement of behavior. He wrote:

> …a teacher arranges contingencies under which the student acquires behavior which will be useful to him under other contingencies later on. The instructional contingencies must be contrived; there is no way out of this. The teacher cannot bring enough of the real life of the student into the classroom to build behavior appropriate to the contingencies he will encounter later (Skinner, 1976, 202-203).

In 1953, Skinner observed a fourth grade math class and watched as the teacher tried to teach a group of children with different skills, aptitudes and learning styles. He realized that students often had to work many problems before they were given any feedback and that they could not work at their own pace. As a solution to this problem he created a teaching machine. Over the years, he came to believe that teaching was possible using a machine if the material was broken into small steps, each building on the other and if feedback was presented immediately (Skinner, 1954). He used a programmed instruction technique to teach his students at Harvard on a teaching machine. This was the beginning of the instructional design movement and programmed instruction (Cooper, 1993).

Behaviorism as a learning theory proposes that immediate feedback and reinforcement will strengthen desired behaviors in organisms, including students. Since cats can "learn" to escape from puzzle boxes, people should be able to learn much more complicated tasks and concepts using the same operant behavior techniques. Repeated exercise with the right environment and immediate feedback should produce the desired behavioral results in people. However, later studies examined the feedback given to students and found that, under some circumstances, it was more powerful if it was delayed. Also, "student control of feedback can lead to students not interacting with the material if they can obtain the feedback without doing so. The feedback then lacks value" (Cooper, 1993, 12). Cooper also wrote,

> …while feedback (reinforcement) is an effective tool, the quality of feedback is dependent upon the quality of information that it imparts to the learner; which, in turn, is a function of the diagnostic ability of the program. Feedback mechanisms which only provide a bare-bones indication of correct or incorrect response perform relatively poorly (Cooper, 1993, 13).

Most WBH accounting software only shows whether the problem is "right" or "wrong"; so although Thorndike's work leads one to believe the feedback should be wonderful for reinforcing the correct responses, it is only bare-bones and does not seek to diagnose the error if a student performs incorrectly which Cooper reports will result in poor performance.

The two critical elements of behaviorism are feedback and reinforcement, both of which are mainstays in WBH software use. These critical constructs of behaviorism have not been studied in the context of WBH. This study intends to examine feedback and reinforcement in WBH and their impact on student learning over time. Based on behaviorist theory, more use should strengthen the desired behavior which should create the desired results over time. In other words, as students use the software and learn the material, they should perform better on tests which will be reinforcement to encourage them to work more homework problems on new material. Thorndike, Pavlov and Skinner each believed that behaviors were performed in order to receive something which was desired. Thus, if a student desires an "A" in an accounting class, the student should work homework problems and read the textbook in order to earn the desired grade which should reinforce the behavior. Based on Skinner's belief that contiguity of response is important, WBH software should strongly reinforce the desired pattern of homework completion, thus helping the student to retain knowledge of how to work the problems.

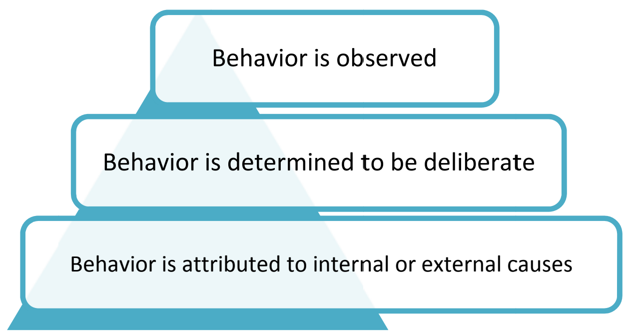
Cognitivism

Theories of learning that focus on mental representations are called "cognitivist" (Wortham, 2003, 6). William James (1842-1910) wrote, "Psychology is the science of Mental Life, both of its phenomena and their conditions. The phenomena are such things as we call feelings, desires, cognitions, reasonings, decisions and the like" (James, 1890, 1). Cognitivism is primarily concerned with mental processes and faculties, thought, self-awareness, intuition and perception (Uttal, 2000).

Bernard Weiner (1972) is credited with developing attribution theory. He studied people's perceptions of causality or why people believed certain events occurred. He wrote that the allocation of responsibility for an event guides subsequent behavior. For example, if Student

A asks to borrow notes from class, Student B will help if B perceives that A is needy and of low ability (external cause and not his fault or under his control) because A probably could not take good notes anyway. But if Student A is perceived as capable but lazy, Student B will be less likely to help because B figures A was just goofing off (internal cause, his fault and under his control) and deserves whatever happens (Weiner, 1994). Student B is attributing Student A's lack of notes to a cause he only perceived to happen. His three stages are summarized in the following Figure 3.

Figure 3: Three Stages of Attribution (Weiner, 1972)



Weiner (1994) performed an experiment where students had to determine if the next number drawn was "0" or "1". The numbers had been previously determined so the students had nothing to do with obtaining the next number but they did not know that. Afterwards, they were asked to evaluate their performance as successful or unsuccessful and then to determine whether the outcome was due to their effort, luck, ability or the difficulty of the task. This is shown in Figure 4.

Figure 4: Achievement Can Be Attributed To: (Weiner, 1994)

Students who measured higher in achievement motivation responded that a successful outcome was due to their effort and unsuccessful outcomes were due to their lack of effort. This was indicative of an internal locus of control that showed they believed they had control of the ensuing event. Students who measured lower in achievement motivation responded that their efforts were only partially responsible for their success but their failure was a result of their lack of effort *and* their lack of ability. Therefore, in terms of persistence of behavior, students who are more highly achievement motivated believe their failures are due to lack of effort and so they prepare to work harder in order to succeed. But students who are less achievement motivated believe their failures are due to lack of effort and lack of ability and therefore may quit trying before they succeed. Students who believe their failure is due to their lack of ability may feel shame and embarrassment and decrease effort in the future. Based on this, students who profess to being determined to succeed in an accounting course should persist at their homework until they complete all of it correctly and students who are less achievement motivated may quit trying before the end of the course

One major difference in the high and low achievement motivation students is that highly achievement motivated students are more apt to initiate activities and work with greater intensity and persist longer in the face of failure. Weiner calls the persistence in the face of failure "frustration tolerance". So the frustration tolerance level of students could be an indicator of their future success. Students who believe their own hard work can overcome hurdles will keep trying, but students who believe their own lack of ability will make the effort pointless will give up. However, since WBH is computer-based, it introduces another frustrating feature. Students must master accounting skills while dealing with computers which are notorious for their ability to drive people crazy. In this case, "frustration tolerance" takes on a new and broader meaning.

The theory of multimedia learning grew out of an attempt to combine educational technology and educational theory. Mayer and Sims (1994) performed experiments where children viewed a computer-generated animation and listened to a narration. One group experienced the two simultaneously, while the other group heard the narration after viewing the animation. They found that the group that experienced the two simultaneously exhibited more retention. They believe that multimedia learning occurs when students are given information in two or more formats so that multiple senses are used. This includes sight and sound but can also include text and illustrations or graphs. Mayer and Sims also believe prior experience related to a specific domain area of the lesson being presented is important. They believe the students with extensive experience in the area can relate the new material to their existing knowledge even if only one sense is affected. Students with no prior experience who view the animation cannot relate the new material to anything and so forget it before they hear the narrative (Mayer and Sims, 1994). Mayer and Moreno (2003) assume the human mind works based on the dual-channel assumption, the limited capacity assumption, and the active processing assumption as shown in Table 2. When using WBH software, even though the student is basically reading a problem and answering it, the question and answer are presented using a medium that is not standard and is presented with colors and figures so the student should exhibit more retention of material after working homework problems and receiving feedback.

Table 2: Mayer and Moreno: Multimedia Learning (2003)

Three assumptions about how the mind works in multimedia learning	
Dual Channel	There are separate information processing channels for verbal and visual input
Limited Capacity	Only a limited amount of processing capacity is available in either channel
Active Processing	Learning requires substantial cognitive processing in the verbal and visual channels

In short, cognitivism views learning as a black box process. Since the brain cannot be opened and observed in operation, scientists are left to imagine how learning is performed. Their studies have found that learning which involves more senses is better and that individual learning is often dependent upon individual characteristics. One basic common characteristic of achievement oriented learners is persistence. Effort, ability, task difficulty and luck are all viewed as determinants of success. From this perspective, one might conclude that WBH could be used by a persistent student to overcome task difficulty and complete the assignment.

Constructivism

Constructivism is the belief that learners use their prior experience and knowledge as a basis from which they make connections and build their own set of content to solve problems.

Knowledge is personally constructed by individuals using their own experiences as a foundation. Constructivism operates on the premise that the learner, rather than the instructor, is the center of education. The teacher becomes a coach who directs projects that offer problems to be solved. The critical elements are learner inquiry, discovery and self-motivation. The onus of learning should be on the learner.

Experiential learning, a theory developed by Kolb and based on the work of Dewey, Piaget and others, is a process that reflects learning as it occurs through our experiences (Kolb and Kolb, 2005). It is based on the belief that all the events in a person's life shape that individual and influence him/her forever, and so learning is a process. One must move back and forth between opposing modes of reflection, action, thinking and feeling in order to learn. Kolb wrote that learning is a holistic process of the way a person adapts to the world. It involves mental and emotional perceptions. Such learning creates knowledge, but that knowledge is personalized for each student. Explaining account balances to someone who has never maintained a checking account is rather like explaining colors to the blind. Some WBH software is capable of determining a student's knowledge in certain topical areas, but most is simply for grading homework.

Discovery or active learning is based on the idea that learners may remember more if they discover relationships and truths on their own and add that knowledge to their own mental model. Discovery learning works on the assumption that learners are mature, self-motivated, and experienced enough to guide their own learning experiences. The instructor is a guide or facilitator to help the students with their active learning. WBH can offer simple questions to beginners that progressively become more complicated as the student learns.

The cooperative model of learning allows individuals to interact with other people to improve their mental models by discussing and sharing information (Slavin, 1991). Students reported they were happier and learned more when working in a group. Other research has shown that people who cooperate begin to like each other (Slavin, 1991). Cooperative learning has been shown to be superior to individualistic instruction in some areas (Leidner, 1995). WBH software was designed to be used by an individual, but it has the capability to offer the same problem to two different people yet have different numbers. This allows students to work in groups to solve the overall problem while working individually to solve their particular version.

Constructivism is based on the student's desire to discover, problem solve and interact with other organisms. Each student's mental model makes him/her unique, creating a problem for the teacher. If every student is unique and comes to the classroom with different levels of knowledge, attempting to have all of them learn the same topic at the same time will require the customizable ability offered by computers. Since each student cannot have a personal tutor, software that can present problems a step at a time can be very useful.

Andragogy and Pedagogy

The theory of andragogy was created by Malcolm Knowles (1913 – 1997) in 1968. Knowles wrote that all the great teachers in our history including Socrates, Plato, Aristotle, Jesus and Confucius were teachers of adults. To them, learning was a process of inquiry. The learner wanted to learn and directed the teacher who became a guide. They used a case method which often involved telling a story or they taught by asking questions. Andragogy is a learner-centric approach and is based on fixed assumptions about the learner as an adult. Over time, children became the students instead of adults and different methods of teaching were practiced. Knowles recognized that adult students were different from children and should be taught differently as seen in Table 3. Since college students cover all ages and maturity levels, andragogy might be applicable.

Table 3: Based on Knowles (1968) Assumptions of Andragogy

Assumptions of Andragogy (Knowles, 1968)	
"Need to know"	Adult motivation lies in "Why" they need to know
"Self-concept"	Adults dislike being told what to do. They have an identity outside the class.
"Life experience"	Adults have experiences that children have not had.
"Readiness to learn"	When adults believe the material will be helpful, they learn it.
"Orientation to learning"	Adults expect learning to be task and job related instead of passively obtaining unrelated information
"Motivation to learn"	Adults are generally self-motivated to work for a better lifestyle. They can be "put off" when a teacher wants to be an authority figure

Knowles (1973) proposed that there is a difference between teaching (for which the term pedagogy is used) and teaching adults (andragogy). His work suggested that adults were more self-directed, experienced, and self-motivated as well as being more attuned to problem solving. They also have a better understanding of the gaps between where they are and where they want to be. After Knowles, there were studies of andragogy in distance learning (Means, Toyama, Murphy, Bakia and Jones, 2009; Isenberg, 2007; Burge, 1988), andragogy as a theory or teaching method (Davenport and Davenport, 1985), and as a construct that focuses on self-directed or learner controlled learning (Merriam, 2001; Pratt, 1988). The studies concluded that adults do not behave or learn in the same ways that younger students do but tend to devote time and energy to topics they believe will be useful. Since they are more self-directed, they should appreciate that some WBH programs allow students to work additional problems if they feel they need more practice.

WBH software appears to be an appropriate epistemological tool for use by adults since its use is self-directed, is task and problem centered, is a virtual recreation of actual accounting problems and allows for independent study and experimentation.

Technology and Education

The US Office of Technology Assessment defines computer-managed instruction as the use of a computer to score tests, interpret results, manage student records and information and prepare material that is used away from the computer (1982). Computer-assisted instruction allows the student to receive individualized instruction by interacting through the computer, using instructional material logic. According to Liedner and Jarvenpaa (1995) and Piccoli, Ahmad and Ives (2001) computer-assisted learning should benefit students when the student can control the pace of learning and receive frequent feedback. WBH is an example of computer-assisted instruction, and it can be set to offer timed or untimed problems. Instructional or educational technology refers to any form of computer-mediated or computer-moderated communication tool that supports the learning process. However, technology is a term that includes the use of PowerPoint slides and response devices as well as interactive software. The basis for the use of educational technology lies in its ability to offer timely feedback as that should enhance learning and as a tool to promote interactive and active learning asynchronously or synchronously (Jonassen, 1990). Gagné (1973) suggested that the computer can be employed to display, respond and give feedback; thus it can be many things to many people. Distance learning owes much to the technology that allows the student to communicate and access materials as if they were on campus. Much of the current educational technology is based on behavioral techniques while the epistemology of education now is focused on the constructivistic belief that knowledge is personally constructed. This is a conundrum since technology is used to bypass much construction while many of the electronic tools used in education assume a specific knowledge of use. If the application of technology in the WBH learning environment focuses on a stimuli response behavioral model, the constructivist view where students create their understanding of the subject matter by doing may be bypassed.

There is also disagreement about the benefits of using educational technology. Some studies find significant improvement in learning or satisfaction when using technology while others find no difference between learning using technology and learning without technology as shown in Table 4. One study found a significant decrease in performance when technology was used instead of paper and pencil (Demirci, 2007).

Table 4: Selected Educational Technology Literature Review

Selected Review of Educational Technology Literature (based on key word searches)	
Author, Date	**Findings**
Alavi, 1994	Found a significant relationship between group decision support system and learning and student satisfaction.
Ocker & Yaverbaum, 1999	Used asynchronous communication for a group project and found learning outcomes were not statistically different from a group that used face-to-face communication, but students using technology were **less** satisfied.
Greenlaw, 1999	Used groupware in class and reported subjective evidence showing its use had the potential to change the nature of teaching and learning.
Rankin & Hoaas, 2001	Use of PowerPoint in economics classes did not significantly affect student performance.
Picciano, 2002	Examined interaction in an online course as an element of student performance and found no significant relationship.

Young, Klemz & Murphy, 2003	A study of educational technology based on Kolb’s learning styles found no significant relationship between a particular style and a specific technology but did find a significant relationship between learning outcomes and the use of PowerPoint.
Wang, 2003	Found a significant positive relationship between satisfaction and intention to reuse an electronic learning system and a significant negative relationship between reusing the system and complaints about the system.
Cole & Todd, 2003	Found WBH did not improve student learning but did reduce grading time.
Bonham, Deardorff & Beichner, 2003	Compared student performance over several years using paper or web based homework and found no significant difference.
Cheng, Thacker, Cardenas & Crouch, 2004	Compared physics students’ WBH to ungraded traditional homework and found online homework students’ performance on tests was significantly better.
Saadé & Kira, 2004	Found use of an interactive web page improved test scores.
Susskind, 2004	PowerPoint use resulted in positive attitudes and greater self-efficacy.
Pascarella, 2004	Compared WBH in physics classes to traditional. Found WBH hindered metacognitive behaviors due to guessing.
Hauk & Segalla, 2005	Compared use of WBH in algebra to paper based and found no difference in performance. Suggest it is at least as effective as paper- based.
Lippincott, et al. 2006	Found that the use of technology to grade homework & provide additional study was preferred by students because they felt it helped them learn.
Bates & Waldrup, 2006	Found that there was no significant statistical difference in student satisfaction or learning when using PowerPoint in a class.
Teeter et al. 2007	CRS (clickers) increased student satisfaction & perceptions of effectiveness.
Demirci, 2007	Students using paper homework performed significantly better than WBH.
Zerr, 2007	Students used WBH created by the professor on Blackboard. He found a significant increase in test scores.
Chen, Lin & Kinshuk, 2008	Found that overall satisfaction of e-learning is related to the frequency of negative incidents.

Palocsay & Stevens, 2008	Found no difference in student performance using WBH compared to traditional homework.
Dillard-Eggers, et al. 2008	Found evidence that WBH increases student performance and satisfaction.
Jones, 2008	Used WBH in accounting classes and found it enhanced learning but students did not think it prepared them for tests.
Roth et al, 2008	Used WBH in math classes and collected data on student responses to understand student answer strategies.
Peng, 2009	Studied WBH and found individual intrinsic motivation and computer efficacy were important in determining system usefulness.
Lenard, Wessels & Khanlarian, 2010	Accounting Information Systems classes that required students to use spreadsheets, databases and accounting software resulted in significant increases in the students' self-confidence. Also, females had significantly higher grades than males in the course.
Jonas & Norman, forthcoming	Found that students realized the benefits of using the free websites hosted by textbook publishers, but did not use them because the teacher did not require it.

In summary, there are: two studies of groupware, both showing positive results from its use; four PowerPoint studies, half showing positive results and half showing the opposite; eleven WBH studies, four showing no difference, four showing improvement and three showing the reverse and one study that revealed that even useful websites are not used unless credit is given by the professor. The studies do not reveal whether students generally embrace technology or if there is a universal aversion to it. The literature is inconclusive about technology use in general or any one method in particular. However, most of these studies focus on a small piece of the artifact and do not view it in its holistic entirety or study it longitudinally. This study attempts to view WBH software in a larger frame. Behaviorism suggests that feedback will help students learn. If so, WBH should fulfill the feedback function. The principles of andragogy suggest self directed problem solving will help students learn. WBH software can be used at the student's own speed to solve problems but no one has examined its use throughout the semester. Several educators suggest the teacher should gain a student's attention in order to teach. WBH software often ignites sparks of interest, but no study has examined whether the novelty effect wears off over time.

Another perspective was offered by an Information Technology User Services instructor who was employed to teach workshops to faculty and staff on how to use educational technology. She found that her audience wanted a "really good show" but did not want to read the manual, practice or expend much effort. Since people could use the 24 hour-banking machine and get money by pushing a few buttons or destroy alien invaders by pressing circles on a game controller, they thought computers would save them a lot of time and effort so they did not want to spend any time or effort learning how to use them. She suggested that her students should investigate the topic before coming to class so they would get the most out of attending (Bahr, 1983).

Simon wrote that whatever technology is used, teachers should keep in mind two basic principles. First, the focus should be on the learner. "Learning takes place in the head of the learner and depends entirely on the activities of the student ….The activities of teachers, and the impact of textbooks or lectures or electronic displays influence education only to the extent that they affect the behavior of the students" (Simon, 2002, 62). Second, the teacher should analyze the learning task and design the technology to fit the task. The technology should not be used just because it is available. Use it if it enables teachers to do a better job of teaching by blending technology and learning theory or if it motivates students to persist longer.

Liedner (1995) investigated the use of educational technology and created a table (Table 5) of variables that should be studied further.

Table 5: Liedner's Educational Method Research Variables

Educational Method Research Variables: Liedner, 1995		
Self-variable	**Definition**	**References**
Self-efficacy	The degree to which a student feels capable of learning from a given method	Cennamo 1991, Grusec, 1992
Affective	The degree of satisfaction with and interest in learning from a given method	Martoochie & Webster, 1992, Hidi 1990, Baldwin & Kar 1987
Motivation	The degree to which a method motives a student	
Learning Levels		
Context	The basis of course material, divided according to factual, procedural and conceptual	Walberg & Haetel, 1992, Tennyson 1992, Davidson, 1990
Learning Style	The preferred mode of learning, a psychological measure	Bostrom, 1990, Hambree, 1992, Fourqurean, 1990
Cognitive		
Thinking level	Higher-order thinking versus lower-order thinking	Tenebaum 1982, Bruning 1983
Strategies	The ability of learners to identify the strategies necessary for understanding and performing tasks	Walberg & Haertel 1992
Processing	Measure of how students process new information	Tobias, 1982, Bovy, 1981
Behavioral		
Performance	A surrogate measure of the amount of learning	
Attention	A measure of directed non-verbal participation	Bostrom 1990
Participation	The amount of usually verbal participation	

Web-Based Homework

Educational technologies are created to help students learn. Web based technology offers several benefits not available using paper and pencil. The student uses a standard internet browser although the purchase of an access code is required. Teaching material can be distributed on-line, overcoming time and space problems, especially in distance learning. This also allows for rapid updating and correcting of the material. Multimedia can be included by embedding videos or animations in web pages. Teaching platforms allow the teacher to limit access to registered students in order to use copyrighted material. They also permit personalized tests or practice problems and can be set to present feedback immediately or after the assignment due date. Since it is web based, no other installation of software is usually required. Currently, accounting web based homework allows for the use of algorithmic homework problems so each student has the same problem but with different numbers to discourage cheating.

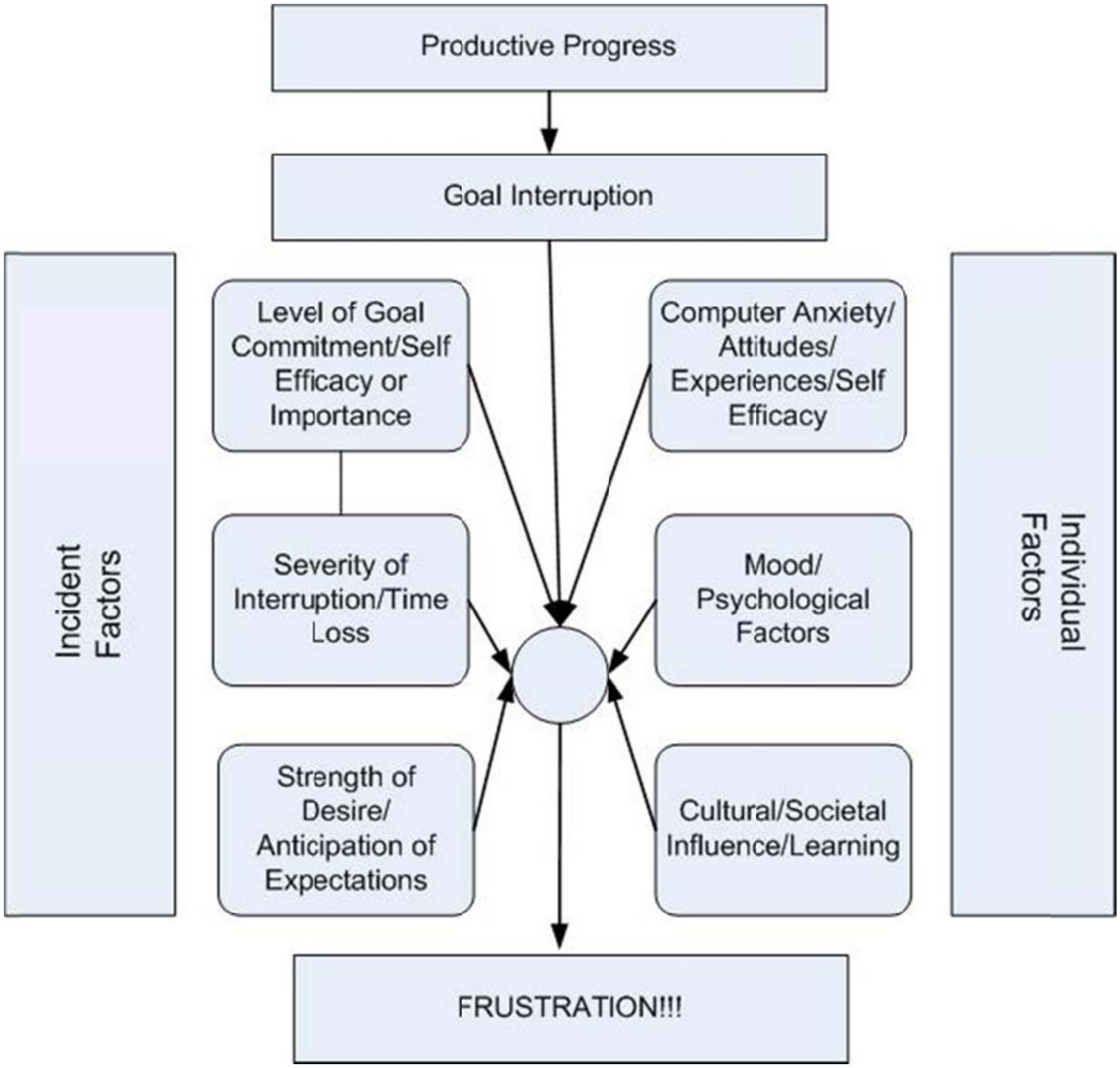
Homework is assigned to allow students the chance to gain experience working problems, but there is disagreement on its benefits. Books have been written in support of homework saying it has been proven to be a powerful tool for ensuring a child's success in school by teaching children responsibility (Canter and Hausner, 1987) and in rebuttal proposing more than forty hours a week of anything (especially class and homework) is hazardous to your health (Kralovec and Buell, 2000). Cooper performed a seminal research project on homework and concluded that homework and achievement have a positive relationship but the relationship differs with grade level (Cooper, 1989). Young children should not have homework while high school students benefit from it. However, Cooper did not research homework effects on college students. Warton (2001) suggests different variables (perceptions of adult position, self-concept, goals, affective response, task value and expectation of success) at the child level affect the homework behavior of the student in terms of choices of activity type and task persistence. Trautwein and Koller (2003) suggest the relationship between homework and achievement is still a mystery and propose various studies to find a conclusive answer. At the university level, homework is assigned in an attempt to allow the student to become familiar with the material and to help boost their course grades. In many classes, if there were no homework, a student's only grades would be from the mid-term and the final exams.

Based on most theories presented, homework *should* be beneficial to students. It allows them to spend more time on task, allows them to construct problems and uses reinforcement techniques. Yet, according to one accounting study, assigning homework is more beneficial to female students than male students (Ravenscroft and Buckless, 2002). They found that grading policies that include homework grades benefit females who tend to have better attendance records and turn in more homework. Males in the study performed better in general on the final cumulative exam, but did not turn in homework thus lowering their final grade. This suggests that course requirements should differ by student, according to their learning style. A study of the effect of culture on homework found that homework is a form of practice and that cultures that value longer homework assignments produce students with higher scores on achievement tests (Chen and Stevenson, 1989). They believe that interesting homework that the student recognizes as being useful will facilitate academic achievement. Web based homework is used in this study because of the assumption that it will enhance learning through its interactivity, provide an interesting environment and give prompt, accurate feedback. Students in grammar school sit in class five days a week, all day long. University students are not required to attend class, and when they do they are only there for three hours a week. Homework is supposed to allow them to go over material that was presented in class or it should help them prepare for the next class. Logically, students who work on homework should show higher levels of learning than students who do not. To follow that logic, people who are more interested in a subject should be more motivated to complete the homework assigned. But a search did not turn up any papers that report studies of homework completed by students majoring in the subject compared to non-majors.

Factors That Impact the Efficacy of WBH

Several factors have an effect on the success of WBH as a learning tool. Usability, defined as "the effectiveness, efficiency, and satisfaction with which a specified user can achieve specified goals in particular environments" (Crowther, Keller and Waddoups, 2004, 290) is a prime component of a successful educational technology. The design of the software should be built with the user in mind. Navigation through a website can be frustrating if loading times are long, back buttons do not work or pages have to reload. Icons should be clearly marked and easily found. WBH that is poorly designed will impede a student's ability to engage in significant learning. On the other hand, properly designed WBH should allow learning to take place (Soderberg, 2000). Interactive and motivating components are necessary to involve the student. The appearance should be aesthetically pleasing and the tone should be encouraging. Students prefer to have control over the speed of presentation, being allowed to rewind and go again (Leidner, 1995).

Studies have measured the frequency, cause and level of severity of frustrating computing experiences (Ceaparu, Lazar, Bessiere, Robinson and Shneiderman., 2004; Bessiere, Ceaparu, Lazar, Robinson and Schneiderman, 2002). Ceaparu et al. found that annoying experiences occur frequently, mainly when using the web, email or word processing. Their study found the time lost due to provoking experiences amounted to almost half of the entire time spent on a computer. The study defines error as the system not providing the desired outcome so that the user cannot reach his or her task goals. Errors are even more of a problem for novice users because they generally do not understand the cause of the error or how to respond to it. The report included emotional reactions to computer response time. They designed a computer game that intentionally froze during play and recorded significant physical behavior such as skin conductivity, blood pressure and muscle tension during frustrating events. If user satisfaction is used as a measure of the success of the technology and completion of a goal or task, then frustration could be seen as a measure of failure to achieve said goal or task. The group also asked students to log their computer usage, report any frustration causing events and record their solution to the problems. The students' problems were classified as internet, application, operating system, hardware or other. They found that email, operating system and web browsing produced the most frustrating experiences. In most cases, the student knew how to solve the problem because it had happened before, but 13% of the time they were unable to solve the problem. Bessiere et al. (2002) presented a model of frustration as seen in Figure 5.



Mendoza and Novick (2005) used a longitudinal study and found that a test of usability was actually a test of learnability. As software users gained experience over time, their level of frustration dropped, the causes of their frustration changed and their responses to episodes changed. They suggest that, over time, many of the events that create frustration in novice users become very insignificant as they become more familiar with the software.

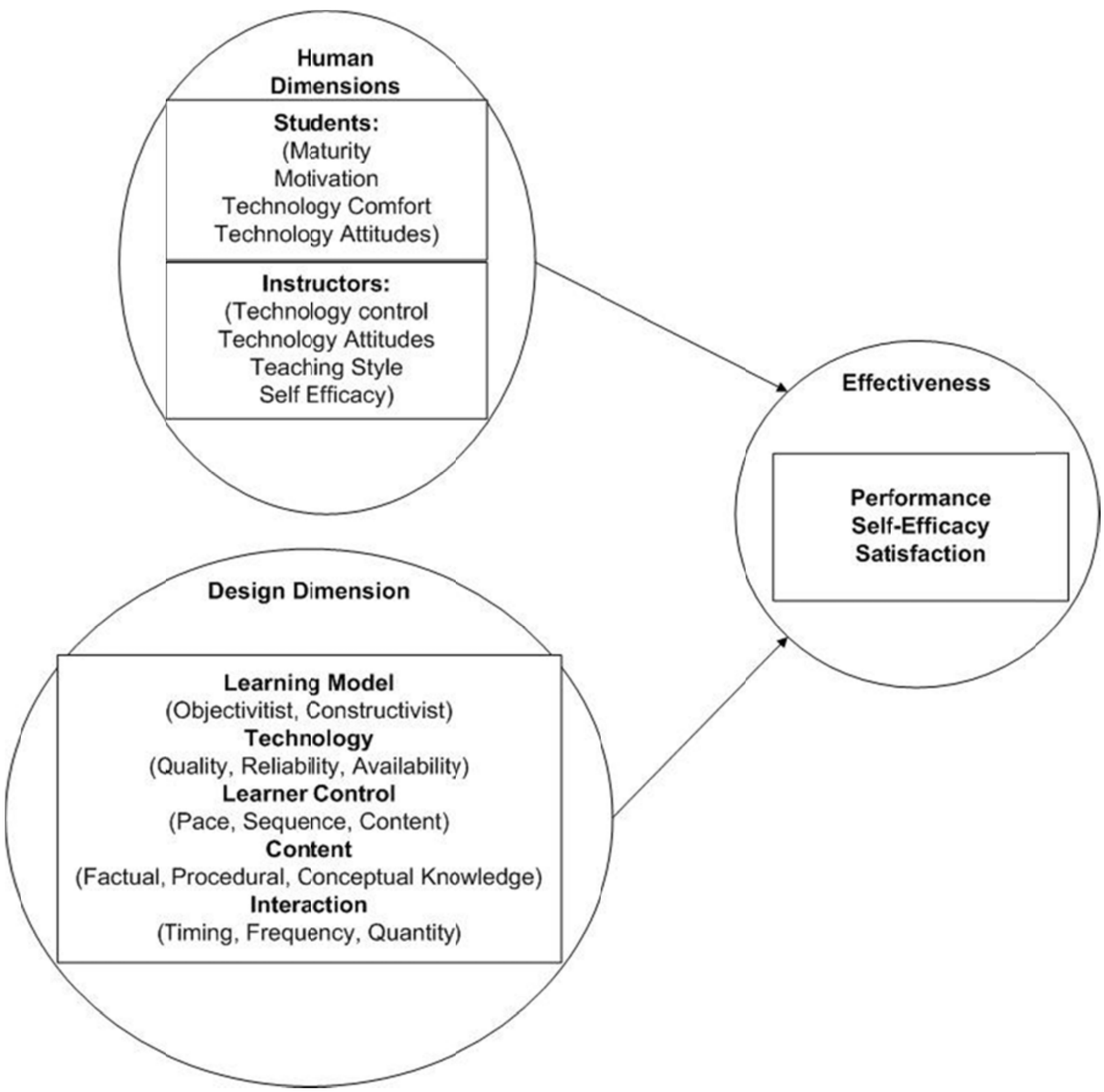
Some studies have been performed on design techniques (Liedner, 1995). Results show that some colors grab the student's attention more than others, but no color seems to result in greater learning. Some graphics can create interest as well as increase comprehension and memory of the material (Liedner, 1995). Liedner also reported a positive relationship between student control of learning and motivation and performance. Pituch and Lee reported that the functionality of the e-learning system was more important than perceived ease of use, personal characteristics such as self-efficacy and internet experience or response time (2006). Dillard-Eggers et al. report that 53% of their students believed the WBH increased the quality of their study time, and 55% believed it allowed them to attain a higher level of understanding (2008).

Efficacy of WBH Environment on Student Performance

Before one can measure the efficacy of a web based environment on student performance, it is useful to examine traditional determinants of student performance. Eskew and Faley (1988) created a model to explain college student performance as measured by final exam scores in their first accounting course. They determined that six variables contributed significantly in explaining student outcomes: SAT score, number of quizzes taken in the class as a measure of attendance and motivation, high school grades, high school accounting experience (classes taken), college grades and related accounting experience. Other antecedents that are seen to affect performance are social support, health and mental health and acceptance-focused coping mechanisms (smoking and drinking) (DeBerard, Spielmans, and Julka, 2004). Gunawardena and Duphorne (2000) report that functionality and features of a course offered online are the best predictors of learner satisfaction. They also found that usefulness is more important to students than ease of use.

Piccoli, Ahmad and Ives (2001) created a framework for a virtual learning environment and said the effectiveness of said environment could be measured in terms of performance as in achievement and recall, self-efficacy and satisfaction. Two constructs were antecedents to effectiveness: human dimensions (students and instructors) and design dimensions (learning model, technology, learner control, content, interaction). Their framework appears as Figure 6.

Figure 6: Virtual Learning Environment Framework (Piccoli et al., MISQ, 2001)



But sometimes, the functions added for the students' benefit seem to backfire. In one study of younger students using a software tutor program similar to WBH, they found some students tried to "game the system" meaning they tried to complete the task of finishing the assignment without actually doing any work. Some WBH can be set to provide hints after the first, second, or n^{th} attempt so students quickly learn to enter anything the first few times in order to get to the hints. Sometimes the hints are very useful, even to the point of providing a formula so the student does not have to open the book. When students realize the computer is looking for a number, they enter 1, 2, 3, etc. until they find the right answer. In multiple choice questions or matching, if they have unlimited attempts they click and submit until they get it right. The study found a significant relationship between "gaming the system" and post-test scores and suggested that learned helplessness[1] might be the reason the students attempt this instead of learning the material (Baker, Corbett, Koedinger and Wagner, 2004).

Unfortunately, WBH does have other drawbacks (Bonham, Beichner, Deardorff, 2001). If a student enters the wrong answer, the computer gives no indication as to why it is wrong. It could be something as simple as a rounding error or transposed numbers, but the student does not know that. If the computer is set to allow unlimited attempts in an effort to reward persistence, the student might attempt a trial-and-error strategy instead of trying to solve the problem. Also, simply grading based on right-or-wrong places emphasis on the correct answer and not on the process. Their study also found that students using WBH spent an average of thirty minutes to an hour more each week on homework than paper based homework students. The reason is that

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[1] Learned helplessness describes a personality trait or behavior that arises out of an inability to control trauma. The organism is slower to respond, is slower to learn its responses control the event and it shows more stress (Seligman, 1972).

students get credit for doing homework whether it is right or not, but online homework only gives credit for correct answers. A study by Caruso (2004) also found problems with the technology. Many students believed it was extra work to learn the software and the course material. Some of them had trouble running the applications or web pages on their computers, some had trouble printing and several lacked technical support.

Psychological Theories of Achievement

Goal setting theory (Locke and Latham, 1990) asserts that task performance is directly regulated by one's goals. Goals affect performance in four ways: 1) they direct attention and effort toward goal related activities and away from nonproductive ones; 2) goals energize; 3) goals affect persistence; 4) setting a goal leads to action in that one must pick a strategy and get started (Locke and Latham, 2002). High goals combined with high self-efficacy lead to longer persistence and more time spent on completing a task. The goal selected should be difficult but attainable in order to motivate one to change a behavior to achieve the desired end. Feedback is necessary in order for people to measure their performance. Their model proposes that setting high goals with high expectancy of fulfilling them can lead to high performance, but there are four mediating factors: effort, persistence, direction and task strategies.

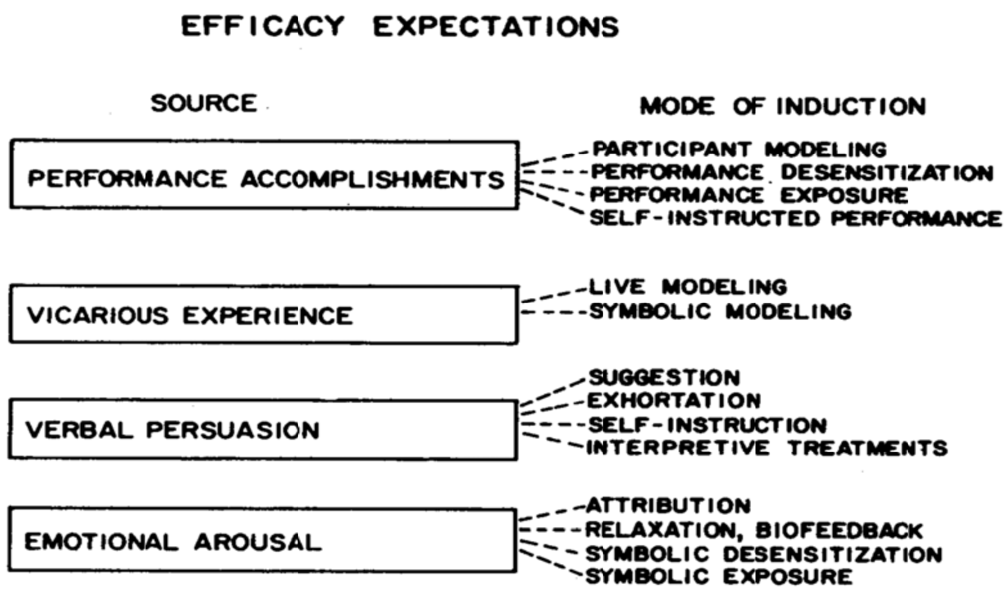
Social learning theory (Rotter, 1975) was an attempt to combine reinforcement from behaviorism with the cognitive theories of the mind. It is based on four main variables: the behavior one chooses to engage in, expectancies or the result one expects following one's behavior, reinforcement is the outcome produced by one's behavior, and psychological situations which is Rotter's way of saying that each person views events differently. Social learning theory holds that if an organism perceives two events as being similar, he/she will generalize the result so that the next time a similar event occurs, the same or similar result will be expected.

Reinforcement of behavior can be extrinsic or intrinsic. If E represents the individual's expectancy and E′ is the specific expectancy, GE is the generalized expectancy and N represents the amount of previous experience the individual has had in that area, then social learning theory can be expressed as $E_{s1} = f(E'_{s1} + GE/N_{s1})$. In education, a student should expect his grade in a particular class (E_{s1}) to be a function of the specific activities performed in that class and the generalized expected grades from previous, similar classes. If the student has had many accounting classes, then the expectation would be a grade similar to previous accounting grades. Locus of control refers to the belief the individual has that a person can control the events that affect his/her life. People with a high internal locus of control believe events are controlled by their own actions. Thus, students with an internal locus of control would feel that if they study, they will make good grades. Students with an external locus of control would feel that there is no need to study because if they did, the teacher would ask the questions they did not know.

Dweck and Leggett (1988) investigated motivation and personality to identify patterns of behavior and their underlying causes. They studied children who were of equal ability and found that by age nine or ten they exhibited strong individual differences in response to failure. While some children show a mastery style of response, others exhibit signs of helplessness. The research showed that some children relate being "good" to succeeding and being "bad" to failure. One study (Heyman, Dweck and Cain, 1992) found evidence that young children who receive criticism respond by behaving in a helpless manner. This may be a type of defense mechanism if they believe that being good equates with succeeding while failure means the person is bad. If they are helpless and cannot help failing, perhaps that means they are not bad, just not smart. This seems to tie in with further study that suggests people have theories about themselves. Young children who believe their intelligence is fixed (the entity theory) are more likely to be in the helpless category while children who believed they could grow and learn (the incremental theory) were in the mastery-oriented category. In fact, the more students believed the ability to learn can be improved the more they valued education and persistence (Schommer and Walder, 1997). The mastery group did not give excuses for failure, partly because they did not believe they were failing. They saw unsolved problems as challenges to be mastered. When monitored, researchers found this group not only attempted to find the solution through self-instruction and self-monitoring, they also verbally told themselves to try harder or concentrate more. The research suggested that helpless children focused on their inadequacy while mastery children focused on mastery through strategy and effort. Mastery children found it an opportunity for learning while the helpless felt it was a threat to their self-esteem. The studies also reveal that mastery children were more optimistic than helpless children.

Bandura (1977) defined an outcome expectancy as one's estimate that a particular behavior or act will lead to a particular result or outcome. He defined efficacy expectation as the conviction one has about one's ability to successfully execute the act required to produce the desired outcome. "The strength of people's convictions in their own effectiveness is likely to affect whether they will even try to cope with given situations…….The stronger the perceived self-efficacy, the more active the efforts." (Bandura, 1977, 193). Thus, people who believe strongly in their own ability will persevere despite setbacks. He presented the model of the main sources of efficacy information which follows. This 1977 model seems to be confirmed, in part, by Eskew and Faley (1988) who do not cite Bandura but perform a regression of determinants of student performance in the first college accounting class and find six variables that significantly contribute to student performance. In Bandura's model, the first source of efficacy is "performance results" which can come from participant modeling, performance desensitization, performance exposure and self-instructed performance. The model seen in Figure 7 seems to be supported by Dweck's studies of children (1988). In that study, children who were highly achievement motivated would verbally encourage themselves when faced with problems they had trouble solving.

Figure 7: Bandura: Main Sources of Efficacy Information (1977)



WBH adoption and use

TAM, the Technology Acceptance Model (Davis, Bagozzi and Warshaw, 1989), is a model of why people use technology. Based on the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980) it proposes that external variables are antecedents to the perceived usefulness of the technology and its perceived ease of use. These two constructs are antecedents of a person's attitude toward using the technology and their behavioral intention to use. The theory of reasoned action is different in that the construct named "external variables" by Davis seems to be called normative beliefs, motivation and subjective norm. In TRA, behavioral intention is a measure of strength of one's intention to act, and beliefs are the individual's subjective probability that the desired consequence will result. TAM cites Bandura's (1982) work by listing efficacy as one of the most vital factors in determining intrinsic motivation. TAM defines usefulness as the user's subjective probability that the technology will increase job performance. Davis' study also included a longitudinal factor. He found that at the beginning of a fourteen-week period, behavioral intention to use and ease of use were both influential in determining use. But at the end of the period, intention to use was affected directly by usefulness on its own. From this, WBH would be expected to be adopted and used by students because of its usefulness after the instructor demonstrates how to use it. Even though the homework is required for all students, it would be logical to assume that some students would be hesitant to begin, especially if they do not have much experience using software. But based on TAM, over time the students should use it because of its usefulness in helping them complete their job of learning accounting and finishing their homework.

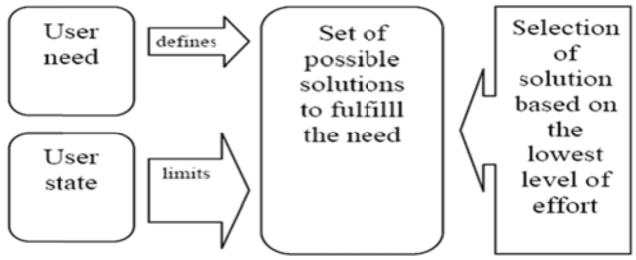
A fairly new theory of the technology user has its basis in behavioral research. Gengerelli (1930) performed experiments with rats in various mazes. He found that over time the rats learned the most direct method to the food and in fact, "cut corners" by showing a tendency to turn before getting to the corner. He extrapolated that the rat's behavior had "directedness" and that if the obstacle had not been there, the rat's path would have shortened the route. In this experiment, any error or deviation from the most direct path resulted in the rat traversing excess distance. Gengerelli defined excess as any amount over and above the least quantity which would suffice (Gengerelli, 1930, 232). He called this the principle of maxima and minima in learning.

Waters (1937) performed similar experiments with rats and people and reported that there were circumstances when the principle of maxima and minima did not apply. He chose to call it "the principle of least effort in learning". One of his experiments involved maze pathways that were so confusing they "represented time and energy differentials beyond the discriminative capacity of the animal" (Waters, 1937, 16). The subjects would have to spend more energy finding the shortest way out than they were spending getting out. Although they did not discover the fastest way, they did expend the least effort and they found the way out.

Each scholar also performed experiments with blind rats. In the easier mazes, all the rats learned the most direct path to the food, but in the mazes with obstacles, the blind rats stayed near the walls. The observers noted that when the rats bumped into the sharp corners of the metal maze, it hurt. Therefore, the easiest way to get to the food without suffering any pain was indeed by staying near the wall and taking the longer way around. Therefore, Waters added a pain dimension to the Law of Minimum Effort so that it would hold for the dimensions of distance, time, effort and pain. These principles also seem to hold true for students using WBH. If they are stressed and under time constraints, they will most likely attempt to complete their task using the method that takes the least amount of time. Even though WBH offers many desirable learning characteristics, if students are faced with dimensions of distance, time, effort and pain, they will take the shortest, fastest, easiest, least painful way out which might include guessing. The irony is that in many cases, it is possible that actually reading the book and learning the material would be the easiest way to complete the task.

The term "lazy user" appeared in Baan et al., (2001) and in a recent paper and model by Collan (2007). Baan defined lazy user as "users investing only limited effort to express their information need" (2001, 8). Collan called his model the lazy user theory of solution selection. He said it attempts to explain how a user of technology fulfills a need from a possible solution set. The model is shown as Figure 8.

Figure 8: Lazy User Theory of Solution Selection (Collan, 2007)



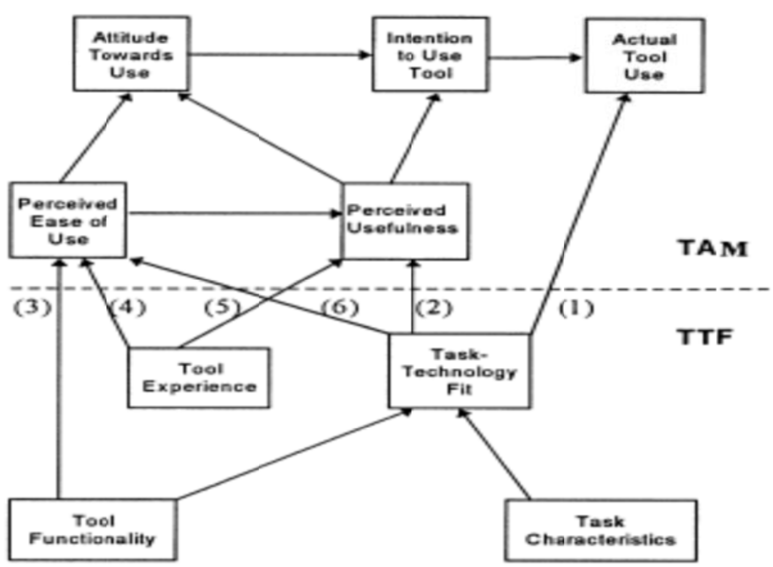
The principle of least effort and the lazy user appear to be remarkably similar to Simon's theory of bounded rationality (1991) which states that people have limited time and memory so they select from all possible choices that one which satisfices or meets their greatest needs for the lowest cost. A particularly interesting feature of the lazy user of technology is that it is supported by Davis (1989) and his finding that, over time, usability (and features) are more important to the user than ease of use. Since technology offers the promise of time savings and students are so time constrained, WBH would appear to be eminently suitable as a tool the students can use to complete their task even down to finding ways to cut corners. However, another way to view the principle of least effort in technology use is that it is not an act of a lazy person, but the act of an efficient one. If technology is used to save time and effort, finding the short cuts in the use of technology simply makes it more useable, rather like adding another function. On the other hand, perhaps the lazy user is just an indifferent one. If so, in terms of bounded rationality, the lazy user is satisficing by selecting the best solution with the least amount of effort.

TTF and Technicism

Goodhue and Thompson (1995) presented a model that combined user attitudes as predictors of utilization (TAM) and task-technology fit (TTF) as a predictor of performance. They called it the technology-to-performance chain (TPC) and stated that in order for an information technology to have a positive impact on an individual's performance the technology must be used and it must be a good fit with the task functionally. Straub and Karahana (1998) introduced the task technology fit model for use in media choice and presented the task closure model of communications in which knowledge workers select the media that will allow them to complete their communications task. They found that people were "highly motivated to bring closure to or complete a communication sequence" (Straub and Karahana, 1998, 171). Unfortunately, there are not many studies about task closure and why people are motivated to complete tasks. It would seem logical to have a general task closure theory, not just one for communications tasks.

When task-technology fit is added, the efficient user selects the proper tool and uses it in the most productive manner. The user adds that experience to previous episodes and has a new knowledge base on which to draw in the future. This model is presented as Figure 9.

Figure 9:TTF and TAM, (Dishaw and Strong, 1999)



Modern Social Learning Theories

Humanistic psychology was formed in the 1950's as a branch of psychology organized by Abraham Maslow (Maslow's Hierarchy of Needs), Carl Rogers (student centered learning) and others (Miller, 1983). They were concerned with issues that were uniquely human such as the self, human emotions such as hope and love, human creativity, individuality and man's humanity. This branch of psychology offers more in the way of qualitative research as opposed to the positivist works that preceded it (Miller, 1983).

Based on his experience as a therapist, Rogers believed the individual has vast resources for self-understanding and the ability to alter the self-concept basic attitudes and self-directed behavior. He concluded there are conditions necessary to create a climate that will allow for change (Rogers, 1979, 2007).

- Two people are in psychological contact – have a genuine relationship
- The client/student is in a state of incongruence (vulnerable or anxious) and is valued by the therapist/teacher who creates a climate of unconditional positive regard
- The therapist/teacher is empathic and understanding – sensing the feelings of the client/student

A broad movement of student-centered learning swept through schools during the end of the last century based on the idea of treating students as humans and actually listening to them to hear what they have to say about their education and the way they want to be treated. This became student-centered education.

This chapter has presented three major educational theories, behaviorism, cognitivism and constructivism and their use as a foundation for other assumptions. Kolb believed learning was holistic which supports the view that there are many factors contributing to learning, and therefore many must be studied. This point of view was supported by Bruner who believed each person's reality was unique and must be viewed holistically. Using this literature review as motivation, in order to confirm or deny the belief that WBH is theoretically based and capable of aiding the learning process, the next section of this study will focus on the methodology, including the research design to be employed, the constructs, instruments and data collection methods.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

WBH has become a very important phenomenon. However, scholars know very little about it, its character and composition, the nature of its impact on students and how that impact evolves over an academic term. In other words, there is little research to help understand the WBH learning environment and the impact of that learning environment on student performance during the course of a semester. The research questions at the heart of this study are:

1. What are the factors in the WBH learning environment?
2. How do these factors relate to each other?
3. Do these relationships change significantly over time?

Construct Development

The review of the educational, psychological, technological and sociological literature presented in Chapter Two revealed multiple potential constructs for this study. The survey instrument contains items validated in previous studies in four areas: educational learning theories, psychological theories about goal achievement, theories about technology use and sociological theories about interpersonal relationship as a method to promote learning. Fourteen potential constructs were identified for use in this study:

- From Education: Feedback, Engagement in learning, Discovery learning
- From Psychology: Locus of Control, Mastery Goals, Performance Goals, Self-efficacy
- From Technology: Usefulness, Technological-efficacy, Frustration, Lazy User
- From Sociology: Humanistic Learning, Cooperative Learning, Student Centered Learning.

Instrument Development

This section presents the theoretical constructs used in the study and the development of the instrument to measure the construct in the WBH learning environment.

Educational Theories about Learning

Feedback Construct

Feedback is a component of behaviorism. Kulhavy (1977) studied the feedback construct and found that in order for feedback to be beneficial to learning, the student must not be able to find the correct answer *easily*. If the answer is easily found the student simply copies the response, which does not lead to learning. The feedback provided by WBH may be beneficial as a learning tool. From the behavioral studies of Pavlov and Skinner, feedback should aid in a student's learning process.

Nguyen and Kulm (2005) used WBH in math classes and asked students to respond to the statements, "Computer immediate feedback is useful for mathematics problem solving" and "I like to receive immediate scores on my homework and tests from the computer." This was the basis for the first feedback question used in this study. The second question was created for this study to capture students' preferences for explanations instead of just being told whether something was right or not.

Demirci (2007) asked university physics students their response to the statements, "I spend less time when doing homework online." This was the source for the third feedback construct question. Personal experience with WBH led to the fourth feedback question since students cannot receive credit for completing their homework assignment unless the answers are correct.

Feedback Construct Items

- 1 – When working homework problems, I like that software tells me instantly whether I'm right or wrong.
- 2 – When working homework problems, I prefer to know WHY I'm wrong.
- 3 – The web-based homework system allows me to finish my homework faster because it tells me if I'm right.

- 4 – The homework software slows me down when doing my homework because I can't get credit for it unless it is correct.

Engagement Construct

Engagement has been defined as the "extent to which students are motivated to learn and do well in school" (Libby, 2004) and as "sustained behavioral involvement in learning activities" (Skinner and Belmont, 1993). The National Research Council of the Institute of Medicine defines the engagement in schoolwork as involving "both behaviors and emotions and is mediated by perceptions of competence and control (*I can*), values and goals (*I want to)*, and social connectedness (*I belong)*" (Appleton, Christenson and Furlong, 2008, 371). Engagement is important in education as reflected in the statement, "More than 20 years ago, researchers remarked that although attendance at high school was compulsory in the United States, engagement could not be legislated" (Appleton et al., 2008, 369). "Laws may regulate the structure of the educational system but student perspectives and experiences substantially influence academic and social outcomes" (Appleton et al., 2008, 369). Many educators feel that engagement leads to more time spent on task, resulting in a better understanding of the material.

Agarwal and Karahanna (2000) investigated the cognitive absorption construct. Theoretically, it is based on the trait of absorption, the state of flow, and the idea of cognitive engagement. They found that individual interaction with technology can become an absorbing, engaging process. Dimensions of cognitive absorption include temporal dissociation, focused immersion, heightened enjoyment, control and curiosity, playfulness and personal innovativeness. Focused concentration on a particular topic can impact a student's learning. They also found that cognitive absorption was a significant antecedent of perceived usefulness (Agarwal and Karahanna, 2000). Their study included the items, "Time appears to go by very quickly when I am using the Web," "I often spend more time on the Web than I had intended," and "While using the Web I am able to block out most other distractions" (Agarwal and Karahanna, 2000, 692). The literature suggests that increased cognitive absorption would result in enhanced learning.

Pintrich (2000) examined task value and goal orientation in learning and achievement. He found that task value refers to the student's evaluation of how interesting, how important and how useful the task is. He found that high task value should lead to more involvement and perhaps, engagement, in one's learning. Pintrich (1996) asked students to respond to the statement, "I am very interested in the content area of this course." Another questionnaire (Pintrich, 2000) measured interest by asking "I think that what we are learning in this class is interesting." This literature would suggest that the level of interest a student has in the content area of a course is related to student performance.

The final engagement item is meant for students who are not engaged in their work but complete assignments just to get them done. It says: I work hard so I can get done with the homework and do other things. There is no study that was found in the literature review that asked this question.

Engagement Construct Items

- 1 – Time appears to go by very quickly when I am working homework using the web-based homework software.
- 2 – Time appears to go by very quickly when I am working homework on paper.
- 3 – I often spend more time using the web-based homework software than I had intended.
- 4 – I often spend more time on working homework problems on paper than I had intended.
- 5 – I am able to block out most other distractions while using the web-based homework software.
- 6 – I am able to block out most other distractions while working homework problems with paper and pencil.
- 7 – I work hard at school because I am interested in what I am learning.
- 8 – I work hard using the web-based homework software because it keeps me interested in what I am learning.
- 9- I work hard so I can get done with the homework and do other things.

Discovery Construct

Discovery is a theory of constructivist learning. Learning is self-directed and based on a learner's experiences. Dewey (1916) believed there was a connection between education and personal experience. Kolb (2005) suggested learning is the process of adapting to the world. Discovery or active learning is centered on the individual and the idea that learners may remember more if they discover relationships on their own and add them to their own mental models (Bruner, 1985).

Smart and Cappel (2006) examined student use of web-based assignments through the use of a questionnaire. They asked students if they were aware of web-based assignments and if they had any experience completing web-based work. However, the study did not reveal whether or not having used WBH previously made a difference in the student's performance. This item was included in the questionnaire.

Torres, Gross and Dadashova (2010) examined commuter students and found that most of them work more than 30 hours per week. They found evidence to support earlier studies (Peltier, Laden and Matranga, 1999) showing commuter students were less likely to graduate on time, less likely to participate in campus functions and come from families with lower levels of education and aptitude. However, discovery learning proposes that students may remember more of what they are studying if they have personal experience in that area. Perhaps students who have work experience will perform better in accounting classes. This led to the inclusion of the question, "Do you live on campus?"

Eskew and Faley (1988) examined determinants of accounting students' performance and found past academic performance to be the best indicator of future performance in that grades predict other grades. They also found the standardized tests such as the SAT or ACT also aid in predicting academic performance. A study by Palocsay and Stevens (2008) also found GPA to be the best predictor of student performance. Based on this, the students in this study were asked to provide their GPA to date. Eskew and Faley (1988) also reported that students who had taken bookkeeping in high school performed better in elementary accounting than students who had no previous experience. This suggested a connection between education and personal experience and was added to the questionnaire. The same study also reports a significant relationship between previous related experience and student performance in an accounting class. Therefore, the idea of operating a cash register or having a checking account as previous experience may be related to student learning; these questions were included.

Age was included based on Knowle's work with adult students and andragogy. According to his work, age makes a difference in the way people learn.

Discovery Learning Items

- 1 – Have you used a web-based homework grading system in any other class?
- 2 – Do you live on campus?
- 3 – Have you taken an accounting course before?
- 4 – Have you ever had a job operating a cash register?
- 5 – Do you have a checking account?
- 6 – What is your age?

Psychological Theories about Behavior

This study is an attempt to identify the significant factors in the WBH learning environment. Educational learning theories have a role in a learning environment through the teaching techniques used by the teacher. Students bring their personalities to the learning environment. Extant literature suggests that student personality traits and behaviors should be included in a study of the WBH learning environment.

Mastery Goals and Performance Goals Constructs

Simon (1976) found motivation to affect engagement. He believed that motivation is the impetus behind personal goal setting. Motive is “something that causes a person to act a certain way; incentive; the goal or object of a person’s actions” (Random House, 2009). Mastery goals involve the desire to achieve, to demonstrate academic competence, understanding or improved performance using self-established standards. Mastery goals are more intrinsic compared to performance goals (Dowson and McInerney, 2004).

Academic achievement goals directly influence the quantity and quality of the student’s focus on learning (Downson and McInerney, 2004). There are different kinds of goals, including mastery and performance. Performance goals in school include wanting to achieve to outperform other students, to attain certain grades or to obtain tangible rewards associated with academic performance.

Greene and Miller (1996) found that a student’s mastery learning goals were linked to perceived ability, and together they were antecedents of meaningful cognitive engagement and led to student performance. Students were asked to respond to the statements, “One of my primary goals in studying for this exam was to understand the concepts” and “One of my primary goals in studying for this exam was to acquire new knowledge." Greene and Miller (1996) also asked about performance goals: "One of my primary goals in studying for this exam was to do better than others." These were used to measure student mastery learning goals and performance goals and were included in this survey.

Mastery Goals Items (Motivation)

- 1 – One of my primary goals is to understand the major concepts.
- 2 – Web-based homework software helps me reach my primary goal which is to understand the major concepts.
- 3 – One of my primary goals in studying for this class is to acquire new knowledge.
- 4 – Web-based homework software helps me reach my goal of acquiring new knowledge.

Performance Goals Items

- 1 – I want to learn things so that I can be near the top of the class.
- 2 – Web-based homework software helps me reach my goal of being near the top of the class.

Self-Efficacy Construct

Bandura (1974) described self-efficacy as a person's belief that they are capable of behaving in a way that will allow them to achieve their goals. Greene and Miller (1996) found evidence to support a connection between self-efficacy, an attitude of mastery learning and successful achievement of student goals. Their survey included the statement, “I can do well on this exam”. This was included in the questionnaire.

Self-Efficacy Items

- 1 – I can complete homework assignments successfully.
- 2 – When I work accounting problems using the web-based homework software, I can get the right answers.

Locus of Control Construct

Rotter (1954, 1966) studied locus of control or the belief that a person can control or has no control over the events that occur in his life. An external locus of control is the belief that others have more control over one’s life, while an internal locus of control is the belief that each individual exerts control over events in their own lives. Rotter found that in children, an external locus of control was predictive of achievement but was less successful in predicting outcomes as the child aged. In Rotter’s research (1966) he asked children to respond to these statements, “Chance or luck plays an important part in my success,” “Becoming a success is a matter of hard work. Luck has little or nothing to do with it.” Rotter also included the statements, “When I make plans, I am almost certain that I can make them work.” This was reworded to, “I am able to finish homework assignments by deadlines.”

Perceived Ability Construct

Rotter (1966) also worked with the expectancy-value framework which included questions about one's perceived ability. The perceived ability construct requires the student to measure his or her own ability (Miller, Greene, Montalvo, Ravindran and Nichols, 1996). Green and Miller (1996) found perceived ability to be an antecedent to test grades when they asked students to respond to the statement, "My knowledge and skills are better than those of other students in this class."

Locus of Control Items

- 1 – Chance or luck plays an important part in my success.
- 2 – Chance or luck plays an important part in my success when using the web-based homework.
- 3 – Doing well in school is a matter of hard work. Luck has little or nothing to do with it.
- 4 – Doing well on my homework using the software is a matter of hard work. Luck has little or nothing to do with it.
- 7 – I am able to finish homework assignments by deadlines.
- 8 – I will be able to finish the web-based homework assignments by the due date.

Perceived Ability Items

- *5 – My problem solving skills are better than those of other students in this class.*
- *6 – My problem solving skills using the web-based homework software are better than those of other students in this class.*

Theories of Technology Use

The use of technology to increase performance has been studied by many (Sundaram, Schwarz, Jones and Chin, 2007; Palocsay and Stevens, 2008; Baker, 2010). Some studies found a significant relationship between technology and learning (Alavi,1994; Greenlaw, 1999; Young, Klemz and Murphy, 2003; Wang, 2003; Cheng, Thacker, Cardenas and Crouch, 2004; Susskind, 2004;) while others found performance was not enhanced (Ocker and Yaverbaum, 1999; Rankin and Hoass, 2001; Picciano, 2002; Cole and Todd, 2003; Bonham, Deardorff and Beichner, 2003; Saadé and Kira, 2004; Hauk and Segalla, 2005).

Perceived Usefulness Construct

Davis (1989) defined perceived usefulness as the prospective user's belief that the technology will improve or increase his job performance. Usefulness is an important construct in information systems research. Santhanam et al. (2008) studied self-regulatory learning and suggested that three key factors work together to increase learning outcomes. The factors are information technology, instructional strategy and the learners' psychological processes. They also found that characteristics such as learning orientation, computer self-efficacy and positive feedback influence learning outcomes.

Brown, Massey, Montoya-Weiss and Burkman (2002) explored the use of mandated technology in the banking industry. In testing the perceived Usefulness construct they asked people to respond to the statements, "[the software] enables me to accomplish tasks more quickly," "[the software] has improved the quality of the work I do," and "[the software] give me greater control over my job." These questions were adapted for use in this survey.

Perceived Usefulness Items

- 1 - Using web-based homework software enables me to finish the homework assignment faster than if I used paper.
- 2 – Web-based homework software has improved the quality of the work I do compared to paper homework.
- 3 - Web-based homework software gives me greater control over my work compared to paper homework.

Technical Efficacy Construct

Sitzmann, Ely, Bell and Bauer (2008) report that technology self-efficacy, technical-efficacy, refers to trainees' confidence in both their computer skills and their ability to overcome technical difficulties. They found that low technical-efficacy was associated with higher dropout rates. This seems very pertinent to the current study.

In examining task-technology fit, Dishaw and Strong (2002) found that the fit between task requirements and technology drives its use. They also found that IT experience is positively and directly associated with IT use. They called the construct "Attitude towards Use". These questions describe technical-efficacy and they are included.

Agarwal and Karahanna (2000) found that personal innovativeness was an antecedent to cognitive absorption and perceived Usefulness but was not related to Self-efficacy. One technical efficacy question has been adapted from their work even though they used the term "personal innovativeness" based on a willingness to try out new technology. They asked, "If I heard about a new information technology, I would look for ways to experiment with it."

Santhanam, Sasidharan and Webster (2008) investigated e-learning-based IT training and used a construct called computer (learning) self-efficacy. In their study, learners were trained through a computer-based program so it was believed that their self-efficacy beliefs regarding learning through computers would influence learning outcomes. They found a relationship between computer self-efficacy and learning. They asked users to respond to the statement, "Using a computer is an efficient way for me to learn new things." This question appears to be at the heart of this WBH study so it was included.

Technical-efficacy Items

- 1 – I tried to discover new functions in the web-based homework software (calculator, hints, etc.)
- 2 – If I heard about a new information technology, I would look for ways to experiment with it.
- 3 – Using a computer is an efficient way for me to learn new things.

The Lazy User Construct

Collan (2004) defines the lazy user as one who expends the least effort yet still completes a task. The lazy user theory of solution selection is a systems view of a technology user and explains how the user selects the solution that demands the least effort. Dowson and McInerney (2004) define work avoidance as, “Wanting to achieve with as little perceived effort as possible.” These appeared to capture the essence of the Lazy User construct used in the study. Respondents were asked, “If schoolwork is too hard for me I just don’t do it” and “I choose easy options in school so that I don’t have to work too hard.” Their study (Dowson and McInerney, 2004) also included the statement, “If I’m having trouble learning something, I ask someone for help.” This seemed to capture the idea that people who do not want to learn for themselves might ask for help to make it easier, so it was included.

Persistence in learning is related to higher achievement (Weiner, 1994). Persistence seems to be the opposite of the Lazy User construct. A question was created to test student persistence, “If schoolwork is too hard for me I just work harder.”

Many students who have taken this course using WBH software have asked instructors for help. The teachers report that students do not read the chapter first because they have unlimited attempts to get the answer right. When a formula is necessary, sometimes the WBH software provides it as a hint. The last question in this construct was added to see if WBH allowed students to learn with less effort.

Lazy User Items

- 1 – If schoolwork is too hard for me I just don’t do it.
- 2 – If schoolwork is too hard for me, I get friends or the teacher to help.
- 3 – If schoolwork is too hard for me I just work harder.
- 4 – I choose easy options in school so that I don’t have to work too hard.

- 5 – Using homework software makes it easier to do my homework because I don't have to read the chapter first. (The links take me to the parts I need in the book.)

Frustration Construct

Bessiere et al (2002) and Ceaparu et al (2004) define user frustration as being thwarted in one's progress by a technical issue. Students use WBH software which presents technical challenges of its own. Weiner (1994) studied perseverance in highly achievement-oriented students and found that those who persevered achieved more. All four questions were directly adapted from the Ceaparu et al. (2004) study to capture students' level of frustration.

User Frustration Items

- 1 – I feel anxious when I run into a problem on the computer or have a problem with the web-based homework software.
- 2 – I feel helpless when I encounter a problem on the computer or have a problem with the web-based homework software.
- 3 – When there is a problem with a computer that I can't immediately solve, I keep trying until I have the answer.
- 4 – Frustrating experiences with the web-based homework software severely impacted my ability to get the assignment completed.

Theories of Social Learning

Modern theories of social learning are based on the premise that people learn from others through their relationships and interactions. These theories are based on human needs including the need for other people and communication.

Cooperative Model Construct

Cooperative learning involves groups of students working together to solve problems (Slavin, 1995). Laird and Kuh (2005) studied the use of technology in a university setting and found a good fit between information technology and its use in collaborative learning. He reported increased engagement in the use of technology that could lead to more time spent on task. Since cooperative learning generally reported a better learning experience, several group learning activities were scheduled for the classes participating in the study. It was hoped that as they experienced more positive group problem solving activities their appreciation for cooperative learning would increase. Since there were distance learning students also completing the same questionnaire, it was theorized that there would be a significant difference between the two groups. The first two questions come directly from Laird and Kuh's work. The third question is adapted from Demirci's (2007) study of physics students using WBH. She wanted to study student perceptions of the technology. While this was not labeled "cooperative learning model", the wording of the question was appropriate.

Cooperative Model Items

- 1 – Whenever appropriate, I prefer to work with classmates outside of class to prepare class assignments.
- 2 – Whenever appropriate, I prefer to work with other students on projects during class.
- 3 – I learn better when I work with a group to solve problems rather than by myself.

Humanistic Learning Construct

Humanistic learning is based on Carl Rogers' facilitation theory that communication and the relationship between the learner and the teacher are important for learning. Rogers also believed that learning could only occur when the student was in a nurturing environment. If this is true then perhaps technology allows people to connect on a level that formerly was reserved for face-to-face communication. Perhaps the important part of face-to-face communication is the communication and not the face-to-face.

Humanistic Learning Items

- 1 - I have communicated with classmates online to complete academic work.
- 2 - I have expressed ideas to a professor via e-mail that I did not feel comfortable saying in class.
- 3 – I used e-mail to ask an instructor to clarify an assignment.

Student Centered Control Construct

Andragogy is a learner-centric approach which is based on fixed assumptions about the learner as an adult. Knowles recognized that adult students were different from children and should be taught differently. Based on Knowles' work, students should appreciate the practice problems included in their assignments that are presented for them to use at their own pace to help them learn. Liedner (1995) reported a positive relationship between student control of learning and motivation and performance. This led to the creation of the first item in this section which was an attempt to capture the feelings that result from having control over technology and control over life and learning.

Premkumar and Bhatterchajee (2008) performed a longitudinal study that examined continued use of technology and determined satisfaction was an antecedent of intention to use. They measured student use of WBH and asked students to respond to, "Compared to my initial expectations the ability of [the software] to provide me flexibility to learn on my own time was (much worse than expected…much better than expected)" and "Compared to my initial expectations the ability to learn at my own pace was (much worse than expected…much better than expected."

Student Centered Control Items

- 1 – I work the practice problems because they give me more control over my learning.

- 2 – Having access to assignments weeks in advance improves my understanding of the material since I have more time.
- 3 – Having access to assignments weeks in advance is efficient because I can decide when to work them.

Student Performance

One objective of this study is to examine the impact of the WBH learning environment on student performance. Therefore, in this study, student performance is the dependent variable, or the Y-variable. It is measured at three time periods. At time T1 the average of the first three homework grades and the grade from the first test are the items used to measure the Y-variable. At time T2, the average of the second three homework grades and the grade from the second test is used to measure student performance. The last three homework grades are averaged at time T3 and used along with the student's final exam grade.

The items discussed were used in the survey and are attached as Appendix A. The following sections describe the population and the data collection.

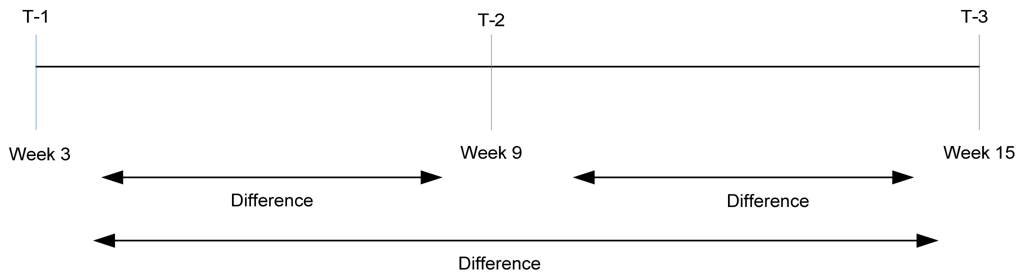
Data Collection

The survey was created by selecting questions from published research studies and adapting the questions to the current study as discussed above. Students were given a link to SurveyMonkey.com where they answered questions online. The same survey without demographic questions was given a second and third time at the middle and end of the semester. The survey asked students about their perceptions, beliefs and attitudes about the WBH software and the learning environment with the WBH. This method is appropriate since the research questions are about student use of WBH. The study uses a Likert scale where "1" is "strongly agree" and "5" is "strongly disagree".

Responses were collected from 222 students who used WBH throughout a semester in an accounting class. They were offered extra credit for completing each survey. Over 300 students began the term but a number of students dropped the course for personal or academic reasons. Of the remaining students, some did not complete all three surveys and their answers were not included in the analysis. At the end of the term, 222 complete sets of data were collected (96 males and 126 females), with a completion rate of over 70%.

Students in four accounting classes completed the same survey three times during a semester: time T1 refers to the first time the data was collected two weeks after the start of the term; T2 refers to the time the second survey was administered and occurred after the second test; and, T3 was at the end of the term. This is represented in the schematic shown in Figure 10.

Figure 10: Schematic of Data Collection



Summary

The constructs, taken from the literature review, include Feedback, Engagement, Discovery Learning, Locus of Control, Mastery Learning, Performance Goals, Self-Efficacy, Usefulness, Technical Efficacy, Lazy User, Frustration, Cooperative Learning, Humanistic Learning, and Student Centered Control. A survey was created to collect student responses to questions about their use of the Web-based homework learning environment. The survey questions came from previously validated studies that examined similar constructs. The data was collected from 222 students enrolled in accounting classes at a large, regional university at three time periods at the beginning, middle and end of the semester.

CHAPTER IV

ANALYSIS OF DATA

This chapter presents the results of the data analysis. This research is an exploratory study to determine the significant factors within the WBH learning environment. As mentioned in the previous chapters, students using web-based homework (WBH) software to complete assignments are asked about the WBH learning environment using a questionnaire with constructs selected from published research.

The purpose of the study is to answer three research questions: 1) What are the relevant factors in the WBH learning environment? 2) How do those factors relate to each other; and 3) If there are relationships, do these relationships exhibit changes over time? Questions one and two will be answered in this chapter using appropriate statistical data analysis methods. Question number three will be answered in chapter five where any differences in the relationships will be analyzed.

This study uses SPSS version 17, SmartPLS and WarpPLS to analyze the data. PLS tools identify the linear (SmartPLS) and nonlinear (WarpPLS) relationships among the latent variables/constructs by estimating coefficients of the paths as well as the regression between latent variables (Hubona, 2010). In the analysis, the constructs are called latent variables.

A variety of statistical techniques are employed to answer these questions. Structural equation modeling (SEM) is used to test for significant factors and relationships among constructs within the research domain of interest. T-tests are an appropriate method to use to determine if changes over time are due to a significant relationship change. SEM will be used to develop the analyses that will help us answer research questions one and two. SEM tests and estimates relationships and can be used in exploratory or confirmatory modeling (Hubona, 2010). SEM allows the user to construct latent variables and calculate weights, loadings and factor scores using a least squares minimization algorithm. The weights and loadings of a model with latent variables comprise the outer model, and the path coefficients among the latent variables make up the inner model. The outer model confirms that the items measure the constructs appropriately while the inner model focuses on identifying the paths or relationships between the constructs in the model. The outer model provides evidence of significant factors in the learning environment while the inner model indicates which relationships are significant. The outer model validates that the constructs are measured appropriately while the inner model reveals the path relationships between these constructs. Together, they provide an appropriate analysis technique to answer questions one and two.

The questions are drawn from existing studies as described in chapter three. It is important for this study to test the reliability of each construct. Construct reliability concerns the internal consistency of the measurement model (Henseler and Ringle, 2009), and the traditional criterion for internal consistency is Cronbach's alpha (Cronbach, 1951). SPSS was used to compute Cronbach's alpha to test the reliability of each construct at T1, T2 and T3. According to Chin (1998), Cronbach's alpha should be 0.7 or higher to provide evidence of a reliable construct; however, in exploratory studies, 0.6 and above is viewed as acceptable. The study also tests for improvements in the reliability of a construct if the item was removed which allows for experimentation to identify which combination of items measures the construct most reliably. Some constructs do not have adequate scores such as Feedback, parts of Engagement, Discovery Learning, LOC 1 and 2, Humanistic Learning and parts of Lazy User and Frustration. These questions are used in several models, but they are not found to be significant. They are subsequently removed from further analysis. Table 6 below presents Cronbach's alpha for each construct at times T1, T2 and T3.

Table 6: Construct Reliability Table: Cronbach's Alpha at Times T1, T2 and T3

Cronbach's Alpha (* constructs were later removed) (Grey cells indicate acceptable values)	**T1**	**T2**	**T3**
Feedback*	.112	-.035	.168
Engagement (all questions)	.363	.436	.613
Engagement 7 & 8	.724	.669	.778
Discovery Learning*	.042	.042	.042
Performance	.712	.682	.737
Mastery 2,3,4	.762	.801	.821
Self Efficacy	.741	.783	.828
LOC (all questions)	.430	.469	.508
LOC 3 to8	.721	.733	.784
LOC 3, 4, 7, 8	.782	.784	.810
LOC 3 & 4	.806	.809	.838
LOC 5 & 6	.891	.830	.916
LOC 7 & 8	.918	.881	.895
Lazy User (1-5)	.188	.288	.478
Lazy User 1 & 4	.623	.627	.768
Frustration (1-4)	.585	.188	.574

Frustration 1, 2 & 4	.747	.708	.763
Cronbach's Alpha (* constructs were later removed) (Grey cells indicate acceptable values)	**T1**	**T2**	**T3**
Useful	.820	.651	.723
Technical Efficacy	.657	.653	.733
Tech 2 & 3	.646	.684	.738
Cooperative Learning	.829	.766	.793
Humanistic Learning*	.395	.467	.360
Student Centered	.693	.707	.693
All items	**.813**	**.833**	**.905**

An asterisk indicates a complete construct that is later eliminated. Numbers next to construct names indicate the question used to measure the construct. Cronbach's alpha scores that are acceptable measures of reliability for the constructs in this study are shaded in Table 6. For example, when items one through five are included in the Lazy User construct, the Cronbach's alpha is 0.188 at time T1, but when only items one and four are used, the reliability score increases to 0.623 which is acceptable as a reliable measure of the Lazy User construct.

The tests for construct reliability demonstrate that most of the construct scores are in the acceptable range as shown in Table 1. PCA (principal components analysis) is used to confirm the results of the construct reliability tests. PCA is a method used to find patterns to help reduce the multidimensionality of the data (Smith, 2002) and facilitate data analysis. Using the patterns, the data can be condensed into smaller components. For example, if the responses to five questions all measure the same construct, these five responses will form a single component or construct. Ideally, the components produced by the PCA will be similar to the constructs discussed in Chapter Three.

Data is collected at three different times. The first decision is to select which time period, T1, T2 or T3, to process first. Data from time T1 might be skewed by people who had never used WBH before. Time T3 data might reflect students who were "blaming" the technology for their grade in the course. Therefore, time T2 data is used for analysis first. Subsequently, the procedure is repeated with time T1 data and then time T3 data.

Table 7 below shows the results of the first PCA created by SPSS. The highest factor score on each row should be grouped with other items that have similar scores in the same column. For example, in Table 7 below, t2mast4 (4th question in the proposed mastery construct collected at time T2) has a score of 0.713 which is the highest score on the first row and the first column and is part of the first component. The second component begins with t2self2 with a score of 0.586. This is the largest score in the second column and the largest number on that row. However, from the fourth component/column, the component scores do not form clear patterns. Fifteen components are identified by SPSS, and they explain 67.89% of the variance.

Table 7: Component Matrix with All Questions at Time T2

Extraction Method: Principal Component Analysis. **15 components extracted.**

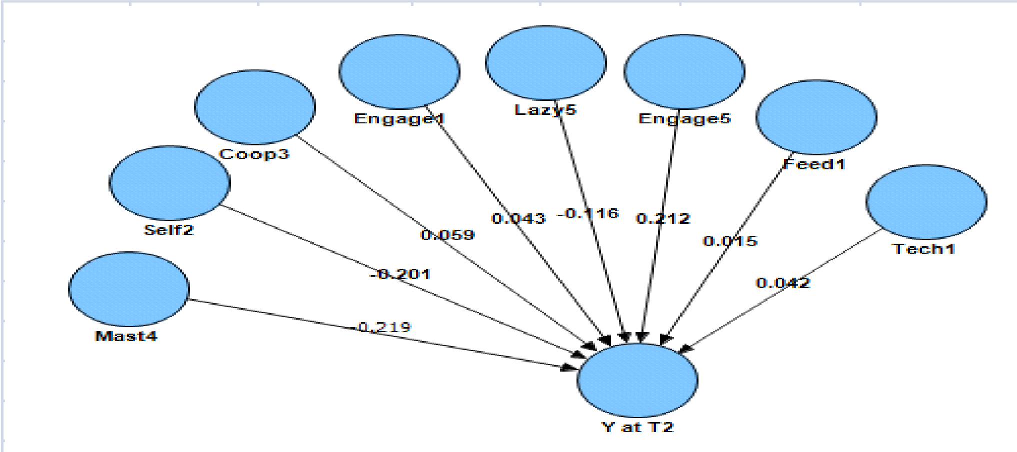
	Component Matrix with All Questions at Time T2														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
t2mast4	.713				-.314		.121			.154		.100			
t2mast3	.685	.157	-.193	.251	.203	-.204							.131		-.102
t2mast1	.667		-.144	.235	.114	-.235				.138	.169				
t2loc3	.633		.174		.116	.248	-.205		.212		.105	.139		.255	.147
t2per1	.629	.126	-.139	.268	.119		-.191	.110			.113	-.131	-.190		
t2loc6	.621		.153	-.171	-.282		.295	.306					-.248		
t2stu2	.589		.221	-.292		.234	.135			.275			.283	.117	
t2loc7	.583		.124	-.141	-.196	.132	.311	.293		.144		.125	-.271	-.120	.117
t2tech2	.577	.123	-.191	-.247	.211			-.252		-.187				-.142	
t2stu1	.571		.190	-.304		.224				.249			.344	.140	-.111
t2self1	.571		-.213		-.355					.232	-.130			-.127	

t2eng7	.557	.228		.143	.164	-.243		.162		.179	-.176	.193			.108
t2loc2	.556	-.216	.206			.279	-.202		.128			.185	-.196	.174	.329
t2eng9	.545		.236	.400			-.144		-.106	-.154			-.152	.104	-.175
t2mast2	.540		.276	.436	.239	-.188	.139	-.220				-.137	.119		
t2use2	.512	.303	-.308	-.363	.205			.212					.130		
t2lazy2	.500		.290	.174					-.327	-.197		.186	-.127		
t2per2	.491	-.105	.249	.363	.216	-.191	.208			-.166		-.289			
t2eng4	.473						-.303		.154		.336	.190	.228	-.382	
t2use1	.467	.381	-.378	-.317	.297			.193							
t2frus2	.467			.158		.233			-.451			-.206	.139		
t2eng6	.466	.107	.121	.321	.273	-.115		.147	-.377						
t2feed3	-.465	.345	.139	.217	.133	.274						.282			.137
t2frus4	.434	.331	-.383	-.262		.114	-.198		-.116	-.178		-.126	-.125		
t2frus1	-.411	.377		.226	.319	.367		.214	.180		-.154				-.174
t2stu3	.398	.185				.135	.239	.263	.194			-.258	.171	-.182	.247
t2self2	-.428	.586	-.278	.125		-.156	.273		-.177	.181					
t2tech3	-.126	.578	.388	-.303		-.296	-.130								
t2coop1		.554	.464	-.270	-.238	-.272	-.126		-.113	-.161			.115		
t2loc1	-.468	.530	-.235	.146		-.161	.266	.127	-.203	.172	-.106				
t2coop2	-.104	.518	.422	-.243		-.257	-.158	.148		-.196	-.114		.121		.104
t2lazy3	-.433	.470	-.254	-.102			.102		.100	.116					.123
t2frus3	-.418	.456		.259	.175	.159		.103	.181		-.110		-.180		
t2lazy4	-.169	.411	-.358		-.181	.112				-.195	.384	-.201	.173	.107	
t2loc8	-.344	.405	-.360	.127		.127	-.288		.103	.176		-.147			
t2hum1	.142	.392	.273		-.122	.180	-.149	-.325		.365		-.230		-.134	.200
t2coop3		.441	.479	-.192	-.203		-.156	-.138	-.233	.110	.254	-.104	-.131		-.109
t2lazy1	.109	.377	.434	-.106					.155		.289	-.211	-.184	-.108	-.158
t2eng1	-.203	.339	.132	.400	-.182	-.144	-.143		.131			.196	.133	.303	.105
t2loc4	.244	.272	-.208	.303	-.456	.340		-.155	-.118	-.347	-.130	.101			
t2loc5	.353	.321	-.290	.177	-.400	.317		-.154	-.150	-.324		.111			
t2lazy5	-.225	.317	.178	.128	.388	.357		.273						.115	-.266
t2eng5		.116	.231	.288	-.226	-.330	.132		.288	-.180	.300	.317	.210		
t2feed1		.198	.144		.121		.481	-.126	.270	-.201	.131	-.224		-.143	.233
t2feed4	.266	.106	-.294	.261		-.174	-.350		.180	.102			-.238	-.248	
t2tech1	.292	.310	-.168	-.289	.320		.183	-.441		-.168	-.110	.222			
t2use3	.198	.307		-.270	.263	-.132	.218	-.372					-.355		-.179
t2feed2	.369	.246	-.314	-.191		-.140		.124	.389	-.169		-.155	-.173	.194	
t2hum2	.349	.221	.165	.123	-.125		-.102	-.343	.227	.182	-.415		.101		
t2eng3		.103	-.225		.166			-.195	-.173	.328	.384			.351	.300
t2eng2	-.190	.214	.234	.152	.366	.256					.106	.235		-.449	
t2eng8	.277	.202		.223	-.102	.138	.260			.131	.265	.123		.137	-.507

The principal components analysis reveals that the empirically extracted components do not match the literature derived constructs used in the questionnaire. It is not clear whether the empirically extracted components are a better fit than the literature-based constructs. To test the extracted components, a model is created using SmartPLS and the eight factors that predominantly emerge from PCA (shaded in Table 7 above). PLS software is more efficient for exploratory use (Chin, 1998). “PLS is preferable to other techniques, like regression, that assume error-free measurement. As a components-based approach, PLS allows for the use of both formative and reflective measures, which is not generally achievable with covariance-based structural equation modeling techniques such as LISREL” (Jones, Sundaram and Chin, 2002, 148).

SmartPLS is used in this study since it lends itself to ad hoc modeling necessary for exploratory analysis to determine relevant factors and relationships. SmartPLS produces multiple measures to quantify the goodness of fit. Six scores (Hubona, 2010) are generated for each construct. The six scores are: Average Variance Explained (AVE), Composite Reliability, R-squared, Cronbach’s Alpha, Communality and Redundancy. AVE or average variance explained is acceptable if it is above 0.5, while composite reliability should be 0.6 and above for an exploratory study. R square values of 0.19 are weakly predictive while 0.33 is moderately predictive and 0.67 is substantially predictive (Hubona, 2010). Cronbach’s Alpha should be 0.7 and above. Communality should be above 0.5 and Redundancy should be as low as possible. Figure 11, below, shows the eight constructs and their relationship to student performance at time T2. The six goodness of fit measures are also shown in Figure 11.

Figure 11: Model Based on SPSS Factor Analysis



	AVE	Composite Reliability	R Square	Cronbachs Alpha	Communality	Redundancy
Coop3	0.5187	0.6705	0	0.0815	0.5187	0
Engage1	1	1	0	1	1	0
Engage5	1	1	0	1	1	0
Feed1	0.5229	0.3582	0	-0.2601	0.5229	0
Lazy5	0.3519	0.4219	0	0.1736	0.3519	0
Mast4	0.2115	0.7104	0	0.7751	0.2115	0
Self2	0.2342	0.1964	0	0.4818	0.2342	0
Tech1	0.5041	0.5581	0	0.3381	0.5041	0
Y at T2	0.7272	0.842	0.2226	0.6255	0.7272	0.0166

Based on these scores, the model in Figure 11 is not acceptable since AVE, Composite Reliability and Cronbach's alpha are too low.

The entire procedure is repeated with time T1 and time T3 data. The time T1 data is used in a factor analysis which explains 66.698% of the variance (see Table 8). The principal components analysis does not find the same components in all three analyses. The following figures and tables show analysis results using the same procedure for data collected at times T1 and T2.

Table 8: Component Matrix with All Questions at Time T1

Component Matrix with All Questions at Time T1

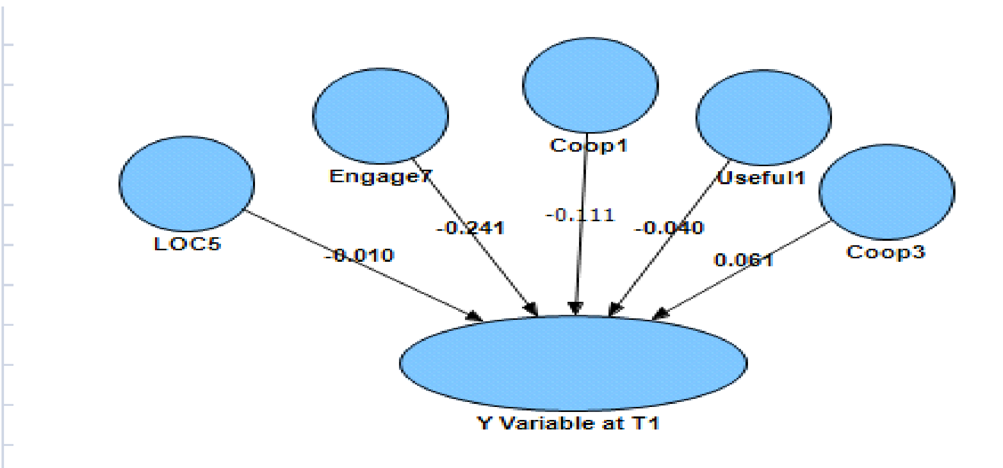
	Component														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engage7	.684	.121			.190		.220								.259
Mast3	.682		-.112	.142		-.265	.307	.161			.152	-.106			-.105
Mast4	.668				-.267	.107				.188					
Perf1	.640	.280	-.124	.126			.123	.188				-.115			
Mast1	.625	.119	-.216			-.190	.328	.176	.222		.122			.195	-.135
Engage6	.591		.305		.133	-.115	.113		-.153		-.241		.235		.151
Tech2	.585	.214	-.306		.120		-.111	-.241							
Student1	.577				.284	.317				-.252	.274	.162	.308	-.112	
LOC7	.568		.211	-.198	-.226	.318		-.346		.296				.107	
Self1	.556		-.192	.167	-.256					.264		-.208			.156
LOC6	.552		.247	-.156	-.182	.419		-.362		.230				.153	
LOC3	.552	-.144		-.108	.192	.265		.300	.185	.136			-.186		
LOC1	-.538	.422	-.211	.129	-.189		.115	-.270	-.267					.135	
Frust4	.535		-.489	-.174											
Lazy2	.532		.380	.193		-.201	-.109							-.112	
Frust1	-.529	.302	.125	.296	.387	.270				.164					
Human2	.527		.119		.222		-.279		-.187	-.131	.119			.348	
LOC2	.524	-.261	.299		.216	.352		.271		.123	-.188		-.128		
Student2	.517				.169	.380	.101	-.139		-.269	.319		.213	-.238	-.120
Engage4	.506		-.179				-.183	.161	.344	-.208				.129	
Engage9	.491	.212	.356	.266				.136	-.269		-.115		-.205	-.113	
Frust3	-.483	.345		.212	.300	.265	.135								
Mast2	.463		.403	.124		-.361	.285				.131			.136	
Feed3	-.456	.357	.148	.287	.204				.137		.104				
Feed2	.361	.180	-.135			.218	.108		.120	.170	-.310	.159	-.246	.177	.113
Coop1		.661	.218	-.320		-.187		.135						-.156	
Tech3		.584	.281	-.452				.130							-.109
Coop2	-.193	.559	.173	-.413	.163	-.137		.313		.104		-.206			
Self2	-.401	.461	-.220		-.177	-.152	.280	-.262	-.199						.173
Useful3	.261	.427			.255	-.156	-.414	-.113		-.134	-.199	.140			
Lazy4	-.177	.421	-.272		-.158	.220	.142	.150	.132			.172			-.270
Lazy5	-.365	.377	.163	.298	.218	.267	.188								-.148
Useful1	.435	.254	-.537		.222			-.126		.165	-.156		.177		-.168
Useful2	.457	.184	-.522		.289			-.136		.193					-.168
Lazy3	-.397	.317	-.439		-.160	.209			.178	-.126	.100	.114	-.104	.282	
Perf2	.338	.131	.401	.165		-.321	.291	-.105		-.117			-.258	.219	-.241
LOC8	-.382	.169	-.392			.100		.251			.301		.183	.242	.195
Engage1	-.208	.185	.359	.260	-.201		-.178		.333	.202	.238			.126	
Coop3	.105	.376	.213	-.459	-.134						.152	-.100		-.200	.222
Lazy1		.290	.224	-.433	-.224							.420			-.200
LOC5	.402	.226	-.106	.392	-.520	.177	-.126	.234	-.193	-.108		-.125	.128	-.104	-.107
LOC4	.368	.199		.409	-.494	.118	-.174	.257	-.200			-.150	.116	-.221	
Engage2	-.237	.248	.153	.340	.364			-.161		.233	.174				.160
Tech1	.373	.219	-.234	.116	.218		-.530			-.195		.158	-.151		.139

Engage5		.166	.408			-.182	-.277		.489	-.116			.343	.130	
Human1	.117	.240		-.226	-.119	.278		.137	-.366	-.226	.239		-.200	.229	.246
Student3	.232			-.117		.154	.264	-.149	.353	-.222		-.186	-.114	-.343	.302
Feed4	.367	.123	-.121	.102	-.135	-.186		.135		.388	.273	.217			
Feed1		.258	.228	.184		.198	.123	-.102	.247	-.364	-.403	-.103		.201	
Engage3	.119			.144		-.162	.146	.348			-.113	.659			.176
Frust2	.376	.142				-.126	-.224	-.256	.143		.296		-.481	-.109	-.221
Engage8	.224	.258		.160	-.312	-.104	.178	-.191	.267			.207	-.175	-.267	.327

Extraction Method: Principal Component Analysis. 15 components extracted.

Using data collected at time T1, five components are identifiable before the pattern collapses. SmartPLS is used for generating the model, and the results are shown in Figure 12. AVE scores of some factors are below 0.5, some factors report a Composite Reliability that is below 0.6, and the R squared is less than 0.19 making this model unacceptable.

Figure 12: Model at Time T1 Based on Factor Analysis



	AVE	Composit	R Square	Cronbachs	Communa	Redundancy
Coop1	0.2651	0.0784	0	0.4348	0.2651	0
Coop3	0.5488	0.7077	0	0.1799	0.5488	0
Engage7	0.1972	0.5218	0	0.6196	0.1972	0
LOC5	0.3541	0.4313	0	0.1111	0.3541	0
Useful1	0.3703	0.7735	0	0.6731	0.3703	0
Y Variable at T1	0.5919	0.737	0.1499	0.3396	0.5919	0.0332

The process is recreated using data collected at time T3. The principal components analysis using SPSS explains 72.093% of the variance as shown in Table 9.

Table 9: Component Matrix with All Questions at Time T3

Component Matrix with All Questions at Time T3

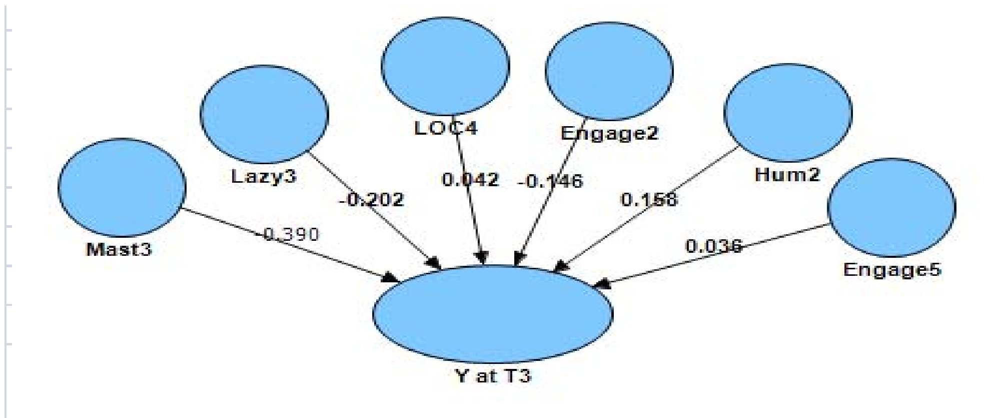
	Component														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
t3mast3	.760			-.159		-.216			.110			.117	-.114		
t3eng7	.745					-.317				-.123	-.140				
t3per1	.694			-.233				-.219		-.235		-.162		-.155	.208
t3mast1	.674		-.126	-.122		-.230	-.136	-.133		-.285	-.111				
t3mast2	.665		.316			-.220		.276	-.156					-.120	
t3loc6	.660	-.109	.107	-.156		.375	-.286				-.101			.155	.144
t3mast4	.645			-.256			-.258	.127	.252	.112	-.173		.197		
t3tech2	.643		-.186	.352		-.116		.124		.159	.158				
t3loc7	.634		.107	-.117		.376	-.251	-.174			-.146				.260
t3stu1	.633			.210	.196	.349	.111			-.253		.137	-.110		.110
t3stu2	.626		-.114	.375	.241	.468		.147		-.176	.124				
t3stu3	.626		-.114	.375	.241	.468		.147		-.176	.124				
t3per2	.622		.343			-.162		.271	-.318						
t3eng6	.610		.236			-.369	.122	.236	-.211		-.124			.147	
t3frus2	.608		.133		.134	.137		.227		.192	.118			.211	
t3self1	.606		-.110	-.383			-.189		.318				.171		
t3use1	.605	.106	-.494	.136		-.209	-.139					-.109	.158	.116	
t3use2	.605		-.361	.118		-.165	-.100	-.138					.156	.289	-.125
t3loc3	.590	-.206	.307	.175	.209	-.116		-.324	.160		.170	.105			.141
t3lazy2	.589		.310	-.198							-.111	.193		.159	-.230
t3frus4	.568	.203	-.502	.154					-.105				.112	.207	.127
t3eng9	.552		.317	-.254		-.164			-.161	-.140		-.147			.276
t3loc2	.531	-.238	.365		.101		.135	-.288		.197	.280	.134			
t3feed2	.510		-.334		-.194		-.117		-.128		.173	.301	.121		
t3eng4	.467			.153		-.106	.301		.269	.399			-.118	.205	
t3tech1	.453		-.303	.374		-.188		.246		.189	.153		-.351		
t3feed4	.430	.186	-.217				.286	-.140		-.129	-.172	.304			-.417
t3lazy3	-.204	.685	-.331					-.147		.186		.184			.108
t3self2	-.224	.682	-.316	-.162	.115	.104		.296			-.209				.187
t3loc1	-.247	.674	-.264	-.186		.135		.362	-.149		-.117				
t3loc8	-.299	.607	-.260	-.184	.107	-.145	.128	-.155	.128	.120					.171
t3frus3	-.240	.598	.155		.404			-.105			.108	-.125	.118	.117	
t3coop2	.143	.577	.226	.213	-.453		-.203				.160			.202	
t3frus1	-.257	.577	.217		.442			-.147	-.162	-.106		.140		.134	
t3lazy5	-.152	.554	.288	.111	.387			-.169	-.195					.131	
t3tech3	.227	.549	.179	.210	-.543					-.173					
t3feed3	-.184	.544	.227		.354				.229			-.198			-.141
t3lazy4	.101	.540	-.211	-.168	-.108			-.174	-.108	.238	.352			-.101	-.141
t3coop1	.223	.519	.328	.195	-.506					-.139		.114		.161	

t3coop3	.202	.481	.283	.152	-.377	.160		-.163				-.250		-.234	
t3eng1		.478	.250	-.254		.108	.168	.178	.349			.137	.120	-.118	-.228
t3eng3	.133	.366			.103	-.284	.136	.181		-.189	.175	.182	.268	-.314	.148
t3loc4	.450	.222	-.138	-.563			.289		-.145		.212	-.221	-.219		-.121
t3loc5	.502	.226	-.217	-.512		.192	.217	-.108			.170	-.234	-.194		-.110
t3use3	.392	.179	-.176	.415			-.108		.265		-.253	-.149	-.325		-.128
t3eng2		.372	.322		.396		-.151		.271		.122			.130	-.127
t3hum2	.352	.167		.168		.109	.475		-.175		-.338	.265		-.105	.199
t3eng8	.336	.232					-.452		-.124			.139	-.337	-.332	
t3eng5	.136	.279	.314	-.128			.210	.300	.343	.166	.126	.120			.238
t3feed1	.198	.133	.134		.169	.105	-.261		-.264	.445			.265	-.301	-.107
t3lazy1	.278	.313	.289		-.165	.203		-.285	-.170	.222	-.383				
t3hum1	.264	.336		.245			.260	-.123		.164	-.175	-.416	.344		

Extraction Method: Principal Component Analysis. 15 components extracted.

Fifteen components emerge from the PCA. However, this time, component number six cannot be formed, component eight is inconclusive and the last four are unstable. The factors (shaded above) from the T3 data are used to create a SmartPLS model, but it is not acceptable because the AVE and reliability are too low. The results are shown in Figure 13.

Figure 13: Model at Time T3 Based on Factor Analysis



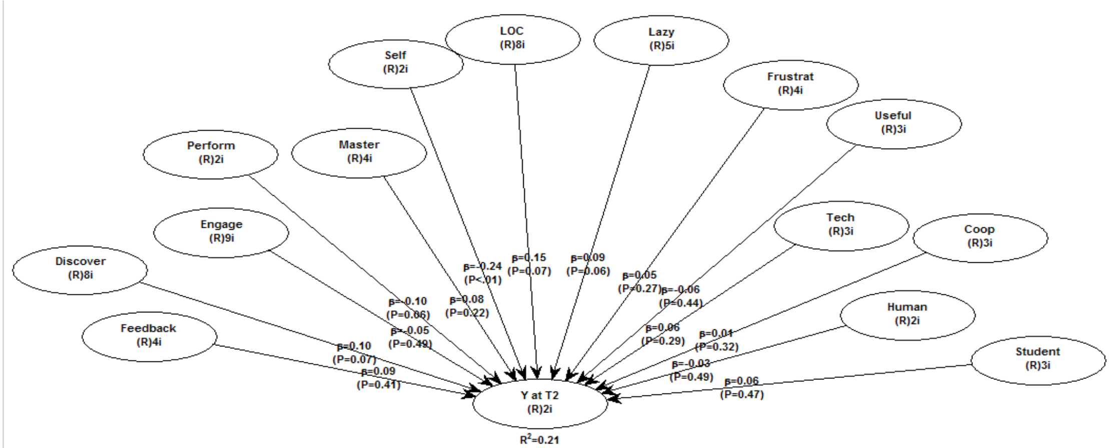
	AVE	Composite Reliability	R Square	Cronbachs Alpha	Communality	Redundancy
Engage2	1	1	0	1	1	0
Engage5	1	1	0	1	1	0
Hum2	0.5021	0.5506	0	0.3246	0.5021	0
LOC4	0.4442	0.7023	0	0.4207	0.4442	0
Lazy3	0.1927	0.2409	0	0.7191	0.1927	0
Mast3	0.2491	0.8228	0	0.8338	0.2491	0
Y at T3	0.654	0.7906	0.2039	0.4727	0.654	0.0087

The goal of the analysis is to identify the constructs and confirm the Cronbach's alpha reliability measures, but so far it is unsuccessful. Since the PCA does not produce reliable factors, the focus returns to the theory-driven view presented in the previous chapter and the fourteen theorized constructs: Feedback, Discovery and Engagement (from learning theories); Mastery Goals, Performance Goals, Self-efficacy and Locus of Control (from psychological theories); Usefulness, Technical efficacy, Lazy User and Frustration (from technology theories); and Cooperative learning, Humanistic learning and Student controlled (from sociological theories).

WarpPLS can be used to compare models to determine whether one model has a better fit with the original data than another by using model fit indices, but it is harder to model with WarpPLS than SmartPLS. WarpPLS offers three "goodness of fit" scores that SmartPLS does not have: APC (average path coefficient), ARS (average R-squared) and AVIF (average variance inflation factor) in addition to the six measures that SmartPLS offers. Kock (2010) suggests the P- values for both the APC and ARS should be lower than 0.05. This indicates that the relationships within the model are significant at the 0.05 level. He also recommends that the AVIF be lower than 5, which denotes an acceptable level of multicolinearity in the model.

In Figure 14, each oval represents a factor, and the digit inside is the number of questions used to create the construct. This model is created by using the fourteen theorized constructs. However, the model in Figure 14 is not acceptable since the APC p-value is not significant. However, there are many significant relationships between constructs as indicated in bold text as shown in Table 10.

Figure 14: WarpPLS Model at Time T2 Based on Theory-Driven View



	Composite Reliability	Cronbach's Alpha	AVE
Y at T2	0.842	0.625	0.728
Feedback	0.361	0.159	0.345
Discover	0.223	0.09	0.208
Engage	0.593	0.438	0.211
Perform	0.863	0.682	0.759
Master	0.877	0.813	0.642
Self	0.902	0.783	0.822
LOC	0.428	0.499	0.396
Lazy	0.462	0.245	0.392
Frustrated	0.694	0.473	0.502
Useful	0.89	0.813	0.73
Tech	0.813	0.653	0.595
Coop	0.912	0.856	0.776
Human	0.808	0.526	0.678
Student	0.834	0.694	0.638

T2: Model fit indices and P values
APC=0.015, P=1.000
ARS=0.207, P=0.042
AVIF=1.341, Good if < 5

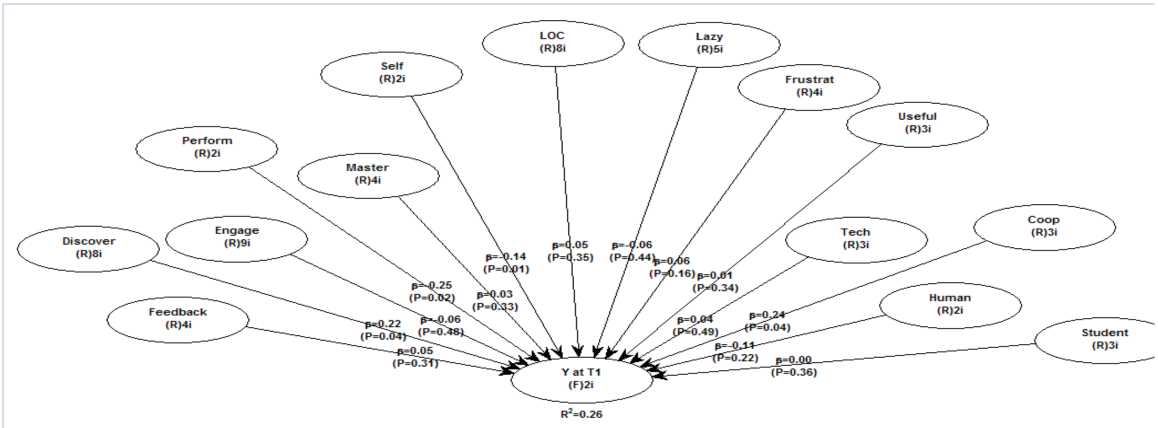
Table 10: P Values for Correlations at Time T2

P values for correlations at T2

	Y at T2	Feedbac	Discove	Engage	Perform	Master	Self	LOC	Lazy	Frustra	Useful	Tech	Coop	Human	Student
Y at T2	1														
Feedbac	0.117	1													
Discove	0.017	0.35	1												
Engage	0.345	**<.001**	0.204	1											
Perform	**<.001**	**<.001**	0.484	**<.001**	1										
Master	0.473	**<.001**	**0.005**	**<.001**	**<.001**	1									
Self	**<.001**	**<.001**	**0.01**	**<.001**	**<.001**	**<.001**	1								
LOC	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	1							
Lazy	**<.001**	0.091	**<.001**	**0.001**	**<.001**	**<.001**	**0.001**	**<.001**	1						
Frustra	**<.001**	**<.001**	**<.001**	**0.01**	**0.006**	**<.001**	**<.001**	**<.001**	**<.001**	1					
Useful	0.837	**<.001**	0.374	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	0.745	0.051	1				
Tech	0.848	**<.001**	0.112	**<.001**	**0.011**	**<.001**	**<.001**	**<.001**	0.274	**0.026**	**<.001**	1			
Coop	0.326	0.534	**<.001**	0.731	0.44	0.241	0.371	0.053	0.116	**0.003**	0.144	0.136	1		
Human	0.911	0.211	**0.031**	0.5	**0.049**	0.712	0.305	0.448	0.116	0.135	0.736	0.107	**<.001**	1	
Student	**0.023**	**<.001**	**0.024**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	0.288	**<.001**	1

The same analysis is run using time T1 data and produces similar results as seen in Figure 15 and again in Table 11.

Figure 15: WarpPLS Model at Time T1 Based on Theory-Driven View



	Composite Reliability	Cronbach's Alpha	AVE
Y at T1	0.752	0.34	0.602
Feedbac	0.449	0.223	0.353
Discove	0.223	0.09	0.208
Engage	0.473	0.416	0.228
Perform	0.863	0.683	0.76
Master	0.846	0.757	0.58
Self	0.876	0.717	0.779
LOC	0.498	0.47	0.398
Lazy	0.414	0.116	0.405
Frustrat	0.709	0.486	0.54
Useful	0.887	0.808	0.724
Tech	0.826	0.682	0.613
Coop	0.89	0.815	0.73
Human	0.757	0.357	0.609
Student	0.846	0.722	0.653

Model fit indices and P values

APC=0.006, P=1.000
ARS=0.262, P=0.113
AVIF=1.508, Good if < 5

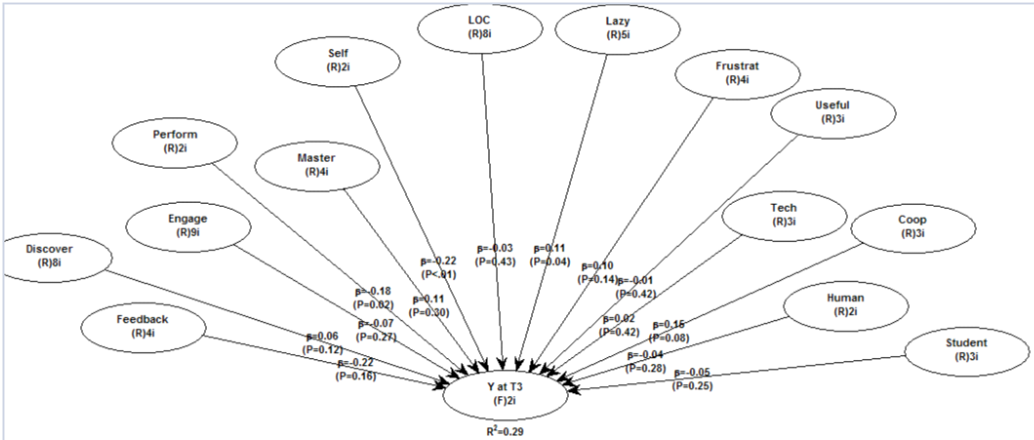
Table 11: P-values for Correlations at Time T1

P values for correlations at T1

	Y at T1	Feedbac	Discove	Engage	Perform	Master	Self	LOC	Lazy	Frustra	Useful	Tech	Coop	Human	Student
Y at T1	1														
Feedbac	0.434	1													
Discove	**0.014**	0.358	1												
Engage	**0.002**	**<.001**	**0.014**	1											
Perform	**<.001**	**<.001**	0.274	**<.001**	1										
Master	0.346	**<.001**	**0.003**	**<.001**	**<.001**	1									
Self	**<.001**	**<.001**	**0.046**	**<.001**	**<.001**	**<.001**	1								
LOC	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	1							
Lazy	0.059	**0.047**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	1						
Frustra	**0.002**	**<.001**	**<.001**	**<.001**	**0.002**	**<.001**	**<.001**	**<.001**	**<.001**	1					
Useful	0.113	**<.001**	0.806	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	0.56	**<.001**	1				
Tech	0.051	**<.001**	0.074	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	0.094	**0.001**	**<.001**	1			
Coop	**0.025**	0.713	**<.001**	0.474	0.254	0.795	0.068	**0.032**	0.114	**0.001**	0.651	0.252	1		
Human	0.251	**0.048**	**0.009**	0.122	**0.035**	0.461	0.101	0.175	0.925	0.237	0.957	0.127	**<.001**	1	
Student	**0.021**	**<.001**	**0.003**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**0.001**	**<.001**	**<.001**	0.323	**0.013**	1

The same analysis is run with data from time T3 as shown in Figure 16 and Table 12. Again, it is not acceptable since the APC p-value is not significant.

Figure 16: WarpPLS Model at Time T3 Based on Theory-Driven View



	Composite Reliability	Cronbach's Alpha	AVE
Y at T3	0.791	0.473	0.655
Feedback	0.604	0.318	0.384
Discover	0.223	0.09	0.208
Engage	0.724	0.604	0.256
Perform	0.884	0.737	0.792
Master	0.882	0.821	0.652
Self	0.921	0.828	0.853
LOC	0.564	0.608	0.405
Lazy	0.597	0.458	0.404
Frustrated	0.759	0.574	0.561
Useful	0.899	0.83	0.747
Tech	0.849	0.733	0.654
Coop	0.918	0.866	0.789
Human	0.796	0.488	0.661
Student	0.832	0.693	0.63

T3: Model fit indices and P- values

APC=-0.019, P=1.000
ARS=0.288, P=0.005
AVIF=1.578, Good if < 5

Table 12: P-values for Correlations at Time T3

P values for correlations at T3

	Y at T3	Feedbac	Discove	Engage	Perform	Master	Self	LOC	Lazy	Frustra	Useful	Tech	Coop	Human	Student
Y at T3	1														
Feedbac	**0.03**	1													
Discove	**0.007**	0.626	1												
Engage	**0.004**	**<.001**	0.096	1											
Perform	**<.001**	**<.001**	0.241	<.001	1										
Master	**<.001**	**<.001**	**0.003**	**<.001**	**<.001**	1									
Self	**<.001**	**<.001**	0.061	**<.001**	**<.001**	**<.001**	1								
LOC	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	1							
Lazy	**0.013**	0.882	**<.001**	0.295	**0.014**	**<.001**	**0.006**	**<.001**	1						
Frustra	**<.001**	**0.036**	**<.001**	0.383	0.064	**0.006**	**<.001**	**<.001**	**<.001**	1					
Useful	0.436	**<.001**	0.944	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	0.688	**0.012**	1				
Tech	**0.033**	**<.001**	0.181	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	0.528	**0.01**	**<.001**	1			
Coop	0.132	**0.036**	**<.001**	**<.001**	**0.05**	**0.003**	0.714	0.917	**<.001**	**0.002**	**0.034**	**0.009**	1		
Human	0.38	0.196	**0.019**	**<.001**	**<.001**	**0.009**	0.337	0.101	**0.002**	**0.017**	**0.009**	**0.001**	**<.001**	1	
Student	**<.001**	**<.001**	0.071	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**0.004**	0.067	**<.001**	**<.001**	0.057	**<.001**	1

This analysis shows some support for the theory-driven view as each model produces some factors that are relevant, reliable and significant and confirms some of the original scores in the Cronbach's Alpha reliability table. This model shows some evidence to help answer the research questions: that some factors are significant, that there are significant relationships, and that some of these relationships change over time. Table 13 shows the factors that have a significant relationship to student performance (Y variable) at times T1, T2 and T3.

Table 13: Significant Paths to the Y Variable

Significant Paths to the Y Variable		
T1	T2	T3
Performance Goals	-	Performance Goals
Self-efficacy	Self-efficacy	Self-efficacy
Cooperative Learning	-	-
Discovery	-	-
-	-	Lazy User

These results provide some support for the literature-based constructs, especially Performance Goals, Self-efficacy, Cooperative Learning, Discovery and the Lazy User. Performance Goals, Self-efficacy and Cooperative Learning also reveal excellent reliability scores. However, other constructs' scores are not acceptable.

Since the study still needs to identify all the significant factors in the WBH learning environment, the focus returns to the literature and data analysis. The original Cronbach's alpha table is reevaluated and the factors and questions with low reliability scores are removed. The Student Centered construct is also removed because it has not been significant in any of the models. Another factor analysis is run, this time resulting in eight factors which explain only 69.56% of the variance. (See Table 14) While this is less than the previous matrix, the factors' groupings are closer to the literature-based constructs and the component matrix is more cohesive leading to eight well-formed components.

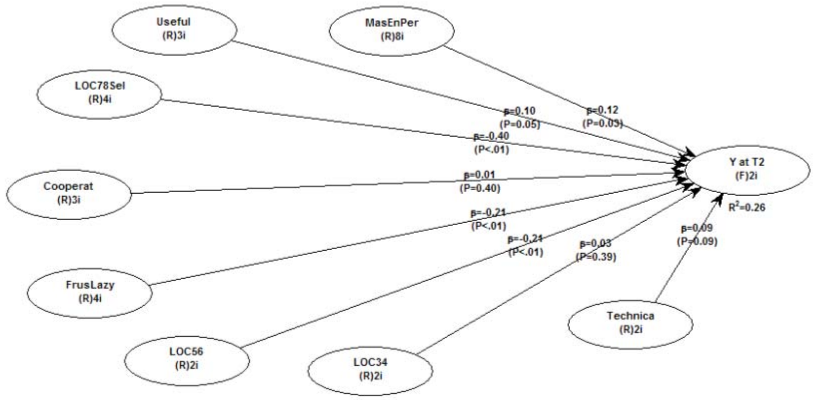
Table 14: Component Matrix at Time T2 (Dropping Items with Low Reliability)

	Component Matrix at T2 (dropping questions with low reliability)							
	1	2	3	4	5	6	7	8
t2mast3	**0.794**	-0.214					0.143	0.274
t2mast1	**0.711**	-0.251			0.125		0.133	0.266
t2mast4	**0.698**	0.332	0.231			0.14		0.211
t2eng7	**0.632**	0.178					0.204	
t2per2	**0.616**	0.441	0.115	-0.116		0.152	0.117	-0.11
t2per1	**0.611**				0.153	0.352	0.304	-0.119
t2mast2	**0.602**	0.286	0.385	-0.162				0.107
t2eng8	**0.542**	0.417	0.247					-0.104
t2use2	0.141	**0.801**	0.128					0.232
t2use3		**0.766**	0.221					0.232
t2use1		**0.691**				0.346	0.129	0.172
t2loc7	0.101	0.125	**0.755**	0.115	0.181		0.353	
t2loc8		0.139	**0.735**		0.108		0.415	
t2self1	0.344	0.109	**0.679**		0.203	0.284		0.108
t2self2	0.28	0.155	**0.604**	-0.104	0.151	0.304	-0.148	
t2coop2				**0.902**		0.105		
t2coop1				**0.848**	-0.143			
t2coop3				**0.847**	-0.113			
t2frus4			0.179	-0.133	**0.793**			0.111
t2frus2		0.12	0.22	-0.11	**0.751**			
t2lazy1		-0.167			**0.658**	-0.162	0.369	
t2lazy4	0.317			-0.134	**0.562**		0.377	-0.194
t2loc5			0.116			**0.887**		
t2loc6		0.185	0.151			**0.848**		
t2loc3	0.17		0.18	-0.107	0.112		**0.78**	
t2loc4	0.263	0.195	0.223				**0.685**	0.141
t2tech2		0.288						**0.8**
t2tech3	0.175	0.347	0.143		0.147	0.106	0.182	**0.672**
Eigenvalue	7.184	2.972	2.164	1.967	1.733	1.264	1.19	1.004
Percent of Variance	25.656	10.615	7.728	7.024	6.189	4.513	4.251	3.587

Rotation Method: Varimax with Kaiser Normalization. Small coefficients suppressed

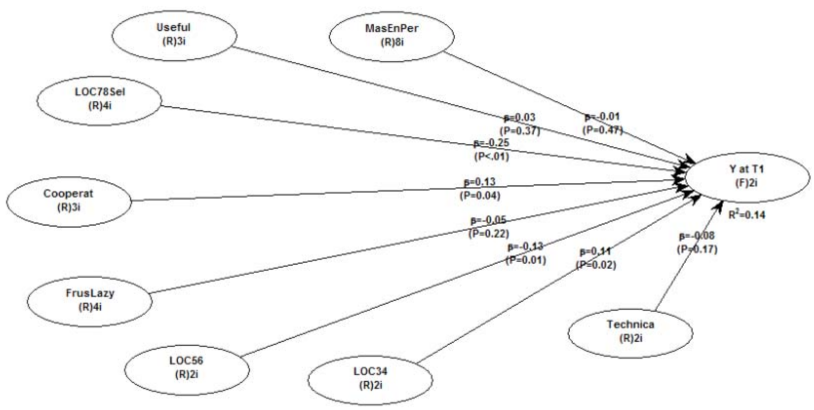
A structural equation model using WarpPLS is created based on this factor analysis and time T2 data. It is run using the default bootstrapping algorithm (resampling with replacement). There are five significant paths to the Y variable and R-squared is 0.26, but three paths are not significant. This model fit is much better than the last, especially at times T2 and T3, but it is not very good at time T1. Figures 17, 18 and 19 show the structural model with data collected at times T2, T1 and T3.

Figure 17: WarpPLS Model at Time T2 Based on PCA



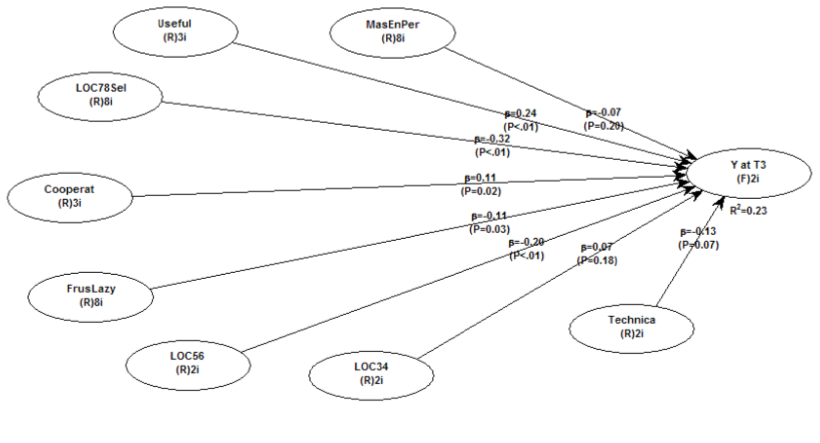
T2: Model fit indices and P values
APC=-0.059, P=<0.001
ARS=0.262, P=<0.001
AVIF=1.410, Good if < 5

Figure 18: WarpPLS Model at Time T1 Based on PCA



T1: Model fit indices and P values
APC=-0.030, P=0.351
ARS=0.142, P=0.024
AVIF=1.421, Good if < 5

Figure 19: WarpPLS Model at Time T3 Based on PCA



T3: Model fit indices and P values
APC=-0.051, P=<0.001
ARS=0.231, P=<0.001
AVIF=1.657, Good if < 5

WarpPLS analyzes nonlinear relationships between latent variables in addition to linear relationships. Table 15 shows the results of this analysis.

Table 15: WarpPLS Report on Linear or Warped Relationship

Click on a "Linear" or "Warped" relationship cell to view plot

	Y	MasEnPer	Useful	LOC78Sel	Cooperat	FrusLazy	LOC56	LOC34	Technica
Y		Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
MasEnPer									
Useful									
LOC78Sel									
Cooperat									
FrusLazy									
LOC56									
LOC34									
Technica									

With this model, since all relationships appear linear, regression analysis is performed. Over 100 regressions are completed. Previous work by Eskew and Faley (1988) found GPA to be the best predictor of a final course average. This study also found GPA to be a significant predictor of student performance. Regressions are run using the same dependent variable as used in the models. The results with the best R squared are shown below in Table 16.

Table 16: Regression Results

Independent Variable	Dependent	R Squared	Sig.
T2 All Psychology	T2 Test & HW	0.218	0.000
T3 LOC 5,6	T3 Exam & HW	0.141	0.000
T3 LOC 3,4,7,8	T3 Exam & HW	0.138	0.000
GPA	T1 Test & HW	0.130	0.000
T3 Self-efficacy	T3 Exam & HW	0.121	0.000
Homework 2	Exam	0.118	0.000
T3 Self 1 & 2	Homework 3	0.113	0.000
T3 Performance Goals	T3 Exam & HW	0.111	0.000
T2 LOC 3,4,7,8	T2 Test & HW	0.103	0.000
T3 Mastery	T3 Exam & HW	0.096	0.000
T2 Self-efficacy	T2 Test & HW	0.094	0.000
T2 Mastery	T2 Test & HW	0.079	0.001
T2 LOC 5,6	T2 Test & HW	0.076	0.000
T3 Cooperative	T3 Exam & HW	0.071	0.001
T1 LOC 5,6	T1 Test & HW	0.058	0.001
T1 Technical-efficacy	T1 Test & HW	0.056	0.006
T1 Self-efficacy	T1 Test & HW	0.054	0.002
T1 Performance Goals	T1 Test & HW	0.053	0.003
GPA	T3 Exam & HW	0.045	0.001
T1 LOC 3,4,7,8	T1 Test & HW	0.044	0.045
GPA	T2 Test & HW	0.044	0.002
T3 Engage 78	T3 Exam & HW	0.037	0.017
T1 Mastery	T1 Test & HW	0.035	0.102

T2 all Feedback	**T2 Test & HW**	**0.034**	**0.115**
T3 Technical-efficacy	**T3 Exam & HW**	**0.031**	**0.079**
T2 Technical-efficacy	**T2 Test & HW**	**0.019**	**0.240**
T2 Frustration 2,4	**T2 Test & HW**	**0.018**	**0.145**
T2 Lazy 1,4	**T2 Test & HW**	**0.016**	**0.174**
T2 Cooperative	**T2 Test & HW**	**0.015**	**0.358**
T1 Cooperative	**T1 Test & HW**	**0.014**	**0.381**
T3 Frustration 2,4	**T3 Exam & HW**	**0.012**	**0.272**
T3 Useful	**T3 Exam & HW**	**0.010**	**0.520**
T1 Frustration 2,4	**T1 Test & HW**	**0.010**	**0.319**
T3 Lazy 1,4	**T3 Exam & HW**	**0.005**	**0.556**
T1 Engage 7 8	**T1 Test & HW**	**0.005**	**0.583**
T2 Performance Goals	**T2 Test & HW**	**0.004**	**0.616**
T2 Useful	**T2 Test & HW**	**0.004**	**0.827**
T2 Engage 78	**T2 Test & HW**	**0.003**	**0.715**
T1 Useful	**T1 Test & HW**	**0.002**	**0.921**
T1 Lazy 1,4	**T1 Test & HW**	**0.000**	**0.985**

However, this does not identify all the significant factors in the WBH learning environment. Although it is interesting, it does not move the research closer to an answer to the first research question which is to find the significant factors in the WBH learning environment.

When at an impasse, it seems advisable to return to the theory-based constructs. The literature review and the questionnaire are again reviewed in light of the items' reliability. The constructs that did not have acceptable Cronbach's Alpha scores had already been dropped. These include Humanistic Learning, Student Centered Control and Feedback. This significantly improves the goodness of fit in the model. A PCA is run again, and SPSS is set to extract twelve components since the Cronbach's Alpha analysis shows high reliability with twelve components. These constructs are: Engagement, LOC 5 and 6, LOC 7 and 8, LOC 3 and 4 (Perceived Ability), Self-efficacy, Performance, Mastery, Usefulness, Technical Efficacy, Lazy User, Frustration and Cooperative Learning. This is shown in Table 16. In effect, this is a confirmatory analysis. If the results are good, it will confirm the theory-based view. PCA analysis with these constructs provides the best results yet, explaining almost 81% of the variance. All the components fit neatly in the matrix and are well-formed. Table 17 shows Cronbach's alpha results for data collected at times T1, T2 and T3 and the component that matches it in the PCA analysis. Table 18 shows the results of the PCA analysis at time T2.

Table 17: Cronbach's Alpha

Cronbach's Alpha (original table with weak constructs removed)	**T1**	**T2**	**T3**	**Component**
Engagement 7&8	.724	.669	.778	9
Performance Goals	.712	.682	.737	9
Mastery	.762	.801	.821	3, 12
Self Efficacy	.741	.783	.828	7
LOC 3 & 4	.806	.809	.838	8
Cronbach's Alpha (original table with weak constructs removed)	**T1**	**T2**	**T3**	**Component**
LOC 5 & 6	.891	.830	.916	5
LOC 7 & 8	.918	.881	.895	4
Lazy User 1 & 4	.623	.627	.768	6, 11
Frustration 2 & 4	.747	.708	.763	6
Useful	.820	.651	.723	1
Technical Efficacy	.657	.653	.733	10
Cooperative Learning	.829	.766	.793	2

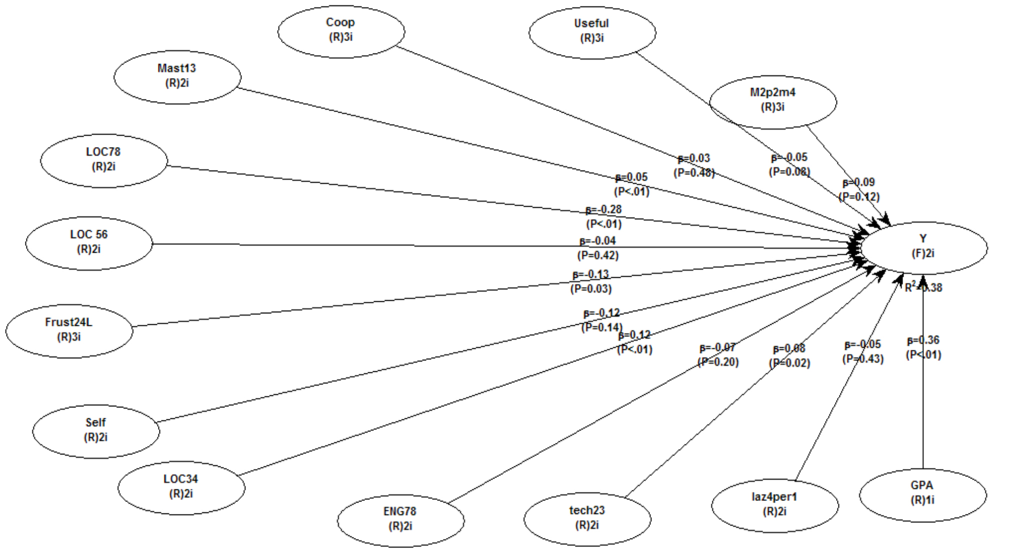
Table 18: Confirmatory Factor Analysis

	T2: Rotated Component Matrix: Set to find 12 Components											
	1	2	3	4	5	6	7	8	9	10	11	12
t2use2	**.845**			.124					.102	.176		.183
t2use3	**.832**			.146			.122	.125		.132	-.102	.104
t2use1	**.712**		-.124		.296					.205	.167	
t2coop2		**.900**			.102							-.110
t2coop1		**.866**	-.137			-.143				.147		.116
t2coop3		**.853**										
t2mast1			**.871**	.126							.160	
t2mast3			**.828**				.116	.173	.228	.107	.112	.140
t2loc7	.170		.118	**.865**		.153	.180	.136				
t2loc8	.135			**.856**			.179	.182	.185			
t2loc5					**.903**		.136					
t2loc6	.152				**.879**		.107			.111		.115
t2frus2				.138		**.844**						.313
t2frus4	.104	-.136				**.778**	.296				.114	-.182
t2lazy1			.196	.328	-.170	**.545**	-.124	.124			.382	-.188
t2self2	.124			.150	.165		**.844**				.107	.151
t2self1	.112		.207	.334	.214	.175	**.686**	.176	.106			.146
t2loc3				.216		.103		**.852**			.174	.106
t2loc4	.175		.155	.105			.188	**.851**	.135			
t2eng7			.304	.113					**.823**		.188	
t2eng8	.186			.124			.157	.117	**.749**			.330
t2tech2	.207									**.875**		.116
t2tech3	.332		.125	.110			.202	.151		**.733**	.107	
t2lazy4		-.147				.338		.217			**.708**	
t2per1			.374		.250		.160	.113	.151		**.671**	.127
t2mast2	.156		.277			.103	.378	.209	.208	.135		**.620**
t2per2	.345		.200	.111	.109		.130		.187		.445	**.588**
t2mast4	.325		.476		.141		.279		.234	.156		**.488**
Eigenvalue	7.18	2.97	2.16	1.97	1.73	1.26	1.19	1.00	0.96	.805	.706	.652
Percent of Variance	25.66	10.62	7.73	7.02	6.19	4.51	4.25	3.59	3.43	2.88	2.52	2.33

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Small coefficients suppressed Rotation converged in 9 iterations.

The literature also includes a student's GPA (grade point average) (Eskew and Faley, 1988) as a significant factor. Figure 20 shows model fit indices and p-values when GPA is added to time T2 data.

Figure 20: WarpPLS Model at Time T2 Adding GPA



T2: Model fit indices and P values
APC=0.001, P=0.008
ARS=0.381, P=<0.001
AVIF=1.331, Good if < 5

R-squared is moderately predictive at 0.38, the highest so far although seven of the paths are not significant. More importantly, the results of the factor analysis created twelve constructs that almost matched the theoretical prediction and mostly matched the results of the Cronbach's alpha reliability table. This is extremely significant as it provides some evidence needed to answer the first research question: What are the factors in the WBH environment? Based on the literature review and data analysis, Table 19 presents the factors found by this study to be significant components of the WBH learning environment.

The results of this factor analysis provide support for the original theory-driven view and the original constructs. It was necessary to confirm the constructs before attempting to create a better model. The empirically supported constructs, presented and explained first in Chapter Three, appear in Table 19 with a brief description.

Table 19: Construct Descriptions

Construct	Description
Mastery Goals	Known as Motive by Simon (1968) and Mastery Goals by others. Wanting to achieve to demonstrate academic competence, understanding or improved performance using *self-established standards*. (Downson and McInerney, 2004). Based on psychological theories.
Engagement	Greene and Miller (1996) found mastery goals were linked to perceived ability which were antecedents of meaningful cognitive engagement and led to performance. Based on educational theories.
Locus of Control	Students who measured higher in achievement motivation exhibited an internal locus of control that showed they believed they had control of the ensuing event. (Weiner, 1994). Based on psychological theories.
Performance Goals	Bandura (1977): Performance results come from exposure and self-instruction and leads to efficacy. Based on psychological theories.
Self-Efficacy	The degree to which a student feels capable of learning from a given method (Cennamo, 1991). Based on psychological theories.
Technical-Efficacy	Santhanam (2008) computer self-efficacy and feedback may influence learning outcomes. Based on theories of technology.
Usefulness	Davis, 1989: the user’s subjective probability that the technology will increase job performance. Based on theories of technology.
Lazy User	Baan, 2001: Users investing only limited effort to express their information need. Based on theories of technology.
Frustration	Bessiere(2002) and Ceaparu (2004): being thwarted in one’s progress by a technical issue. Based on theories of technology.

Construct	**Description**
Cooperative Learning	Individuals interact with other people to improve their mental models by discussing and sharing information (Slavin, 1991). Based on theories of sociology/humanistic learning.
LOC 5 & 6 Perceived Ability	Greene & Miller, 1996: Found perceived ability to be an antecedent of test grades. Based on theories of psychology.
GPA	Eskew and Faley (1988) found GPA to be the most significant predictor of a student's grades.
Homework and Tests (Student Performance)	At T1, the Y variable consists of test 1 and the average of all homework assignments up to test 1 (HW1). At T2, the Y variable consists of test 2 and the average of all homework assignments from test 1 to test 2 (HW2). At T3, the Y variable consists of the final exam and the average of all homework assignments since test 2 (HW3).

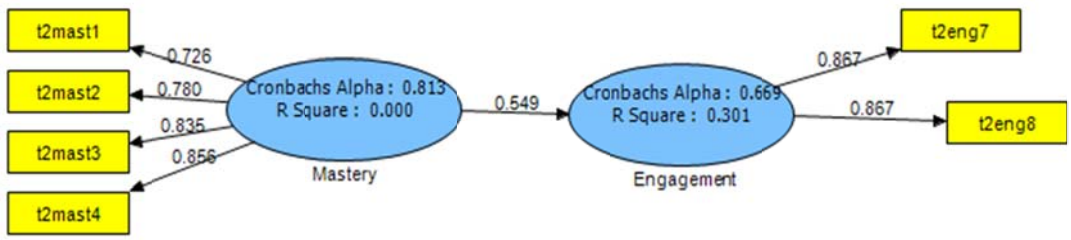
Table 19 summarizes the significant factors in the WBH learning environment that have an impact on student performance. This is in direct response to research question number one and is supported by the preceding analysis. The task is to identify the relationships between these constructs and students' performance in the WBH learning environment. These relationships are tested using SmartPLS and time T2 data. Acceptable models should have all items load above 0.7, and links between constructs should be significant. Table 20, below, provides the constructs and relationships from earlier studies that are tested here in the WBH learning environment. These relationships are examined in an exploratory manner leading to the development of hypotheses to test the existence of relationships between the constructs identified and student performance in a WBH learning environment. The resulting models are presented after the table.

Table 20: Literature Review of Construct Relationships

	Previous Study Examined:	**Source**
1	Mastery/motive leads engagement or interest	Simon, 1967
2	Engagement has a significant effect on Locus of Control	Hedman, 2004
3	Engagement is related to Usefulness and Technical efficacy	Greene and Miller, 1996; Agarwal & Karahanna, 2000
4	High performance goals affect self-efficacy	Schunk, 1989
5	Self-efficacy is positively related to locus of control	Ajzen, 2002
6	Mastery is positively related to Usefulness, self-efficacy and technical-efficacy	Bandura, 1977
7	Self-efficacy is positively related to technical-efficacy and Usefulness , Homework and Test grades	Agarwal & Karahanna, 2000; Bandura, 1977
8	Technical efficacy is related to Usefulness and frustration but Low Technical Efficacy increases one's feelings of Frustration	Bandura, 1977; Bessiere, Jex & Gudanowski, 1992
9	Lazy user characteristics have an effect on Usefulness	Baan et al, 2001
10	Cooperative Learning is related to Frustration	Chase and Okie, 2000
11	Usefulness has an effect on Homework and Test grades	Davis, 1989
12	Locus of Control is significantly related to Homework and Test grades	Rotter, 1966
13	GPA is a significant predictor of Homework and test scores	Eskew & Faley, 1988

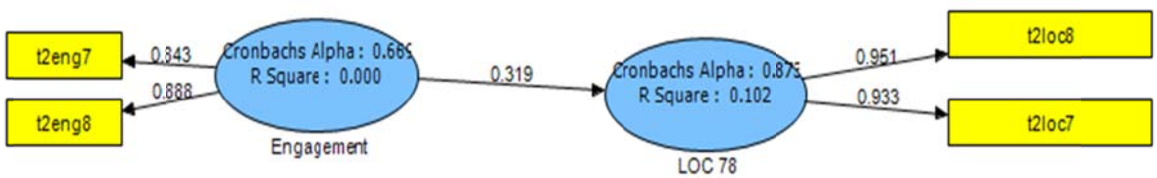
#1: Mastery leads engagement (Simon, 1967): supported by this data in the WBH learning environment. ($p<0.001$) as shown in Figure 21.

Figure 21: Mastery Leads Engagement



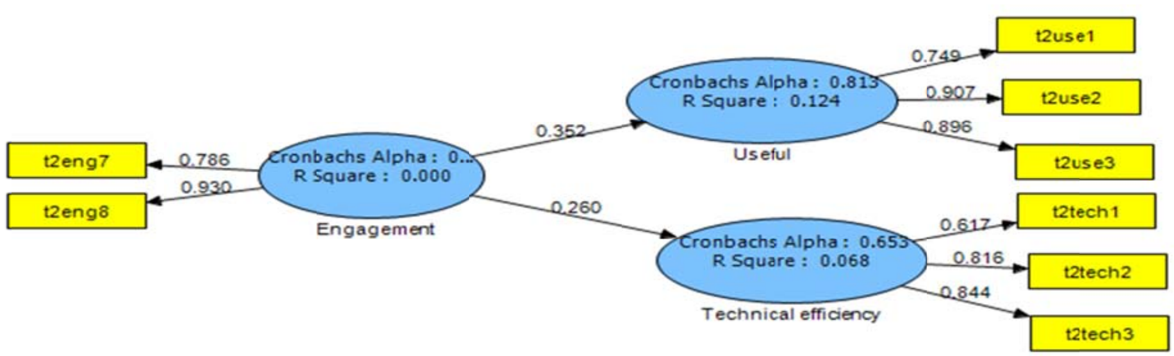
#2. Engagement has a significant effect on Locus of Control (Hedman, 2004): supported by this data in the WBH learning environment. (p<.001) as seen in Figure 22.

Figure 22: Engagement Affects Locus of Control



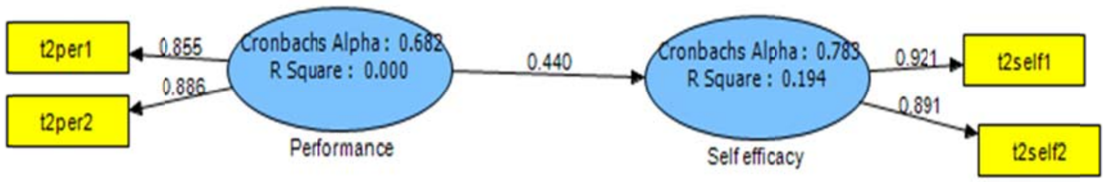
#3. Engagement is related to Usefulness and Technical Efficacy (Greene and Miller, 1996; Agarwal & Karahanna, 2000): supported by this data in the WBH learning environment. (p<0.001 for each one) as depicted in Figure 23.

Figure 23: Engagement Affects Useful and Technical Efficiency



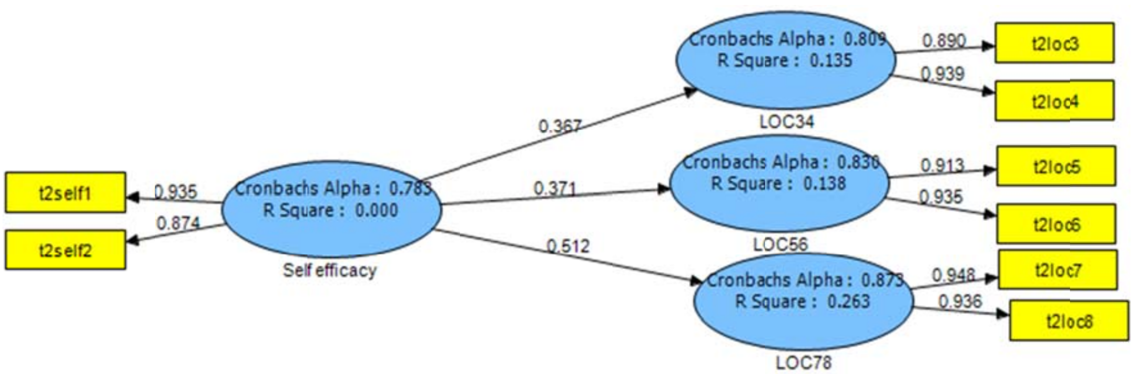
#4. High Performance Goals affect Self-efficacy (Schunk, 1989): supported by this data in the WBH learning environment. (p<0.001) as seen in Figure 24.

Figure 24: Performance Goals Affect Self-Efficacy



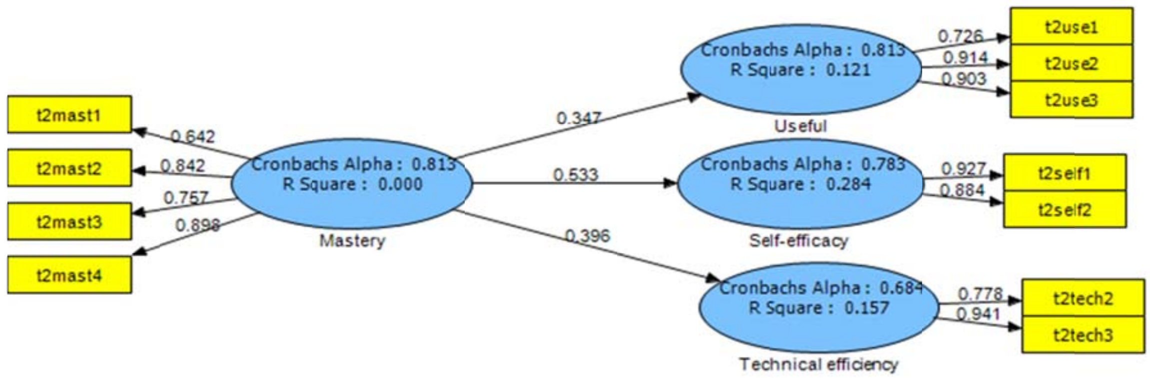
#5. Self-efficacy is positively related to Locus of control (Ajzen, 2002): supported by this data in the WBH learning environment. (p<.001 for each one) as shown in Figure 25.

Figure 25: Self-Efficacy Affects Locus of Control and Perceived Ability



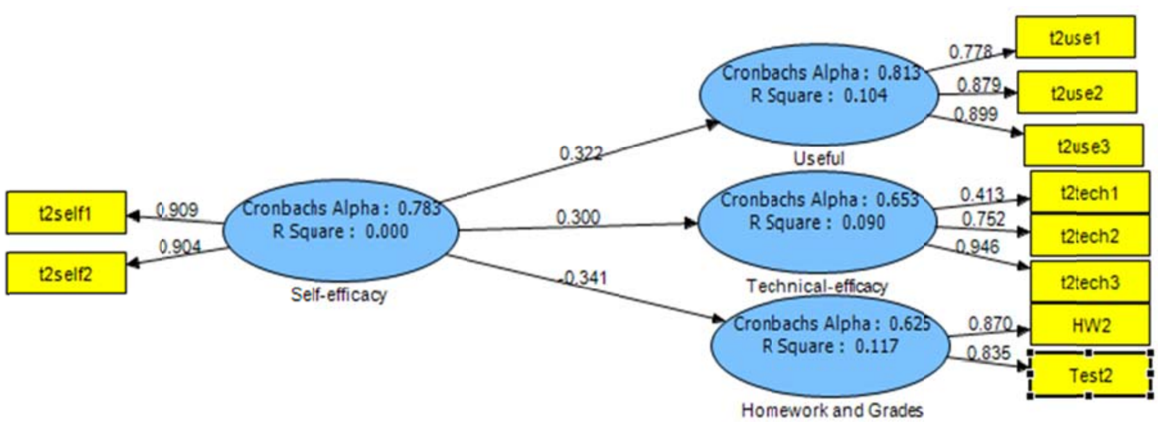
#6. Mastery is positively related to Usefulness, Self-efficacy and Technical-efficacy (Bandura, 1977): supported by this data in the WBH learning environment. (p<0.001 for each one) as seen in Figure 26.

Figure 26: Mastery Motives Affect Usefulness, Self-Efficacy and Technical Efficiency



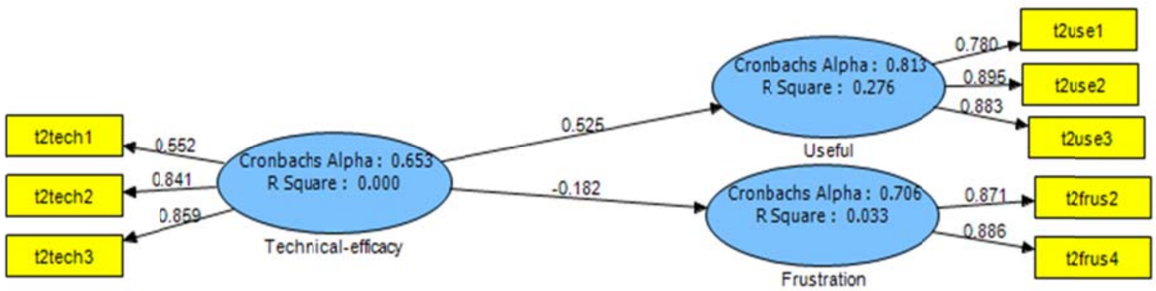
#7. Self-efficacy is positively related to Technical-efficacy and Usefulness, Homework and Test grades (where high grades = 100 and high self-efficacy = 1) (Agarwal & Karahanna, 2000; Bandura, 1977): supported by this data in the WBH learning environment. ($p<0.001$ for each one) as seen in Figure 27.

Figure 27: Self-Efficacy Affects Usefulness, Technical-Efficay and Student Performance



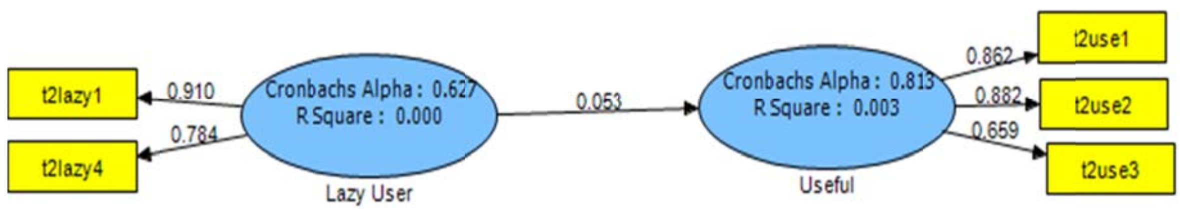
#8. Technical efficacy is related to Usefulness and Frustration, but Low Technical Efficacy increases one's feelings of Frustration (Bandura, 1977; Bessiere, Jex & Gudanowski, 1992): a significant relationship is supported by this data in the WBH learning environment (to useful $p<0.001$; to frustration $p<0.01$) as seen in Figure 28..

Figure 28: Technical-Efficacy Affects Usefulness and Frustration



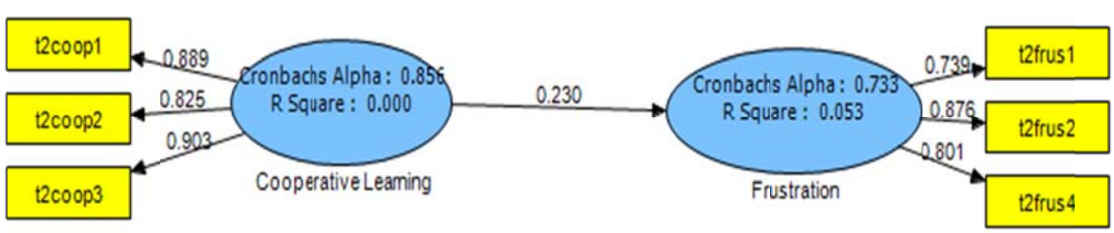
#9. Lazy user characteristics have an effect on Usefulness (Baan et al, 2001): This is not supported in the WBH learning environment (at time T2) (not significant) as seen in Figure 29.

Figure 29: Lazy User Affects Usefulness



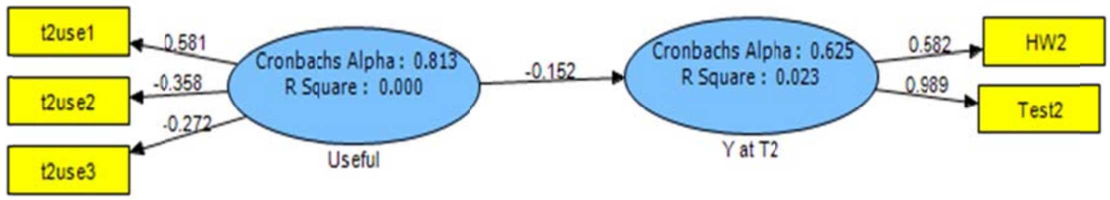
#10. Cooperative Learning is related to Frustration (Chase and Okie, 2000): supported by this data in the WBH learning environment. (p<0.001) as seen in Figure 30.

Figure 30: Cooperative Learning Affects Frustration



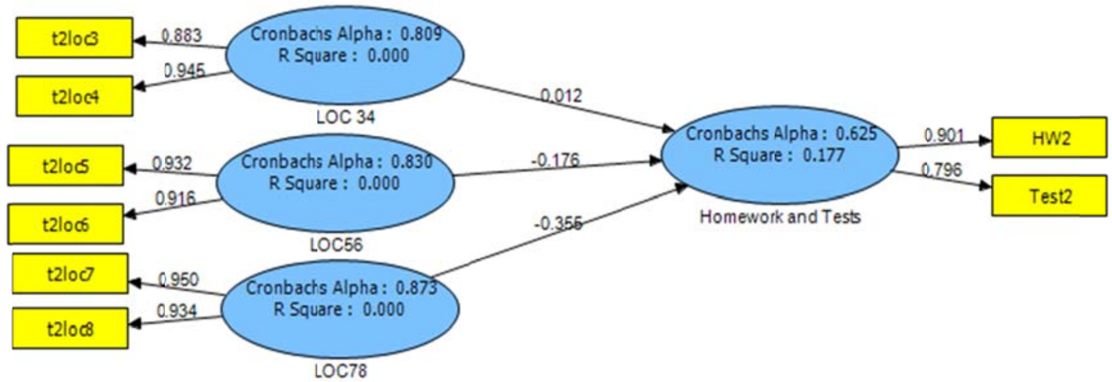
#11. Usefulness has an effect on Homework and Test grades (Davis, 1989): Not supported by this data in the WBH learning environment (not significant) as seen in Figure 31.

Figure 31: Usefulness Affects Student Performance



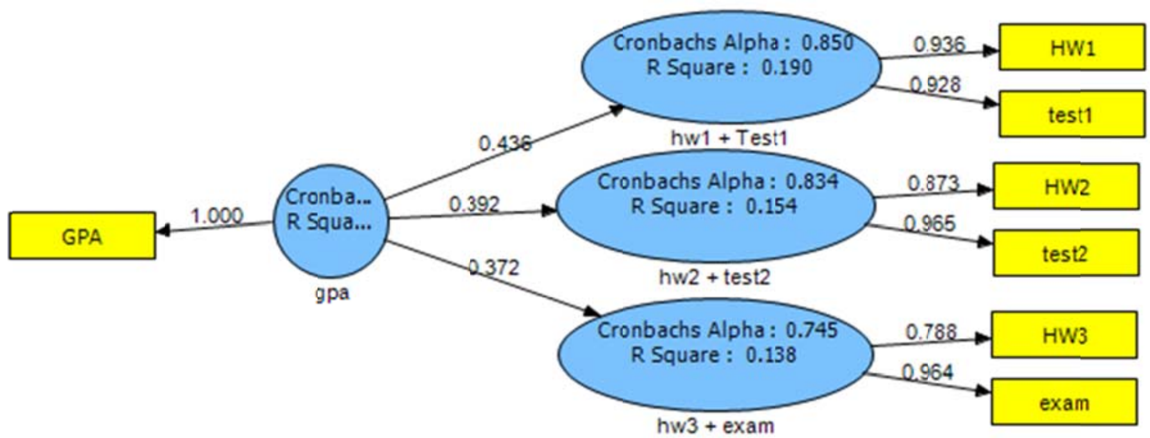
#12. Locus of Control is significantly related to Homework and Test grades (Rotter, 1966): Partially supported by this data in the WBH learning environment. (LOC34, not significant; LOC56, $p<0.01$; LOC 78, $p<0.001$) as seen in Figure 32.

Figure 32: Locus of Control is Related to Homework and Test Grades



#13. GPA is a significant predictor of Homework and test scores (Eskew & Faley, 1988): supported by the data in this study of the WBH learning environment. ($p<0.001$ for all three) as seen in Figure 33.

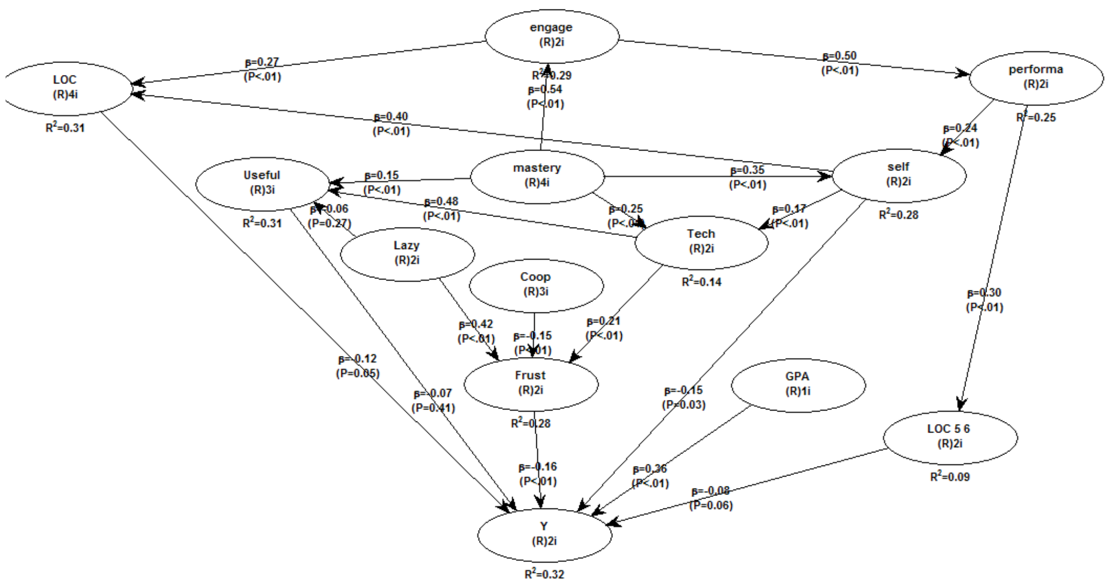
Figure 33: GPA is Related to Student Performance



Each time a literature-based statement is tested, the results support the use of the theory-based view constructs. Almost all factor loadings are above 0.7, and Cronbach's alpha is also acceptable.

When all these models are pieced together (along with some ad hoc modeling) a new model emerges. When the new model is run with time T2 data using WarpPLS, only three paths are not significant (Useful to Y, LOC 56 to Y and Lazy User to Useful). This provides the best model fit so far. (See Figure 34)

Figure 34: Exploratory Research Model with All Constructs at Time T2



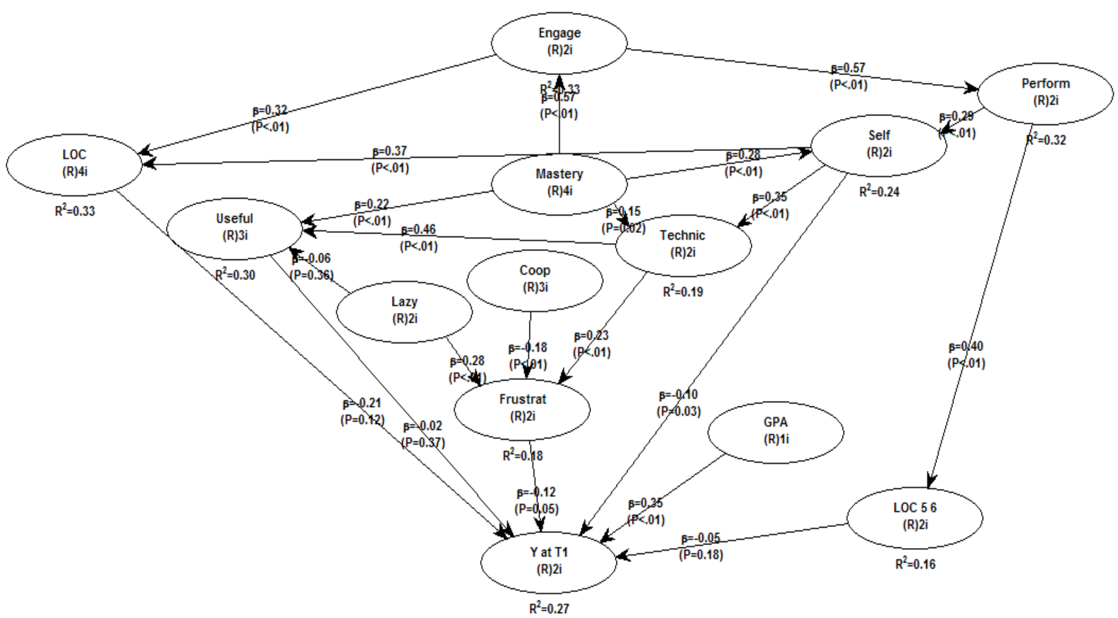
	Engage	Mastery	LOC	Performa	Self	Useful	Tech	Lazy	Frust	Coop	GPA	LOC 5 6	Y at T2
R-Squared	0.289		0.314	0.255	0.28	0.312	0.136		0.28			0.087	0.321
Composite Reliability	0.859	0.877	0.862	0.861	0.903	0.888	0.869	0.843	0.87	0.912	1	0.922	0.843
Cronbach's	0.672	0.813	0.787	0.678	0.785	0.81	0.699	0.626	0.701	0.855	1	0.83	0.627
AVE	0.753	0.642	0.61	0.757	0.823	0.727	0.769	0.728	0.77	0.775	1	0.855	0.728

T2: Model fit indices and P values

APC=0.183, P=<0.001
ARS=0.253, P=<0.001
AVIF=1.217, Good if < 5

Time T1 data is used in the same model and also provides significant results although four paths are not noteworthy: Lazy to Useful (again), LOC 3478 to Y, LOC 56 to Y (again) and Useful to Y (again). The composite reliability is very good, and Cronbach's alpha is acceptable for an exploratory study except for the Y variable. At time T2, Cronbach's alpha for the Y variable is in the acceptable range but it is too low at T1. Since the Y variable is composed of student's actual grades (homework average for time T1 and test 1 scores), that seems to suggest that time T1 homework is not related to T1 test scores. This could be a serious matter since Cronbach's alpha is used to measure the internal consistency or reliability. This is an interesting observation and reaffirms the decision to anchor the analysis at time T2. Homework scores at time T1, which corresponds to the third week in the semester, are intuitively not an accurate predictor of student performance. This relationship grows stronger as the academic term progresses. Since these are the actual scores from students, perhaps it means that students' homework grades are not predictive of their test grades this early in the semester. On the other hand, it could be that students worked homework problems together and found the right answer but could not replicate it on their own. Or, maybe the alternative was true, that students did not complete the homework but still learned the material. In addition, this reaffirms the importance of studying the constructs and relationships in a WBH learning environment over the course of an academic term as opposed to taking samples at any particular time in the semester. (See Figure 35)

Figure 35: Exploratory Research Model with All Constructs at Time T1

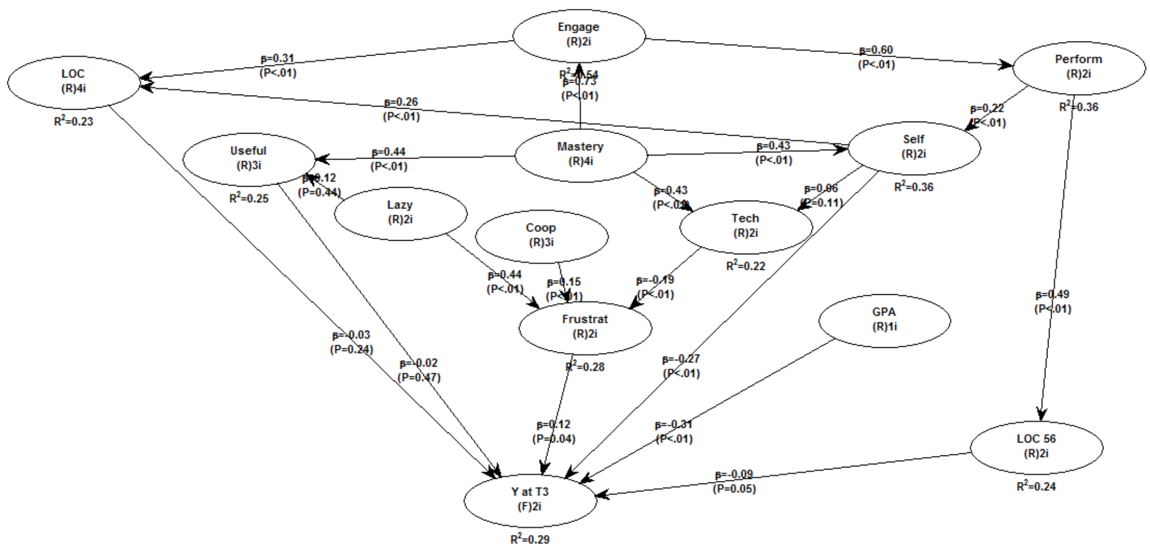


	Engage	Mastery	LOC	Perform	Self	Useful	Tech	Lazy	Coop	Frust	GPA	LOC 5 6	Y at T1
R-Squared	0.329		0.33	0.32	0.244	0.304	0.185			0.178		0.157	0.269
Composite Reliability	0.879	0.846	0.86	0.864	0.876	0.888	0.85	0.837	0.891	0.884	1	0.948	0.753
Cronbach's Alpha	0.723	0.756	0.78	0.685	0.718	0.809	0.646	0.61	0.816	0.739	1	0.891	0.344
AVE	0.783	0.579	0.61	0.761	0.78	0.725	0.738	0.719	0.731	0.793	1	0.902	0.604

Model fit indices and P-values
APC=0.195, P=<0.001
ARS=0.258, P=<0.001
AVIF=1.178, Good if < 5

Time T3 data is used in the same model and produces similar results. Four paths are not significant: LOC3478 and Useful to Y (again), Lazy to Useful (again) and Self-efficacy to Technical-efficacy. Again, the Y variable shows an uncomfortably low Cronbach's alpha score, but it is not a theoretical construct. The Y variable is constructed of students' actual grades, and the composite reliability is acceptable. (See Figure 36)

Figure 36: Exploratory Research Model with All Constructs at Time T3



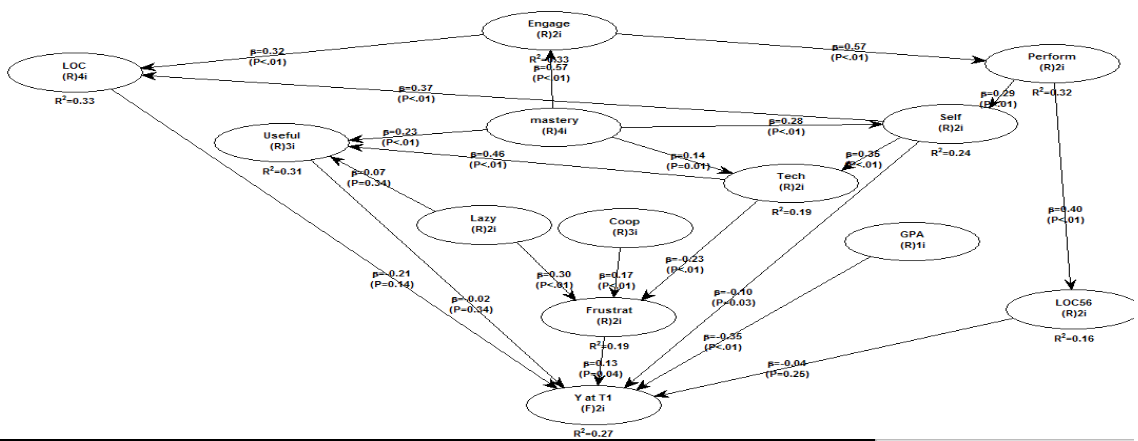
	Engage	Maste	LOC	Perforr	Self	Usef	Tech	Lazy	Frust	Coop	Y at T3	LOC 5	GPA
R-Squared	0.537		0.235	0.358	0.355	0.25	0.22		0.279		0.295	0.236	
Composite Reliability	0.9	0.882	0.861	0.884	0.921	0.9	0.88	0.895	0.894	0.918	0.791	0.96	1
Cronbach's Alpha	0.778	0.821	0.784	0.737	0.828	0.83	0.74	0.766	0.763	0.866	0.473	0.916	1
AVE	0.818	0.652	0.607	0.792	0.853	0.75	0.79	0.81	0.808	0.789	0.655	0.923	1

T3: Model fit indices and P values

APC=0.195, P=<0.001
ARS=0.307, P=<0.001
AVIF=1.274, Good if < 5

The model fit indices for data collected at times T1, T2 and T3 indicate that most relationships between the theory-driven constructs have significant impact on student performance in the WBH learning environment. However, the path from Useful to the Y variable is never significant even though the literature says it should be. The model is run on WarpPLS one more time using data from time T1, T2 and T3 (in order), but this time the default setting is changed from bootstrapping to jackknifing. Jackknifing is a sampling technique that is used to deal with outliers. This results in a significant path from Useful to Y at time T2. At time T1, five paths are not significant: LOC3478 to Y, Useful to Y, Frustrated to Y, Self-efficacy to Y and LOC56 to Y. All the coefficients are the same as those produced when using the bootstrapping method at time T1, T2 and T3. See Figure 37 below.

Figure 37: Model using Jackknifing at Time T2

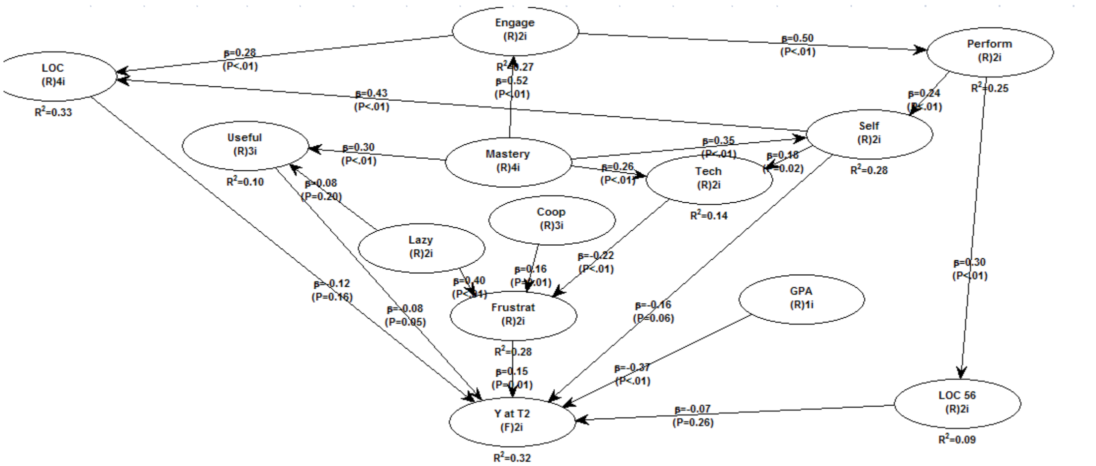


	Master	Engage	LOC	Perforr	Self	Tech	Useful	Lazy	Coop	Frustr	Y at T1	LOC 5 6	GPA
R-Squared		0.329	0.331	0.321	0.244	0.186	0.307			0.188	0.267	0.161	
Composite Reliability	0.846	0.879	0.86	0.863	0.876	0.85	0.887	0.841	0.89	0.888	0.752	0.948	1
Cronbach's Alpha	0.757	0.724	0.782	0.683	0.717	0.646	0.808	0.623	0.82	0.747	0.34	0.891	1
AVE	0.58	0.784	0.606	0.76	0.779	0.739	0.724	0.726	0.73	0.798	0.602	0.902	1

Model fit indices and P values
APC=0.176, P=<0.001
ARS=0.259, P=<0.001
AVIF=1.181, Good if < 5
Algorithm used in the analysis
Warp3 PLS regression
Resampling method used in the
analysis: Jackknifing

At time T2, four paths are not significant: LOC3478 to Y, Lazy to Useful, Self-efficacy to Y and LOC56 to Y. See Figure 38.

Figure 38: Model using Jackknifing at Time T1

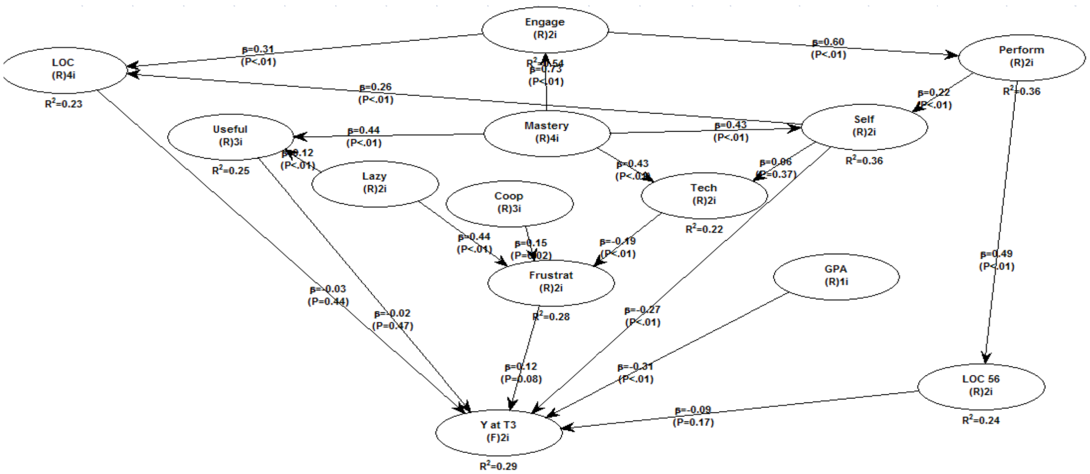


	Master	Engage	LOC	Perforr	Self	Tech	Useful	Lazy	Coop	Frustr	Y at T2	LOC 5 6	GPA
R-Squared		0.272	0.333	0.254	0.277	0.143	0.099			0.279	0.319	0.091	
Composite Reliability	0.877	0.879	0.861	0.863	0.902	0.864	0.89	0.843	0.912	0.872	0.842	0.922	1
Cronbach's Alpha	0.813	0.724	0.784	0.682	0.783	0.684	0.813	0.627	0.856	0.706	0.625	0.83	1
AVE	0.642	0.784	0.607	0.759	0.822	0.76	0.73	0.728	0.776	0.773	0.728	0.854	1

Model fit indices and P values
APC=0.157, P=<0.001
ARS=0.230, P=<0.001
AVIF=1.210, Good if < 5
Algorithm used in the analysis: Warp3 PLS regression
Resampling method used in the analysis: Jackknifing

At T3, five paths are not significant: LOC3478 to Y, Useful to Y, Frustrated to Y, LOC56 to Y and Self-efficacy to Technical-efficacy. All coefficients are the same as before. See Figure 39.

Figure 39: Model using Jackknifing at Time T3



	Engage	Master	LOC	Perforr	Self	Useful	Tech	Lazy	Frustr	Coop	Y at T3	LOC 5 6	GPA
R-Squared	0.537		0.235	0.358	0.355	0.252	0.221		0.279		0.295	0.236	
Composite Reliability	0.9	0.882	0.861	0.884	0.921	0.899	0.884	0.895	0.894	0.918	0.791	0.96	1
Cronbach's Alpha	0.778	0.821	0.784	0.737	0.828	0.83	0.738	0.766	0.763	0.866	0.473	0.916	1
AVE	0.818	0.652	0.607	0.792	0.853	0.747	0.793	0.81	0.808	0.789	0.655	0.923	1

Model fit indices and P values

APC=0.195, P=<0.001
ARS=0.307, P=<0.001
AVIF=1.274, Good if < 5
Algorithm used in the analysis: Warp3 PLS regression
Resampling method used in the analysis: Jackknifing

WarpPLS reports in Table 21 that all relationships shown in this model are warped or nonlinear.

Table 21: WarpPLS Report on Warped or Linear Relationships

Click on a "Linear" or "Warped" relationship cell to view plot

	Engage	Mastery	LOC	Perform	Self	Tech	Useful	Lazy	Frustrat	Coop	Y	LOC 56	GPA
Engage		Warped											
Mastery													
LOC	Warped				Warped								
Perform	Warped												
Self		Warped		Warped									
Tech		Warped			Warped								
Useful		Warped						Warped					
Lazy													
Frustrat						Warped		Warped		Warped			
Coop													
Y			Warped		Warped		Warped		Warped			Warped	Warped
LOC 56				Warped									
GPA													

The User Manual that accompanies WarpPLS offers this disclaimer:

> Multivariate statistical analysis software systems are inherently complex, sometimes yielding results that are biased and disconnected with the reality of the phenomena being modeled. Users are strongly cautioned against accepting the results provided by the Software without doublechecking those results against: past empirical results obtained by other means and/or with other software, applicable theoretical models, and practical commonsense assumptions (Kock, 2010).

To doublecheck, the data is run again using SmartPLS and compared to past empirical results. The results shown below have been recreated using Visio in order to enhance readability. This model indicates that every path is significant at some point, and some paths are significant all the time. See Figures 40, 41 and 42.

Figure 40: Research Model at Time T1 Showing Significance

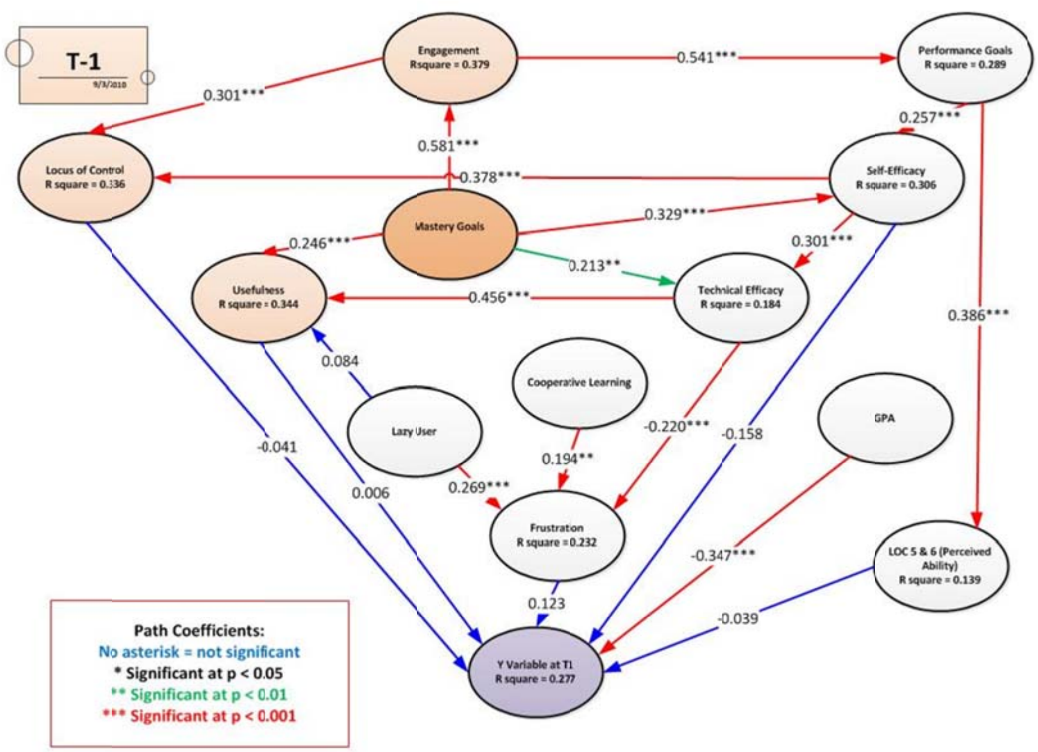


Figure 41: Research Model at Time T2 Showing Significance

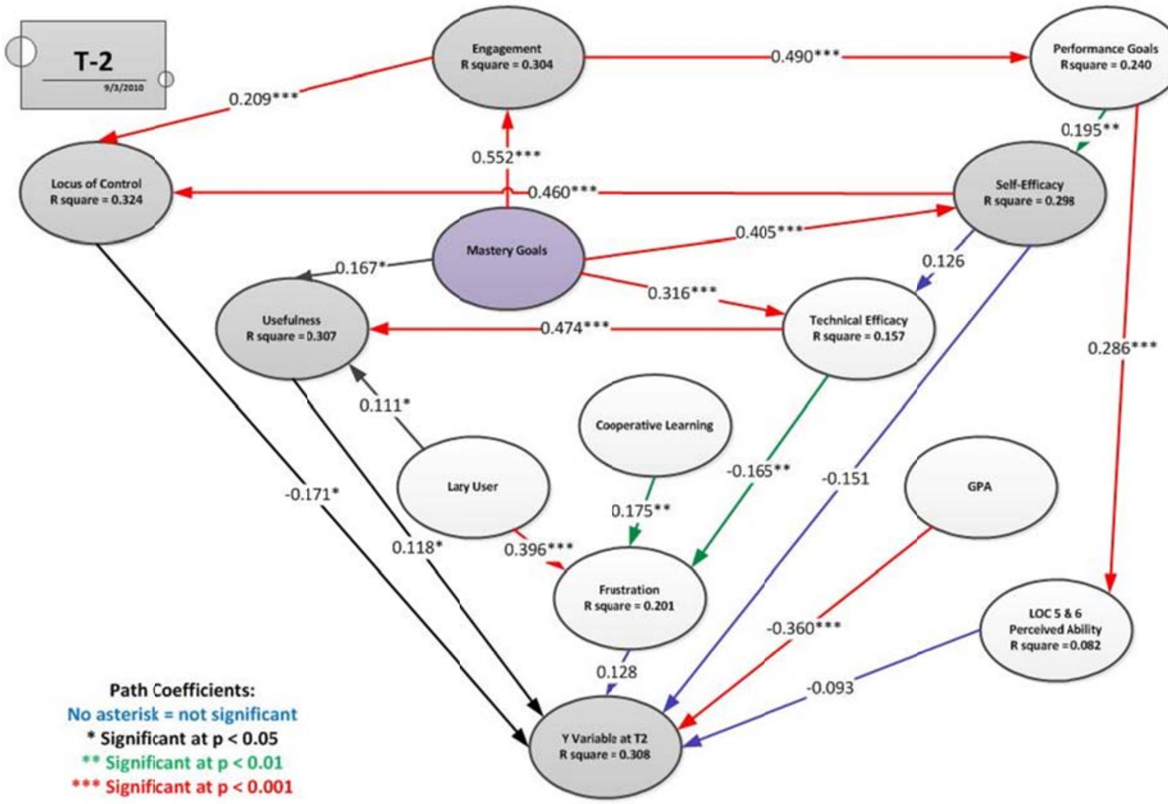
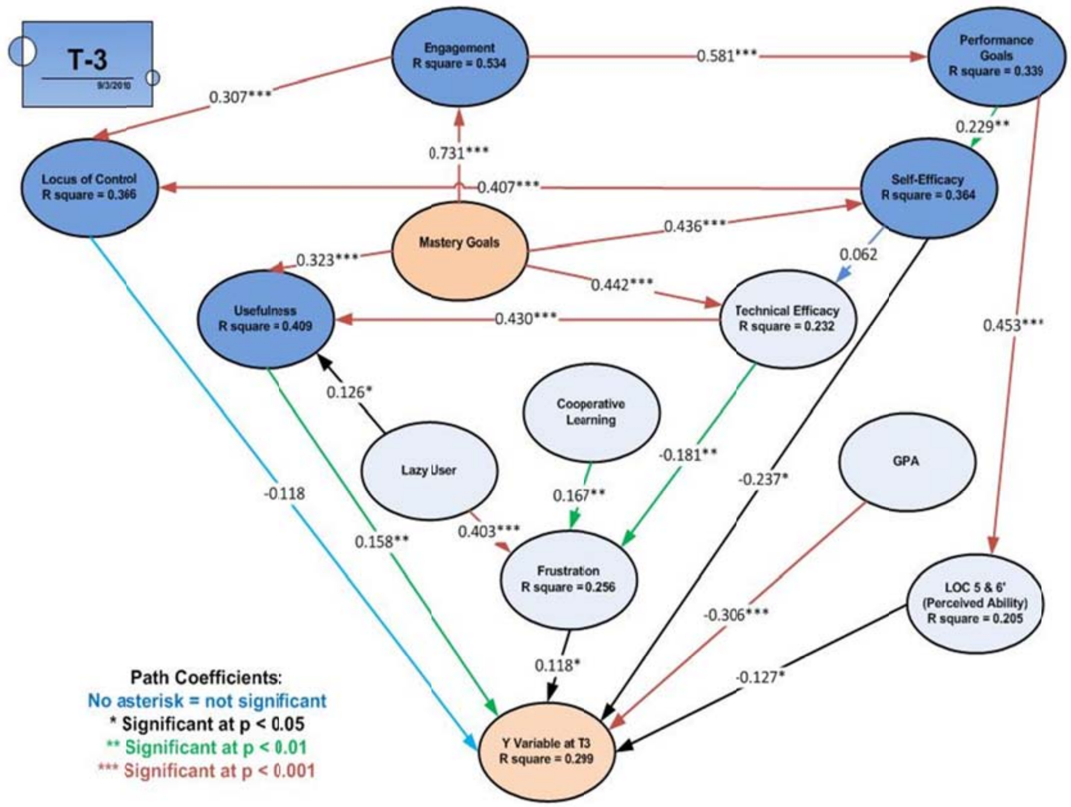


Figure 42: Research Model at Time T3 Showing Significance



These models appear to confirm and even improve on the WarpPLS results based on the six goodness of fit measures provided by SmartPLS. They seem to indicate that all of these factors are significant parts of the WBH learning environment and there are significant relationships between and among the constructs.

Hypotheses Testing

To test this, the linkage suggested by prior research studies will serve as the hypotheses to test the model as a whole as well as the individual links. The results of hypotheses testing will provide an answer to research question two. The model and labeled hypotheses are shown below.

Figure 43: Research Model Hypotheses

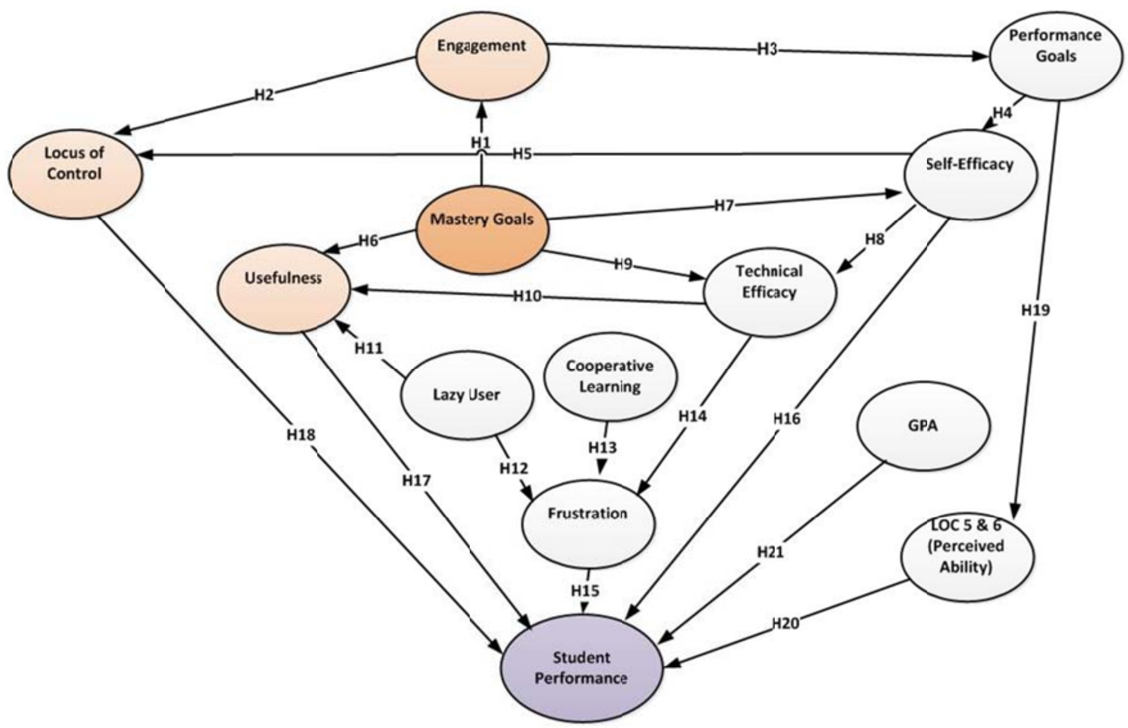


Table 22: Hypotheses Testing

	Hypotheses
H1	The mastery motives of students lead to their engagement in the WBH learning environment.
H2	Student engagement in the WBH learning environment is positively related to Locus of Control.
H3	Student engagement is not related to performance goals in the WBH learning environment.
H4	High performance goals are related to self-efficacy in the WBH learning environment.
H5	Students' self-efficacy is positively related to locus of control in the WBH learning environment.
H6	The mastery motives of students are positively related to perceived usefulness in the WBH learning environment.
H7	The mastery motives of students are positively related to self-efficacy in the WBH learning environment.
H8	Students' self-efficacy is positively related to technical-efficacy in the WBH learning environment.
H9	The mastery motives of students are positively related to technical-efficacy in the WBH learning environment.

	Hypotheses
H10	Technical efficacy is positively related to perceived usefulness in the WBH learning environment.
H11	Lazy user characteristics are related to the perceived usefulness of technology in the WBH learning environment.
H12	Lazy user characteristics are positively related to frustration in the WBH learning environment.
H13	Cooperative Learning characteristics are related to frustration in the WBH learning environment.
H14	Technical-efficacy is negatively related to frustration in the WBH learning environment.
H15	Frustration is negatively related to student performance in the WBH learning environment.
H16	Self-efficacy is positively related to student performance in the WBH learning environment.
H17	Usefulness is positively related to student performance in the WBH learning environment.
H18	Locus of control is positively related to student performance in the WBH learning environment.
H19	Performance goals are not related to the perceived ability in the WBH learning environment.

	Hypotheses
H20	Perceived ability (LOC 5 & 6) is positively related to student performance in the WBH learning environment.
H21	Grade point average (GPA) is positively related to student performance in the WBH learning environment.

Results

Cohen (1992) created a table to compute the minimum sample size needed to achieve the desired predictive power of a model. It begins by selecting the largest number of predictive latent constructs (twelve in this model), selecting the desired alpha level (as in $p<.05$) and choosing the desired effect size (medium in this case). According to his table, N=113 is a reasonable starting point to achieve the desired power. This study has 222 observations which is an appropriate number.

Assessment of the research model was performed using SmartPLS, a structured equation modeling technique that can analyze structural equation models involving multiple-item constructs with direct and indirect paths. PLS assesses the measurement model, including the reliability and discriminant validity of the measure by examining individual item loadings to make sure they are greater than 0.6 for exploratory studies such as this one and 0.7 for confirmatory research. This provides evidence of sound internal reliability for each question that is used in the final model. The following table (Table 23) shows that all loadings are in the acceptable ranges.

Table 23: Item Loadings

	Loading				Loading				Loading		
Item	T1	T2	T3	Item	T1	T2	T3	Item	T1	T2	T3
Coop1	0.792	0.903	0.857	LOC7	0.856	0.851	0.849	Tech2	0.753	0.813	0.846
Coop2	0.821	0.828	0.884	LOC8	0.845	0.859	0.851	Tech3	0.937	0.928	0.928
Coop3	0.923	0.887	0.912	Lazy1	0.860	0.884	0.911	Useful1	0.799	0.772	0.841
Engag7	0.873	0.856	0.881	Lazy4	0.836	0.819	0.888	Useful2	0.874	0.897	0.915
Engag8	0.897	0.87	0.926	Mast2	0.875	0.857	0.843	Useful3	0.879	0.884	0.836
Frust2	0.866	0.851	0.898	Mast3	0.612	0.741	0.760	HW1	0.838		
Frust4	0.918	0.902	0.901	Mast4	0.922	0.914	0.914	HW2		0.838	
LOC3	0.702	0.687	0.719	Perf1	0.846	0.861	0.866	HW3			0.767
LOC4	0.694	0.700	0.755	Perf2	0.896	0.880	0.913	Test 1	0.708		
LOC5	0.944	0.925	0.958	Self1	0.899	0.925	0.929	Test 2		0.868	
LOC6	0.955	0.924	0.963	Self2	0.866	0.887	0.918	Exam			0.846

The composite reliability, also known as convergent reliability, is computed and lies within the accepted ranges (above 0.7). It is a measure of the overall reliability of a collection of items in the questionnaire to show that they are measuring the same construct. The factor loadings are the correlation of each indicator with the composite, thus providing reliability about the construct as a whole.   The average variance extracted also provides evidence of reliability. It measures the amount of variance captured by a construct in relation to the variance due to random measurement error (Fornell & Larcker, 1981). Table 24 shows they are all above the 0.5 level recommended which is evidence of convergent validity (Anderson and Gerbing, 1988). AVE ranges from 0 to 1 and represents the ratio of the total variance that is due to the latent variable.

Table 24: Composite Reliability and Average Variance Explained

	Composite Reliability					Average Variance Explained		
Construct	**at T1**	**at T2**	**at T3**		**Construct**	**at T1**	**at T2**	**at T3**
Coop	0.8837	0.9057	0.9143		**Coop**	0.7178	0.7621	0.7825
Engagement	0.8784	0.8589	0.8993		**Engagement**	0.7832	0.7527	0.8164
Frustration	0.8865	0.8690	0.8943		**Frustration**	0.7963	0.7685	0.8087
GPA	1	1	1		**GPA**	1	1	1
Lazy	0.8587	0.8409	0.8950		**Lazy**	0.7259	0.7258	0.8096
LOC	0.8589	0.8589	0.8727		**LOC**	0.6053	0.6060	0.6327
LOC 5 & 6	0.9482	0.9218	0.9598		**LOC 5 & 6**	0.9015	0.8549	0.9227
Mastery	0.8519	0.8770	0.8814		**Mastery**	0.5677	0.7055	0.7080
Performance	0.8630	0.8613	0.8833		**Performance**	0.7583	0.7564	0.7910
Self	0.8759	0.9020	0.9206		**Self**	0.7785	0.8216	0.8529
Technical	0.8376	0.8639	0.8808		**Technical**	0.7228	0.7612	0.7878
Useful	0.8874	0.8884	0.8986		**Useful**	0.7235	0.7271	0.7474
Y Variable	0.7501	0.8424	0.7890		**Y**	0.5998	0.7277	0.6522

Discriminant Validity is measured by a test to see if a latent variable can explain the variance of its own indicators better than the variance of other latent variables. Hubona (2010) suggests a construct cross-correlation matrix in which the square root of the AVE is compared to and is much larger than the correlations between the latent variable and all other latent variable constructs. This is called a test of Fornell-Larcker Criterion. The latent variable cross correlations are good. The bold numbers in the diagonals represent the square root of the AVEs. The remaining numbers show how much each latent variable correlates with other latent variables. The square roots of the AVEs should be higher than any cross correlations in the same row and/or column, and they all are. See Table 25.

Table 25: Fornell-Larcker Criterion to Test Discriminant Validity

	Coop	Frust	GPA	LOC	LOC 5-6	Lazy	Tech	Useful	Y Variable	engage	mastery	performa	self
Coop1	**0.85**												
Coop2	**0.84**												
Coop3	**0.91**												
Frust1	0.20	**0.75**											
Frust2	0.18	**0.89**											
Frust4	0.20	**0.85**											
GPA	-0.17	-0.07	**1.00**										
LOC3	-0.07	-0.18	0.04	**0.69**									
LOC4	-0.04	-0.16	0.08	**0.70**									
LOC7	0.02	-0.25	0.09	**0.86**									
LOC8	0.01	-0.24	0.10	**0.86**									
LOC5	0.00	-0.06	0.24	0.19	**0.94**								
LOC6	0.00	-0.09	0.26	0.23	**0.95**								
Lazy1	0.08	0.38	-0.09	-0.35	0.08	**0.89**							
Lazy4	0.20	0.34	-0.18	-0.28	0.02	**0.86**							
Tech2	0.07	-0.11	0.00	0.16	0.16	0.02	**0.81**						
Tech3	0.03	-0.23	0.06	0.35	0.18	-0.14	**0.93**						
Useful1	0.08	-0.18	0.05	0.24	0.28	0.04	0.45	**0.81**					
Useful2	0.07	-0.10	-0.02	0.25	0.20	0.02	0.48	**0.89**					
Useful3	0.03	-0.14	-0.01	0.30	0.18	-0.04	0.47	**0.87**					
Test	0.16	0.20	-0.40	-0.16	-0.24	0.12	-0.08	-0.01	**0.85**				
HW	0.03	0.19	-0.25	-0.32	-0.14	0.19	-0.11	-0.07	**0.79**				
Engage7	0.05	-0.14	0.09	0.36	0.18	-0.29	0.28	0.25	-0.10	**0.87**			
Engage8	0.07	-0.19	0.04	0.40	0.22	-0.18	0.35	0.43	-0.11	**0.90**			
Mast1	0.03	-0.14	0.10	0.34	0.11	-0.33	0.23	0.09	-0.09	0.41	**0.68**		
Mast2	0.00	-0.21	0.07	0.38	0.23	-0.11	0.35	0.44	-0.12	0.48	**0.82**		
Mast3	0.06	-0.15	0.13	0.37	0.15	-0.31	0.26	0.13	-0.09	0.50	**0.76**		
Mast4	0.01	-0.24	0.09	0.39	0.32	-0.17	0.39	0.46	-0.13	0.54	**0.88**		
Perf1	0.07	-0.07	0.23	0.38	0.31	-0.30	0.18	0.15	-0.24	0.45	0.42	**0.86**	
Perf2	0.01	-0.18	0.21	0.39	0.34	-0.12	0.33	0.45	-0.23	0.49	0.57	**0.90**	
Self1	-0.05	-0.32	0.11	0.56	0.33	-0.22	0.33	0.33	-0.29	0.39	0.50	0.41	**0.92**
Self2	-0.06	-0.27	0.18	0.39	0.36	-0.12	0.28	0.34	-0.33	0.33	0.43	0.41	**0.89**

Results of Hypotheses Testing

Based on the models presented in Figures 40, 41 and 42, all of these constructs are significant parts of the WBH learning environment. The following table (Table 26) presents the results of the hypotheses testing. As seen in Figure 40, the relationship between the mastery/motive construct and engagement is significant at the p<.001 level. Therefore, we fail to reject the null hypothesis for hypothesis H1. Hypothesis H1 in Table 26 is shown to be supported.

Table 26: Results of Hypotheses Testing

Results of Hypotheses Testing				
		T1	**T2**	**T3**
H1	The mastery motives of students lead to their engagement in the WBH learning environment.	Supported P<0.001	Supported P<0.001	Supported P<0.001
H2	Student engagement in the WBH learning environment is positively related to Locus of Control.	Supported P<0.001	Supported P<0.001	Supported P<0.001
H3	Student engagement is not related to performance goals in the WBH learning environment.	Not Supported P<0.001	Not Supported P<0.001	Not Supported P<0.001
H4	High performance goals are related to self-efficacy in the WBH learning environment.	Supported P<0.001	Supported P<0.01	Supported P<0.01

Results of Hypotheses Testing				
		T1	**T2**	**T3**
H5	Students' self-efficacy is positively related to locus of control in the WBH learning environment.	Supported P<0.001	Supported P<0.001	Supported P<0.001
H6	The mastery motives of students are positively related to perceived usefulness in the WBH learning environment.	Supported P<0.001	Supported P<0.01	Supported P<0.001
H7	The mastery motives of students are positively related to self-efficacy in the WBH learning environment.	Supported P<0.001	Supported P<0.001	Supported P<0.001
H8	Students' self-efficacy is positively related to technical-efficacy in the WBH learning environment.	Supported P<0.001	Not Supported	Not Supported
H9	The mastery motives of students are positively related to technical-efficacy in the WBH learning environment.	Supported P<0.01	Supported P<0.001	Supported P<0.001
H10	Technical efficacy is positively related to perceived usefulness in the WBH learning environment.	Supported P<0.001	Supported P<0.001	Supported P<0.001
H11	Lazy user characteristics are related to the perceived usefulness of technology in the WBH learning environment.	Not Supported	Supported P<0.05	Supported P<0.05

Results of Hypotheses Testing				
		T1	**T2**	**T3**
H12	Lazy user characteristics are positively related to frustration in the WBH learning environment.	Supported P< 0.001	Supported P< 0.001	Supported P< 0.001
H13	Cooperative Learning characteristics are related to frustration in the WBH learning environment.	Supported P<0.001	Supported P<0.01	Supported P<0.01
H14	Technical-efficacy is negatively related to frustration in the WBH learning environment.	Supported P<0.001	Supported P<0.01	Supported P<0.01
H15	Frustration is related to student performance in the WBH learning environment.	Not Supported	Not Supported	Supported P<0.05
H16	Self-efficacy is positively related to student performance in the WBH learning environment.	Not Supported	Not Supported	Supported P<0.05
H17	Usefulness is positively related to student performance in the WBH learning environment.	Not Supported	Supported P<0.05	Supported P<0.001
H18	Locus of control is positively related to student performance in the WBH learning environment.	Not Supported	Supported P<0.05	Supported P<0.01

Results of Hypotheses Testing				
		T1	**T2**	**T3**
H19	Performance goals are not related to the perceived ability in the WBH learning environment.	Not Supported P<0.001	Not Supported P<0.001	Not Supported P<0.001
H20	Perceived ability (LOC 5 & 6) is positively related to student performance in the WBH learning environment.	Not Supported	Not Supported	Supported P<0.05
H21	Grade point average (GPA) is positively related to student performance in the WBH learning environment.	Supported P<0.001	Supported P<0.001	Supported P<0.001

Summary of hypotheses testing results

The results of the hypotheses testing are presented in Table 26, above. The data analysis fails to reject many of the hypotheses. However, this means there is an interesting story in the hypotheses that did not end as expected. Hypotheses H8, H11, H17, and H20 are supported at one time but not in all three measurement periods while H3 and H19 are not supported at any time. Almost all findings are at significant levels.

Summary of Chapter

This chapter has presented the steps taken in the data analysis phase of this study. It has used several analytical techniques to examine the data. From a statistical standpoint, the models have shown significant factors in the WBH learning environment and present one answer to the first research question: what are the factors in the WBH learning environment? The factors in the WBH learning environment, using student performance as the dependent variable, include student mastery motives, student engagement, locus of control, student performance goals, self-efficacy, technical-efficacy, perceived usefulness, perceived ability, frustration, lazy user characteristics, cooperative learning characteristics and GPA.

Research question number two asked: how does the WBH learning environment impact student performance? The models presented in this chapter reveal many significant relationships within the learning environment. Some factors such as frustration appear to have a direct effect on student performance, while other factors such as mastery motives and engagement appear to have an indirect effect. The answer to the second research question is presented more fully in the following chapter, Chapter Five

CHAPTER V

LONGITUDINAL ANALYSIS

This chapter presents the results of the longitudinal analysis in this study to examine the changes in relationships in the WBH learning environment over the course of an academic term. This research is exploratory in nature and designed to determine: 1) What are the significant factors within the WBH learning environment? 2) How do those factors relate to each other? 3) Do these relationships exhibit changes over time? Questions one and two were answered in Chapter IV. This chapter investigates the relationships between the significant factors in a WBH learning environment to determine if they change over time. It will first present the results of a question analysis, which is a rudimentary method to report survey results at the basic level, and to test if the constructs' values change longitudinally. It will then coalesce all the data and run a structural equation model with robust random sampling to establish the significance of the factors across the fifteen weeks. The results of hypotheses testing to examine significant changes in relationships over the academic term will be presented. SPSS, SmartPLS and WarpPLS are used to conduct the analysis and compute these findings. The chapter concludes with a discussion of the hypotheses testing results.

Question Analysis

A question analysis is a basic technique used to present the results of a survey and aid in understanding the model. Each survey question is evaluated individually. The percentage of students that selected a particular response is shown in Table 27 below. Any significant changes in means between times T1 and T2, T2 and T3 and T1 and T3 are calculated. The question analysis here is part of a longitudinal study and presents preliminary evidence that there may be changes in the relationships over time because the mean values of the constructs are different at different time periods. This analysis suggests that changes in relationships between the constructs may exist and subsequent investigation is appropriate. The following Table 27 presents the question analysis with individual questions and the results of the student responses.

Table 27: Question Analysis

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	**Mean**	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Feedback										
I like that software tells me instantly whether I'm right or wrong.	**T1** **T2** **T3**	73.0 77.5 74.8	24.8 21.2 22.5	1.4 1.4 2.3	.9 - .5	- - -	**1.30** **1.24** **1.28**			
When answering homework problems, I prefer to know WHY I'm wrong.	**T1** **T2** **T3**	72.1 75.2 72.5	24.3 22.1 21.2	2.7 1.8 5	.5 .9 .9	.5 - .5	**1.33** **1.28** **1.36**			
It allows me to finish faster because it tells me if I'm right.	**T1** **T2** **T3**	41.9 33.8 34.2	36 41.4 39.6	19.4 19.4 21.2	2.7 5.0 4.1	- .5 .9	**1.83** **1.97** **1.98**	.031		 .023

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
It slows me down because I can't get credit unless it's correct.	**T1**	11.3	35.1	31.5	16.2	5.9	**2.70**	.033		
	T2	7.7	33.3	28.8	25.7	4.5	**2.86**		.009	
	T3	5.0	27.5	33.3	27.0	7.2	**3.04**			.000
Engagement										
Time goes by quickly when I am completing homework using WBH	**T1**	12.2	39.6	31.5	15.3	1.4	**2.54**			
	T2	14.0	39.2	32.9	12.2	1.8	**2.49**		.003	
	T3	17.1	48.2	24.3	9.9	.5	**2.28**			.000
Time goes by quickly when I am completing homework using paper.	**T1**	3.2	19.8	40.1	31.5	5.4	**3.16**			
	T2	5.4	14.4	45.5	28.8	5.9	**3.15**			
	T3	5.4	23.0	36.5	30.2	5.0	**3.06**			
I often spend more time using WBH than I had intended.	**T1**	8.6	32.4	31.1	26.1	1.8	**2.80**	.003		
	T2	14.0	38.7	23.0	23.0	1.4	**2.59**			
	T3	13.1	43.2	26.1	16.2	1.4	**2.50**			.000
I often spend more time completing homework on paper than I had intended.	**T1**	5.4	33.8	34.2	25.2	1.4	**2.83**			
	T2	4.5	36.0	33.8	24.8	.9	**2.82**		.014	
	T3	9.9	35.1	37.8	14.4	2.7	**2.65**			.016

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
I can block out distractions using WBH	**T1**	12.6	50	16.7	17.6	3.2	**2.49**			
	T2	16.2	42.8	24.3	14.4	2.3	**2.44**			
	T3	15.3	51.4	16.2	14.9	2.3	**2.37**			
While working problems using paper and pencil, I am able to block out most distractions.	**T1**	6.3	42.3	27.9	22.5	.9	**2.69**			
	T2	7.2	41.0	32.0	16.7	3.2	**2.68**			
	T3	9.0	41.4	28.8	19.8	.9	**2.62**			
I work hard because I am interested in what I am learning.	**T1**	38.7	50.0	9.5	1.8	-	**1.74**			
	T2	30.6	60.4	7.2	1.8	-	**1.80**			
	T3	37.4	53.2	9.0	.5	-	**1.73**			
WBH software keeps me interested in what I am learning.	**T1**	23	47.3	24.3	4.5	.9	**2.13**			
	T2	15.8	52.7	26.1	5.4	-	**2.21**		.018	
	T3	21.6	50	26.1	2.3	-	**2.09**			
I work hard so I can get done with the homework and do other things.	**T1**	32.4	49.5	14.4	2.7	.9	**1.90**			
	T2	27.5	58.1	11.3	2.7	.5	**1.91**			
	T3	31.5	55.4	9.9	2.7	.5	**1.85**			

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Performance										
I want to learn things so that I can be near the top of the class.	**T1**	34.2	46.4	15.8	2.7	.9	**1.90**			
	T2	29.7	48.2	18.5	3.2	.5	**1.96**			
	T3	31.5	45.9	18.0	4.5	-	**1.95**			
Helps me reach my goal of being near the top of the class.	**T1**	17.1	37.4	40.5	4.1	.9	**2.34**			
	T2	15.3	35.6	41.9	6.8	.5	**2.41**			
	T3	18.0	34.2	40.5	6.8	.5	**2.37**			
Mastery										
In this class, one of my primary goals is to understand the major concepts.	**T1**	54.5	43.2	2.3	-	-	**1.48**	.001		
	T2	44.1	50.9	4.5	.5	-	**1.61**			
	T3	39.6	51.8	8.1	.5	-	**1.69**			.000
WBH helps me reach my goal which is to understand the major concepts.	**T1**	23.9	53.2	19.8	3.2	-	**2.02**			
	T2	21.2	57.7	17.6	3.2	.5	**2.04**			
	T3	22.1	54.5	19.4	3.6	.5	**2.06**			
One of my primary goals in studying for this class is to acquire new knowledge.	**T1**	44.6	50.9	4.5	-	-	**1.60**	.000		
	T2	33.8	55.9	9.0	1.4	-	**1.78**			
	T3	36.5	56.8	5.9	.9	-	**1.71**			.009

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	**Mean**	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
WBH helps me acquire new knowledge.	**T1**	27.5	51.8	17.6	3.2	-	**1.96**			
	T2	36.5	56.8	16.7	2.3	.5	**2.00**			
	T3	23.9	55.4	17.6	3.2	-	**2.00**			
Self-efficacy										
I can complete homework assignments successfully.	**T1**	47.7	47.3	4.5	.5	-	**1.58**	.001		
	T2	35.1	59.0	4.1	1.8	-	**1.73**			
	T3	40.5	52.7	5.0	1.8	-	**1.68**			.038
Using WBH, I can get the right answers.	**T1**	34.2	48.2	14.9	2.7	-	**1.86**			
	T2	27.0	55.4	13.1	4.5	-	**1.95**			
	T3	30.6	55.9	10.4	2.3	.9	**1.87**			
Locus of Control										
Chance or luck plays an important part in my success.	**T1**	24.3	45.9	20.3	8.1	1.4	**2.16**	.007		
	T2	20.3	40.5	26.6	11.7	.9	**2.32**			
	T3	22.5	38.3	21.2	16.7	1.4	**2.36**			.001
Chance or luck plays an important part in my success when using WBH.	**T1**	23.0	45.9	20.7	8.6	1.8	**2.20**			
	T2	22.1	37.4	29.3	9.9	1.4	**2.31**			
	T3	22.1	36.0	25.7	12.6	3.6	**2.40**			.004

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	**Mean**	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Doing well in school is a matter of hard work. Luck has little or nothing to do with it.	**T1**	51.4	36.5	8.1	3.2	.9	**1.66**	.012		
	T2	40.5	44.6	11.7	2.7	.5	**1.78**			
	T3	45.0	40.5	10.4	3.6	.5	**1.74**			
Doing well on my homework using the software is a matter of hard work. Luck has little or nothing to do with it.	**T1**	47.3	36.5	12.2	4.1	-	**1.73**	.046		
	T2	33.8	50.5	14.4	1.4	-	**1.83**			
	T3	41.4	42.3	14.4	1.8	-	**1.77**			
My problem solving skills using WBH are better than those of other students.	**T1**	8.6	28.8	57.2	5.0	.5	**2.60**			
	T2	9.0	30.2	55.0	5.9	-	**2.58**		.002	
	T3	11.3	36.5	49.5	2.3	.5	**2.44**			.000
My problem solving skills using the WBH software are better than those of other students in this class	**T1**	8.1	26.6	60.4	4.5	.5	**2.63**			
	T2	9.5	30.6	54.5	5.4	-	**2.56**		.009	
	T3	11.7	37.8	45.9	4.1	.5	**2.44**			.000
I am able to finish homework assignments by deadlines.	**T1**	56.8	39.6	2.7	.9	-	**1.48**	.001		
	T2	47.3	43.2	7.7	1.4	.5	**1.64**			
	T3	39.2	50.5	8.1	2.3		**1.73**			.000

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
I will be able to finish the WBH assignments by the due date.	**T1**	58.1	37.4	4.1	.5	-	**1.47**	.000		
	T2	46.4	45.0	6.8	1.4	.5	**1.64**			
	T3	40.5	50.9	6.3	1.8	.5	**1.71**			.000
Lazy User										
If schoolwork is too hard for me I just don't do it.	**T1**	.7	2.2	4.5	43.7	48.9	**4.38**	.000		
	T2	1.5	6.7	11.6	45.5	34.7	**4.05**			
	T3	1.9	7.1	10.4	48.9	31.7	**4.01**			.000
If schoolwork is too hard for me, I get friends or the teacher to help.	**T1**	16.4	56.7	15.3	8.6	3.0	**2.25**			
	T2	9.3	62.7	18.3	6.7	3.0	**2.31**		.050	
	T3	14.9	59.0	17.5	7.8	0.7	**2.21**			.000
If schoolwork is too hard for me I just work harder.	**T1**	25.0	64.6	10.1	0.4	-	**1.86**			
	T2	25.0	59.3	14.6	1.1	-	**1.92**			
	T3	25.0	61.9	12.3	0.7	-	**1.89**			
I choose easy options in school so that I don't have to work too hard.	**T1**	1.5	5.2	22.8	50.0	20.5	**3.83**	.014		
	T2	1.5	10.1	22.8	48.1	17.5	**3.70**			
	T3	4.1	9.3	21.3	50.4	14.9	**3.63**			.000

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Using homework software makes it easier to do my homework because I don't have to read the chapter first. (The links take me to the parts I need in the book.)	**T1**	6.7	25.4	27.2	32.1	8.6	**3.10**			
	T2	6.3	28.7	26.1	28.4	10.4	**3.08**		.015	
	T3	9.0	32.1	23.5	28.7	6.7	**2.92**			.012
Frustration										
I feel anxious when I run into a problem on the computer.	**T1**	9.5	38.7	19.8	27.5	4.5	**2.79**	.001		
	T2	2.3	25.7	27.9	38.3	5.9	**3.20**		.000	
	T3	7.7	43.7	20.7	23.4	4.5	**2.73**			
I feel helpless when I encounter a problem on the computer.	**T1**	4.1	22.1	23	39.2	11.7	**2.32**	.000		
	T2	5.4	27.9	25.7	36.9	4.1	**2.06**			
	T3	5.9	30.6	24.3	31.1	8.1	**2.05**			.001
When there is a problem with a computer that I can't immediately solve, I keep trying until I have the answer.	**T1**	.5	.9	9.5	59.5	29.7	**4.17**	.012		
	T2	.5	2.3	11.3	63.5	22.5	**4.05**			
	T3	-	0.5	9.5	68.5	21.6	**4.11**			

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	**Mean**	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Frustrating experiences with the WBH severely impacted my ability to get the assignment completed.	**T1**	3.2	13.1	27.5	42.8	13.5	**2.50**			
	T2	3.2	19.4	25.7	41.0	10.8	**2.37**		.004	
	T3	6.3	18	35.1	32.4	8.1	**2.18**			.000
Useful										
Using WBH enables me to finish faster.	**T1**	20.3	41.4	27.9	9.5	.9	**2.29**			
	T2	15.8	45.9	30.2	8.1	-	**2.31**			
	T3	18.5	47.3	23.4	10.8	-	**2.27**			
WBH has improved the quality of my work.	**T1**	13.1	46.4	26.1	13.1	1.4	**2.43**			
	T2	12.6	46.8	28.8	11.7	-	**2.40**			
	T3	18	41.9	27.5	12.2	.5	**2.35**			
WBH gives me greater control over my work.	**T1**	19.4	45	22.5	11.7	1.4	**2.31**			
	T2	14.9	45.5	31.1	8.6	-	**2.33**			
	T3	16.2	48.6	26.1	8.1	.9	**2.29**			

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Technical Efficacy										
I tried to discover new functions in WBH.	**T1**	14	45	25.2	14	1.8	**2.45**			
	T2	13.1	54.1	20.3	11.7	.9	**2.33**			
	T3	17.1	45.5	23.4	13.5	.5	**2.35**			
I would look for ways to experiment with new technology.	**T1**	18.5	56.8	19.8	5	-	**2.11**			
	T2	18.9	59.9	16.2	4.1	-	**2.08**			
	T3	21.2	51.8	22.1	5	.9	**2.00**			
Using a computer is an efficient way to learn new things.	**T1**	34.7	56.8	7.2	1.4	-	**1.75**	.039		
	T2	27.9	59.5	12.2	.5	-	**1.85**			
	T3	32.9	55.9	11.3	-	-	**1.78**			
Cooperative Learning										
Whenever appropriate, I prefer to work with classmates outside of class to prepare class assignments.	**T1**	12.2	32.9	22.1	25.7	7.2	**2.83**			
	T2	9.5	34.7	30.2	18.0	7.7	**2.80**		.008	
	T3	15.8	35.1	23.9	20.7	4.5	**2.63**			.009

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Whenever appropriate, I prefer to work with other students on projects during class.	**T1**	14.9	36.0	25.2	18.0	5.9	**2.64**			
	T2	9.5	41.9	27.5	16.2	5.0	**2.65**			
	T3	11.7	36.5	27.5	20.3	4.1	**2.68**			
I learn better when I work with a group to solve problems rather than by myself.	**T1**	8.1	32.0	29.7	24.3	5.9	**2.88**			
	T2	9.5	31.1	35.1	18.9	5.4	**2.80**			
	T3	11.3	32.9	31.1	19.4	5.4	**2.75**			
Humanistic Learning										
Where appropriate, I have communicated with classmates online to complete academic work.	**T1**	9.5	43.2	17.6	27.5	2.3	**2.70**			
	T2	9.9	43.7	24.3	17.6	4.5	**2.63**			
	T3	9.9	51.8	18.5	16.2	3.6	**2.52**			.016
I have expressed ideas to a professor via e-mail that I did not feel comfortable saying in class.	**T1**	7.7	27.9	27.0	34.2	3.2	**2.97**	.038		
	T2	8.6	33.3	27.5	28.8	1.8	**2.82**			
	T3	9.0	34.7	36.0	18.0	2.3	**2.70**			.000

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	Mean	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Student Centered Learning										
I work the practice problems because they give me more control over my learning.	**T1** **T2** **T3**	18.5 11.3 9.9	42.3 45.9 44.1	27.0 28.8 35.1	11.7 14.0 10.4	0.5 - 0.5	**2.33** **2.45** **2.47**			.048
Having access to assignments weeks in advance improves my understanding of the material since I have more time to work on them.	**T1** **T2** **T3**	38.7 30.6 27.0	47.7 55.0 52.3	10.8 12.2 17.1	2.3 2.3 3.6	.5 - -	**1.78** **1.86** **1.97**		.038	.001
Having access to assignments weeks in advance is efficient because I can decide when to work them.	**T1** **T2** **T3**	44.1 38.3 32.4	46.8 55.0 56.8	7.7 5.4 9.5	1.4 1.4 1.4	- - -	**1.66** **1.70** **1.80**		.020	.012

The question analysis in Table 27 presents a rudimentary longitudinal analysis. It demonstrates that responses to many questions exhibit a significant change over time. This is evident from the results of the t-tests presented above. This suggests that further investigation of the changes in the relationships over the course of the academic term is worthwhile.

Path Coefficient Analysis

The research model created in Chapter IV and presented here as Figure 44 has twenty-one paths. These path coefficients (presented in Chapter IV, Figures 40, 41 and 42) depict the strength of the relationship between the two constructs. One technique advocated by Hubona (2010) to measure the relationships involves using data from all three collection dates and running it in one model. When completed, it provides data, presented in Table 28 and shows the total direct and indirect effects of each construct in the recursive model. For example, Cooperative Learning feeds into Frustration, and over all three periods explains an average of 18% of the variance in Frustration. Cooperative Learning does not feed directly into the dependent variable and yet Cooperative Learning has an indirect effect on student performance and explains 2.3% of its variance. Mastery and Engagement do not directly affect the dependent variable, and yet together they explain almost 19% of the measures of student performance. GPA is still the strongest predictor of student performance and explains 33%. (It is negative because the survey coded high GPA's with low numbers but homework and tests showed high performance with high numbers.)

Figure 44: Research Model Hypotheses Revisited

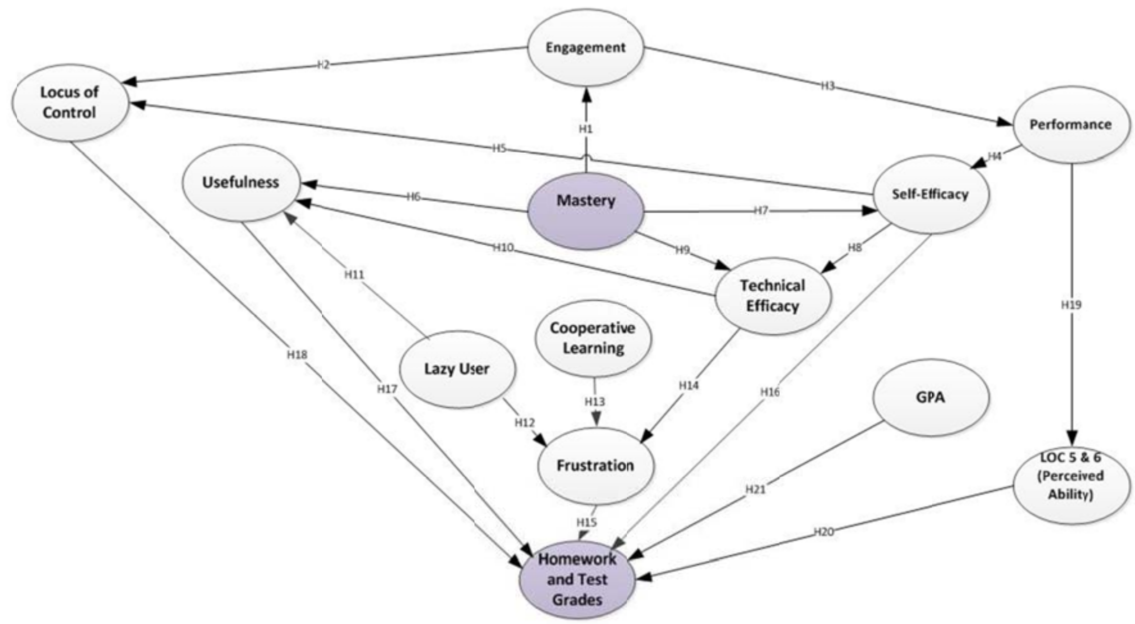


Table 28: Total Effects

Total Effects: Direct (Bold) and Indirect Effects (Italicized)									
	Frust	LOC	LOC 5-6	Tech	Useful	Engage	Perform	Self-eff	Y Variable
Mastery	*-0.0731*	*0.3565*	*0.1233*	**0.3928**	**0.4185**	**0.6155**	*0.3308*	**0.4628**	**-0.1118**
Coop	**0.1808**								*0.023*
Frust									**0.1271**
GPA									**-0.3301**
LOC									**-0.1346**
LOC 5-6									**-0.0575**
Lazy	**0.3665**				**0.112**				*0.0579*
Tech	**-0.1862**				**0.459**				*0.0229*
Useful									**0.1014**
Engage	*-0.0041*	**0.3157**	*0.2003*	*0.022*	*0.0101*		**0.5375**	*0.1248*	*-0.0777*
Perform	*-0.0076*	*0.0976*	**0.3727**	*0.0409*	*0.0188*			**0.2323**	*-0.0787*
Self-eff	*-0.0328*	**0.4202**		**0.1763**	*0.0809*				**-0.2466**

From the results seen in Table 28, Mastery Motives emerges as the most important factor in the WBH learning environment. The table reveals that Mastery Motives, wanting to learn because of intrinsic motives such as being interested and curious, has a direct effect on Technical-efficacy, Usefulness, Engagement and Self-efficacy. Mastery Motives also has an indirect effect on Frustration, Locus of Control, Perceived Ability (LOC 56), and Performance. Table 28 shows that Lazy User characteristics have an indirect effect on the Y variable (student performance) that is as large as the direct effect from Perceived Ability (LOC56). One interesting aspect is that Frustration has a direct effect on the dependent variable and this effect is slightly larger than the direct effect from Usefulness.

The strongest relationship is the direct effect Engagement has on Performance Goals. The relationship explains 53.75% of the variance in Performance Goals. The weakest relationship is the indirect effect from Engagement to Frustration. It only explains 0.41% of the variance and yet, from Table 29 below, it can be seen that at time T1 the relationship is significant.

The following table, Table 29, is created from a SmartPLS report. It presents the level at which each possible relationship from the model in Figure 44 is significant. The figures shown are the significance levels, and "ns" stands for *not significant.* SmartPLS runs many iterations of the model with individual responses selected at random for each time period. It determines the levels at which relationships in the model are significant. The bootstrapping option was set to 199 times (with replacement) for this table in order to produce t-statistics.

To compute the p –values, a two-tailed test with at least 120 degrees of freedom was used. The t-threshold was 1.98 for p-values < 0.05, 2.62 for $p<0.01$ and 3.38 for $p< 0.001$. Direct effects are in bold and indirect effects are italicized. As shown in Table 29, there are significant relationships that are seen directly in the model as well as significant flow-through indirect effects at each time period. In addition, for many relationships, direct and indirect, the significance changes from one time period to another.

Table 29: Significance of Direct and Indirect Effects

Direct and Indirect Effects: Significance at p<___			
	T1	**T2**	**T3**
Coop -> Frustration	**0.001**	**0.001**	**0.01**
Coop -> Y Variable	*Ns*	*ns*	*ns*
Frustration -> Y Variable	**Ns**	**Ns**	**0.05**
GPA -> Y Variable	**0.001**	**0.001**	**0.001**
LOC -> Y Variable	**ns**	**0.01**	**0.05**
LOC 5-6 -> Y Variable	**ns**	**ns**	**0.05**
Lazy -> Frustration	**0.001**	**0.001**	**0.001**
Lazy -> Useful	**ns**	**0.01**	**0.01**
Lazy -> Y Variable	*ns*	*0.01*	*0.01*
Tech -> Frustration	**0.001**	**0.01**	**0.01**
Tech -> Useful	**0.001**	**0.001**	**0.001**
Tech -> Y Variable	*ns*	*ns*	*ns*
Useful -> Y Variable	**ns**	**0.05**	**0.01**
engage -> Frustration	*0.05*	*ns*	*ns*
engage -> LOC	**0.001**	**0.001**	**0.001**
engage -> LOC 5-6	*0.001*	*0.001*	*0.001*
engage -> Tech	*0.01*	*ns*	*ns*
engage -> Useful	*0.05*	*ns*	*ns*
engage -> Y Variable	*ns*	*0.01*	*0.001*
engage -> performance	**0.001**	**0.001**	**0.001**
engage -> self	*0.01*	*0.01*	*0.01*
mastery -> Frustration	*0.001*	*0.01*	*0.01*
mastery -> LOC	*0.001*	*0.001*	*0.001*
mastery -> LOC 5-6	*0.001*	*0.01*	*0.001*
mastery -> Tech	**0.001**	**0.001**	**0.001**
mastery -> Useful	**0.001**	**0.001**	**0.001**
mastery -> Y Variable	*0.01*	*0.01*	*0.01*
mastery -> engage	**0.001**	**0.001**	**0.001**
mastery -> performance	*0.001*	*0.001*	*0.001*
mastery -> self	**0.001**	**0.001**	**0.001**
performance -> Frustration	*0.05*	*ns*	*ns*
performance -> LOC	*0.01*	*0.01*	*0.01*
performance -> LOC 5-6	**0.001**	**0.001**	**0.001**
performance -> Tech	*0.01*	*ns*	*ns*
performance -> Useful	*0.01*	*ns*	*ns*
performance -> Y Variable	*0.05*	*0.01*	*0.01*

Direct and Indirect Effects: Significance at p<___			
	T1	**T2**	**T3**
performance -> self	**0.001**	**0.01**	**0.01**
self -> Frustration	*0.01*	*ns*	*ns*
self -> LOC	**0.001**	**0.001**	**0.001**
self -> Tech	**0.001**	**ns**	**ns**
self -> Useful	*0.001*	*ns*	*ns*
self -> Y Variable	**0.01**	**0.001**	**0.01**

The purpose of this analysis is to test if a path changes significantly from time T1 to T2, time T2 to T3 and time T1 to T3. With respect to the structural paths for the model at time T1, fifteen path coefficients are significant and only five are non-significant. The average variance explained for the endogenous constructs in T1 is 25.6%. For time T2, eighteen of the structural path coefficients are significant and three are non-significant. The average variance explained for the endogenous constructs in time T2 is 24.7% which is moderate. For T3, nineteen of the path coefficients are significant and two are non-significant. An average of 33.3% of the variance explained for each endogenous construct is explained by the structural model for T3.

Table 30: Summary of Changes in Relationships over Times T1, T2 and T3

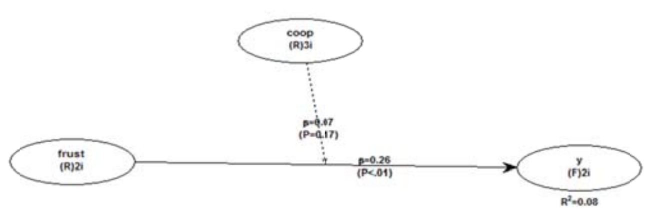
Inner Path Link	Path Coeff T1	Path Coeff T2	Path Coeff T3	T2-T1 Delta	T2 - T1 p-value	T3-T1 Delta	T3-T1 p-value	T3-T2 Delta	T3-T2 p-value
Coop → Frust	0.21	0.175	0.167	-0.035		-0.043		-0.008	
Frust → Y Variable	0.123	0.128	0.118	0.016		-0.005		-0.021	
GPA → Y Variable	-0.347	-0.36	-0.306	-0.014		0.041		0.055	
LOC → Y Variable	-0.041	-0.171	-0.118	-0.129		-0.077		0.052	
LOC 5-6 → Y Variable	-0.039	-0.093	-0.127	**-0.054**	**p < 0.05**	**-0.089**	**p < 0.01**	-0.035	
Lazy → Frust	0.269	0.396	0.403	**0.126**	**p < 0.01**	**0.134**	**p < 0.05**	0.008	
Lazy → Useful	0.084	0.111	0.126	0.027		0.042		0.015	
Tech → Frust	-0.22	-0.165	-0.181	**0.055**	**p < 0.05**	0.039		-0.016	
Tech → Useful	0.456	0.474	0.43	0.019		-0.026		-0.044	
Useful → Y Variable	0.006	0.118	0.158	0.112		**0.152**	**p < 0.05**	0.04	
Engage → LOC	0.301	0.209	0.307	**-0.092**	**p < 0.01**	0.006		**0.098**	**p < 0.01**
Engage → performa	0.541	0.49	0.581	**-0.051**	**p < 0.05**	0.04		0.091	
Mastery → Tech	0.213	0.316	0.442	**0.103**	**p < 0.01**	**0.229**	**p < 0.05**	**0.126**	**p < 0.01**
Mastery → Useful	0.246	0.167	0.323	**-0.079**	**p < 0.05**	0.077		**0.156**	**p < 0.05**
Mastery → engage	0.581	0.552	0.731	-0.03		**0.149**	**p < 0.05**	**0.179**	**p < 0.01**
Mastery → self	0.329	0.405	0.436	**0.076**	**p < 0.05**	0.107		0.031	
Performa → LOC 5-6	0.386	0.286	0.453	-0.101		**0.066**	**p < 0.05**	**0.167**	**p < 0.05**
Performa → self	0.257	0.195	0.229	-0.062		-0.028		0.034	
Self → LOC	0.378	0.46	0.407	**0.082**	**p < 0.01**	0.029		-0.053	
Self → Tech	0.301	0.126	0.062	**-0.176**	**p < 0.05**	-0.24		-0.064	
Self → Y Variable	-0.158	-0.151	-0.237	0.007		-0.079		-0.086	

Table 30 presents a summary of the magnitudes of corresponding structural model path coefficients for times T1, T2 and T3 as well as the difference, increase or decrease, in the magnitudes of the corresponding path coefficients from time T1 to T2, from time T2 to T3, and from time T1 to T3. The significance levels for each change are also presented. Corresponding path coefficients that changed significantly from one time period to another time period are shown as bold in Table 30. The significance levels for the differences in the corresponding path coefficients were determined using the technique prescribed by Andreev et al. (2009) where the differences in the beta coefficients are divided by the square root of the standard error of each coefficient. It can be seen in the table that ten of the twenty-one corresponding path coefficients changed significantly from period T1 to T2, whereas only five corresponding path coefficients changed significantly from period T2 to T3. From the initial time period to the last time period, a total of six of the twenty-one corresponding sets of path coefficients changed significantly in magnitude.

Table 30 presents many changes that appear logical as well as a few that are surprising. For example, Perceived Ability's effect on the Y variable increases significantly from time T1 to T2 and time T1 to T3. This could be explained by a student's learning curve. The more students work in the WBH learning environment, the greater their belief in their perceived ability to complete the assigned tasks. On the other hand, it is surprising that Frustration's effect on the Y variable does not change significantly at all. From the table, it seems that the effect increases at time T2 (but not by a significant amount) and then decreases at time T3. This may be attributed to a learning curve or due to other unknown relationships which would require further investigation.

The relationship between Cooperative Learning and Frustration is interesting. Cooperative Learning is thought to be a moderator of Frustration but the data was used to run a model in WarpPLS with no significant results as shown in Figure 45.

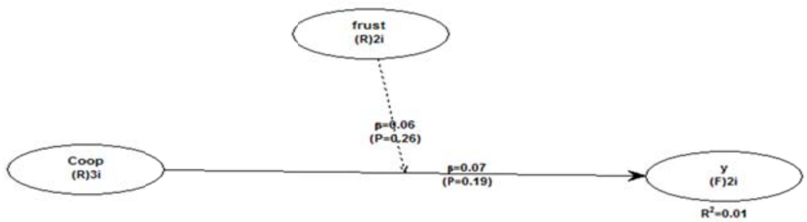
Figure 45: Cooperative Learning Moderates Frustration



Model fit indices and P values
APC=0.164, P=<0.001
ARS=0.077, P=0.012
AVIF=1.014, Good if < 5

The same two factors were tested again but this time using Frustration to moderate Cooperative Learning. The results were not at all significant as seen in Figure 46.

Figure 46: Frustration Moderates Cooperative Learning



Model fit indices and P values
APC=0.064, P=0.295
ARS=0.012, P=0.260
AVIF=1.389, Good if < 5

The survey questions used for these constructs are as follows:

Table 31: Frustration and Cooperative Learning Questions

	T1, T2 or T3	1 Strongly Agree %	2 Agree %	3 Neutral %	4 Disagree %	5 Strongly Disagree	**Mean**	T1-T2 Sig. (2-tailed)	T2-T3 Sig. (2-tailed)	T1-T3 Sig. (2-tailed)
Cooperative Learning 1, 2, 3										
Whenever appropriate, I prefer to work with classmates outside of class to	**T1** **T2** **T3**	12.2 9.5 15.8	32.9 34.7 35.1	22.1 30.2 23.9	25.7 18.0 20.7	7.2 7.7 4.5	**2.83** **2.80** **2.63**		.008	.009

prepare class assignments.										
Whenever appropriate, I prefer to work with other students on projects during class.	**T1**	14.9	36.0	25.2	18.0	5.9	**2.64**			
	T2	9.5	41.9	27.5	16.2	5.0	**2.65**			
	T3	11.7	36.5	27.5	20.3	4.1	**2.68**			
I learn better when I work with a group to solve problems rather than by myself.	**T1**	8.1	32.0	29.7	24.3	5.9	**2.88**			
	T2	9.5	31.1	35.1	18.9	5.4	**2.80**			
	T3	11.3	32.9	31.1	19.4	5.4	**2.75**			
Frustration 2, 4										
I feel helpless when I encounter a problem on the computer.	**T1**	4.1	22.1	23	39.2	11.7	**2.32**	.000		
	T2	5.4	27.9	25.7	36.9	4.1	**2.06**			
	T3	5.9	30.6	24.3	31.1	8.1	**2.05**			.001
Frustrating experiences with the WBH severely impacted my ability to get the assignment completed.	**T1**	3.2	13.1	27.5	42.8	13.5	**2.50**			
	T2	3.2	19.4	25.7	41.0	10.8	**2.37**		.004	
	T3	6.3	18	35.1	32.4	8.1	**2.18**			.000

SPSS was used to compute the following cross tabulations seen in Tables 32, 33, 34 and 35.

Table 32: Cross Tabulation of Frustration2 and Coop2 at Time T2

Crosstab

Count

		t2coop1					Total
		1	2	3	4	5	
t2frus2	1	8	19	11	7	5	50
	2	10	58	41	26	5	140
	3	3	11	8	2	1	25
	4	0	3	1	1	0	5
	5	0	1	0	0	0	1
Total		21	92	61	36	11	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.766[a]	16	.760
Likelihood Ratio	12.238	16	.727
Linear-by-Linear Association	.348	1	.555
N of Valid Cases	221		

a. 15 cells (60.0%) have expected count less than 5. The minimum expected count is .05.

Table 33: Cross Tabulation of Frustration2 and Coop2 at Time T2

Crosstab

Count

		t2coop2					Total
		1	2	3	4	5	
t2frus2	1	7	11	17	9	6	50
	2	12	45	50	27	6	140
	3	2	9	9	5	0	25
	4	0	3	1	1	0	5
	5	0	1	0	0	0	1
Total		21	69	77	42	12	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.095[a]	12	.086
Likelihood Ratio	19.550	12	.076
Linear-by-Linear Association	1.820	1	.177
N of Valid Cases	221		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .90.

The previous cross tabulations did not show significant relationships, but the following one suggests students slightly prefer working with others and they feel slightly helpless when problems with computer technology arise.

Table 34: Cross Tabulation of Frustration2 and Coop3 at Time T2

Crosstab

Count

		t2coop3					Total
		1	2	3	4	5	
t2frus2	1	12	20	7	8	3	50
	2	9	65	36	24	6	140
	3	1	10	10	4	0	25
	4	0	3	0	2	0	5
	5	0	0	0	0	1	1
Total		22	98	53	38	10	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.195[a]	16	.000
Likelihood Ratio	29.481	16	.021
Linear-by-Linear Association	4.216	1	.040
N of Valid Cases	221		

a. 15 cells (60.0%) have expected count less than 5. The minimum expected count is .05.

The fourth Frustration question and the first and second Cooperative Learning questions were not significantly related as seen in Table 35 and 36.

Table 35: Cross Tabulation of Frustration4 and Coop1 at Time T2

Crosstab

Count

		t2coop1					Total
		1	2	3	4	5	
t2frus4	1	7	12	9	4	3	35
	2	10	46	25	20	1	102
	3	3	24	24	10	5	66
	4	1	10	3	2	2	18
Total		21	92	61	36	11	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.095[a]	12	.086
Likelihood Ratio	19.550	12	.076
Linear-by-Linear Association	1.820	1	.177
N of Valid Cases	221		

a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is .90.

Table 36: Cross Tabulation of Frustration4 and Coop3 at Time T2

Crosstab

Count

		t2coop3					Total
		1	2	3	4	5	
t2frus4	1	8	11	9	4	3	35
	2	11	42	24	22	3	102
	3	2	35	17	9	3	66
	4	1	10	3	3	1	18
Total		22	98	53	38	10	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.349[a]	12	.137
Likelihood Ratio	16.984	12	.150
Linear-by-Linear Association	.124	1	.725
N of Valid Cases	221		

a. 8 cells (40.0%) have expected count less than 5. The minimum expected count is .81.

The relationship between Frustration4 and Coop2 at T2 is significant as seen in Table 37 which may indicate that many students felt frustration which affected their grade in the course and they preferred working with others in class when working assignments.

Table 37: Cross Tabulation of Frustration4 and Coop2 at Time T2

Crosstab

Count

		t2coop2					Total
		1	2	3	4	5	
t2frus4	1	6	8	12	4	5	35
	2	11	37	28	24	2	102
	3	3	18	31	9	5	66
	4	1	6	6	5	0	18
Total		21	69	77	42	12	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.441[a]	12	.024
Likelihood Ratio	23.579	12	.023
Linear-by-Linear Association	.460	1	.498
N of Valid Cases	221		

a. 6 cells (30.0%) have expected count less than 5. The minimum expected count is .98.

The final crosstab does not show a significant relationship as seen in table 38.

Table 38: Cross Tabulation of Frustration4 and Coop3 at Time T2

Crosstab

Count

		t2coop3					Total
		1	2	3	4	5	
t2frus4	1	8	11	9	4	3	35
	2	11	42	24	22	3	102
	3	2	35	17	9	3	66
	4	1	10	3	3	1	18
Total		22	98	53	38	10	221

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.349[a]	12	.137
Likelihood Ratio	16.984	12	.150
Linear-by-Linear Association	.124	1	.725
N of Valid Cases	221		

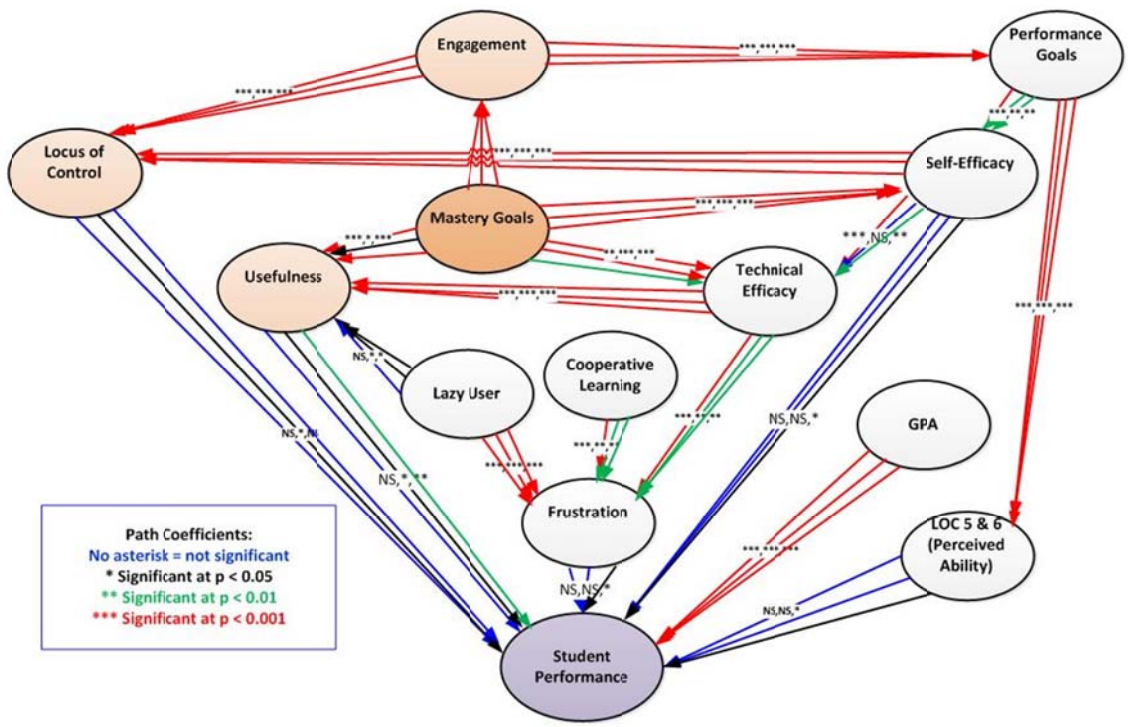
a. 8 cells (40.0%) have expected count less than 5. The minimum expected count is .81.

The relationship between Lazy User characteristics and Frustration is also interesting, partly because it is a positive one. This would seem to indicate that students with the strongest Lazy User characteristics report the most Frustration, and this relationship increases over time.

An important relationship is evidenced in the paths between Mastery Motives and Technical-efficacy. This relationship increases significantly throughout the study, which seems to indicate that students with the highest intrinsic motives become more confident with their technical abilities as time passes and they complete more assignments within the WBH learning environment.

Figure 47 shows the model and the relationships from all three data collection times, T1, T2 and T3, to allow for ease in comparison. Some of the relationships are significant all three times, and some are only significant at one time. However, this figure does not show if the change is significant. Figure 48 shows the paths that change significantly as solid lines and paths that do not change as dashed lines.

Figure 47: Research Model Relationships at Times T1, T2 and T3



Hypotheses Testing

Figure 48: Research Model Depicting Significant Changes Over Time

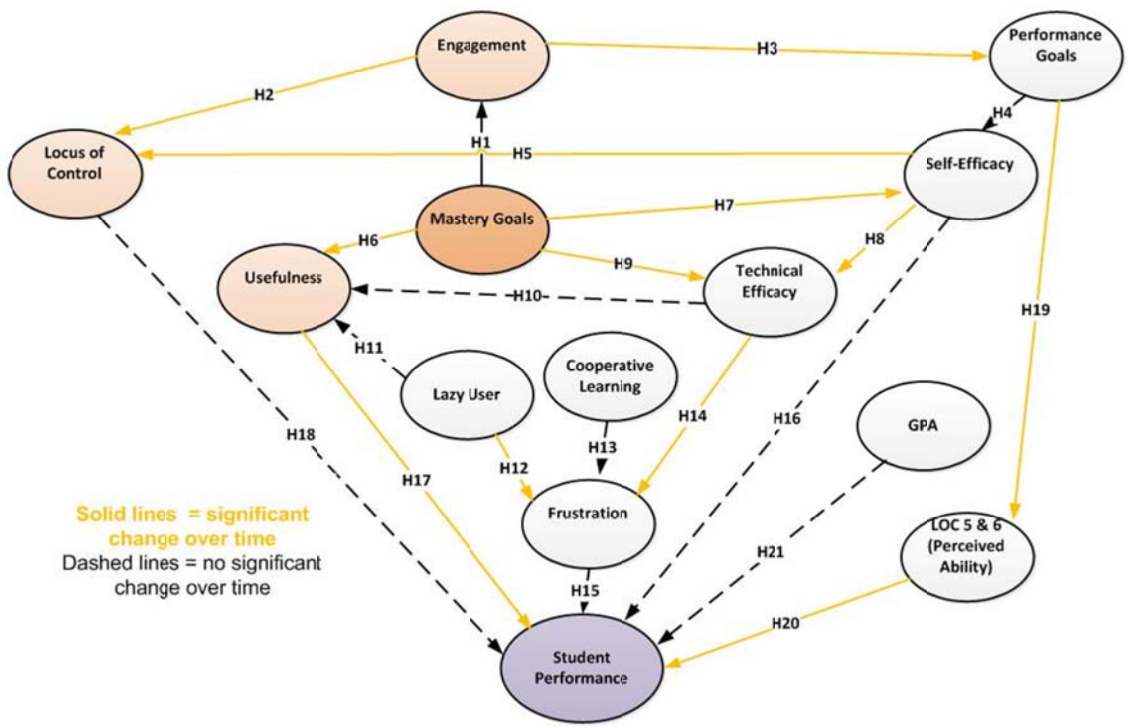


Table 39 presents the hypotheses and results of the test for significant changes over times T1 to T2, T2 to T3 and T1 to T3 and the associated level of significance. Each hypothesis is related to the first set of hypotheses by examining the same relationship, but this time the notation includes “L". This is in direct response to the third research question: “Do these relationships exhibit changes over time?”

Table 39: Results of Hypotheses Testing

	Significant Change **Hypotheses**	**T1-T2**	**T2-T3**	**T1-T3**
H1L	The relationship between students' mastery motives and engagement changes during the semester in the WBH learning environment.	Not supported	Supported P<0.01	Supported P<0.05
H2L	The relationship between student engagement and locus of control changes during the semester in the WBH learning environment.	Supported P<0.01	Supported P<0.01	Not Supported
H3L	The relationship between student engagement and performance goals changes during the semester in the WBH learning environment.	Supported P<0.05	Not Supported	Not Supported
H4L	The relationship between high performance goals and self-efficacy changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported
H5L	The relationship between students' self-efficacy and locus of control changes during the semester in the WBH learning environment.	Supported P<0.01	Not Supported	Not Supported

	Significant Change Hypotheses	T1-T2	T2-T3	T1-T3
H6L	The relationship between students' mastery motives and perceived usefulness changes during the semester in the WBH learning environment.	Supported $P<0.05$	Supported $P<0.05$	Not Supported
H7L	The relationship between students' mastery motives and self-efficacy changes during the semester in the WBH learning environment.	Supported $P<0.05$	Not Supported	Not Supported
H8L	The relationship between students' self-efficacy and technical-efficacy changes during the semester in the WBH learning environment.	Supported $P<0.05$	Not Supported	Not Supported
H9L	The relationship between students' mastery motives and technical-efficacy changes during the semester in the WBH learning environment.	Supported $P<0.01$	Supported $P<0.01$	Supported $P<0.05$
H10L	The relationship between students' technical-efficacy and perceived usefulness changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported

	Significant Change **Hypotheses**	**T1-T2**	**T2-T3**	**T1-T3**
H11L	The relationship between students' lazy user characteristics and perceived usefulness changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported
H12L	The relationship between lazy user characteristics and frustration changes during the semester in the WBH learning environment.	Supported $P<0.01$	Not Supported	Supported $P<0.05$
H13L	The relationship between cooperative learning characteristics and frustration changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported
H14L	The relationship between technical-efficacy and frustration changes during the semester in the WBH learning environment.	Supported $P<0.05$	Not Supported	Not Supported
H15L	The relationship between frustration and student performance changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported

	Significant Change Hypotheses	T1-T2	T2-T3	T1-T3
H16L	The relationship between self-efficacy and student performance changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported
H17L	The relationship between usefulness and student performance changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Supported $P<0.05$
H18L	The relationship between locus of control and student performance changes during the semester in the WBH learning environment.	Supported $P<0.05$	Not Supported	Supported $P<0.01$
H19L	The relationship between performance goals and perceived ability changes during the semester in the WBH learning environment.	Not Supported	Supported $P<0.05$	Supported $P<0.05$
H20L	The relationship between perceived ability (LOC 5 & 6) and student performance changes during the semester in the WBH learning environment.	Supported $P<0.05$	Not Supported	Supported $P<0.01$

	Significant Change Hypotheses	T1-T2	T2-T3	T1-T3
H21L	The relationship between grade point average (GPA) and student performance changes during the semester in the WBH learning environment.	Not Supported	Not Supported	Not Supported

Summary

This chapter has presented the results of the data analysis used to answer the third research question: do these relationships change over time? Using SmartPLS, WarpPLS and SPSS, reliable constructs were noted and used in the creation of a research model that is based on the existing literature. Every relationship in the model is significant at either time T1, T2 or T3. Many of the relationships change significantly during the semester as shown in Table 48

CHAPTER VI

CONCLUSIONS

This chapter will provide a summary of the study and highlight the major findings to conclude this research. It will propose future research that is suggested by the models presented in this study and identify some limitations. The chapter will close with a brief synopsis of the entire study.

Summary

This study began by examining WBH (web-based homework) used by students in accounting classes. The research questions asked were:

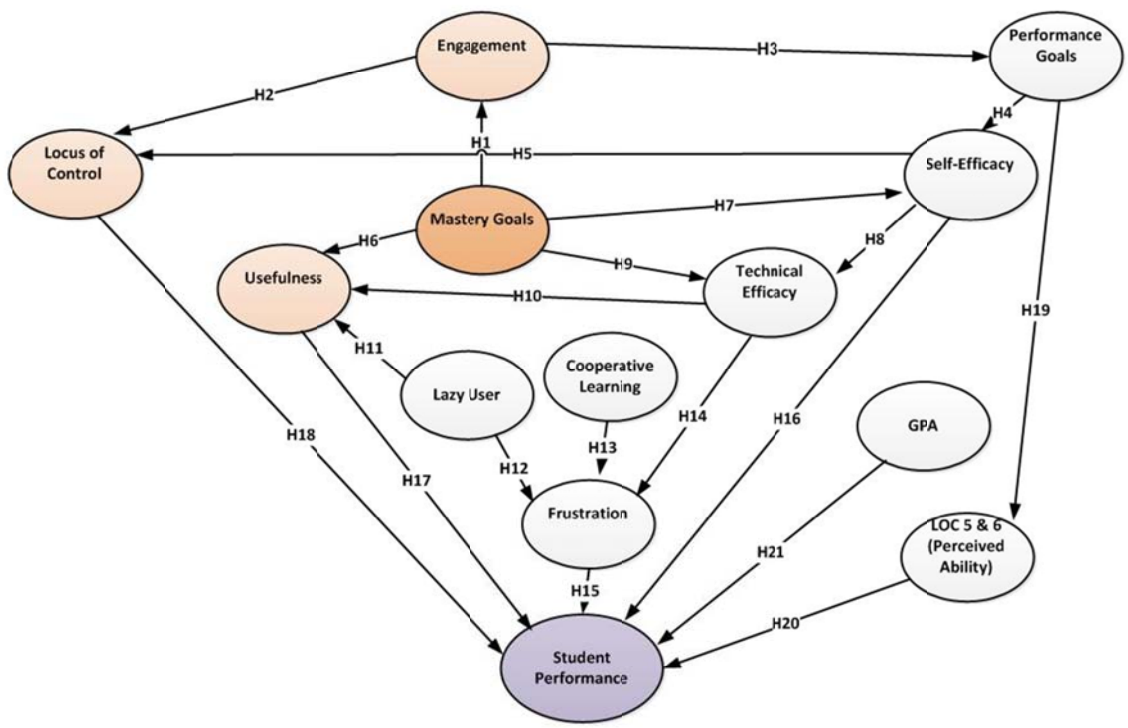
1. What are the factors in the WBH learning environment?
2. How do these factors relate to each other?
3. Do these relationships change significantly over time?

Based on the literature review, several theories from four disciplines, including education, psychology, technology and sociology were used to develop a theory-driven view of the WBH learning environment. Studies, based on these theories, guided the development of the data collection instrument. A questionnaire was created and administered to students at three different times across the semester. About 70% of the students in the study completed all three surveys over a period of fifteen weeks. A total of 222 observations, at each time period, were used in the data analysis.

Findings

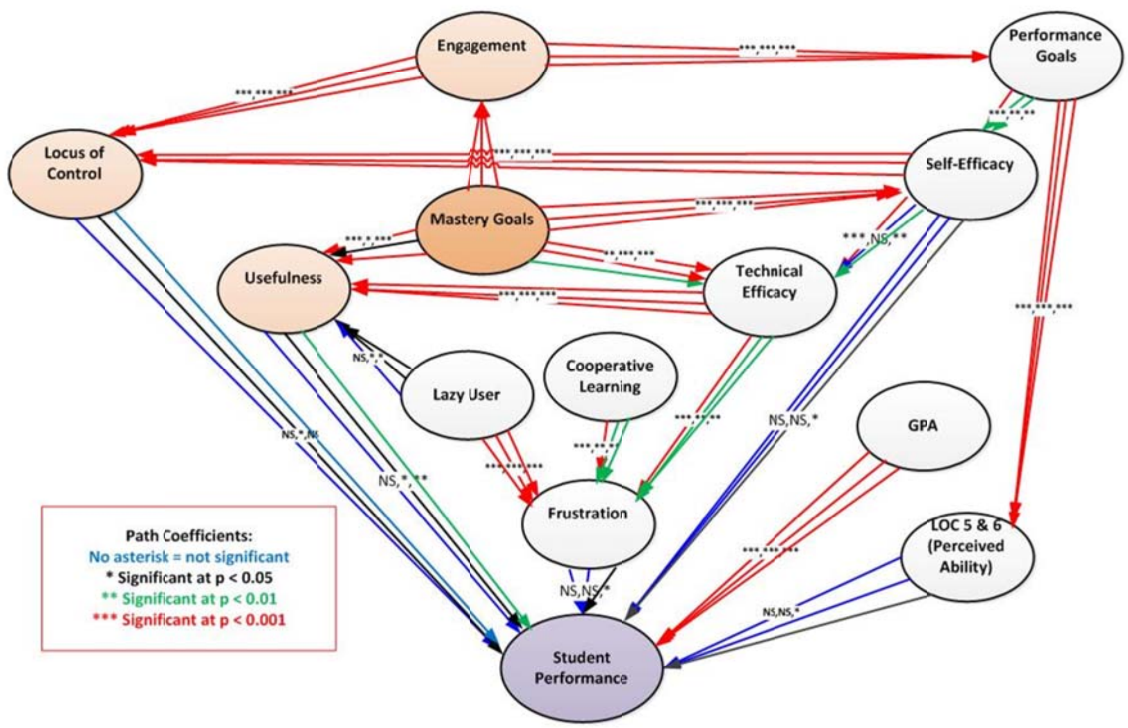
The data analysis began with a test of the data's reliability. Most of the constructs demonstrated acceptable Cronbach's alpha scores. The ones that had a Cronbach's alpha below 0.60 were dropped. The data was used in a principal components analysis for construct development and several models were tested. These tests resulted in elimination of the constructs of Feedback, Discovery, Humanistic Learning and Student Centered Control. The confirmatory factor analysis revealed fully formed factors that supported the theorized constructs. Based on the literature review, several relationships were tested using the data from this study and a model shown in Figure 49 was created based on the results.

Figure 49: Research Model Revisited



Data was collected at three time periods, T1, T2 and T3. SmartPLS and WarpPLS were used to test the model for goodness of fit and to measure the relationships between constructs. The longitudinal study revealed that several of the relationships change significantly over time. The results of the model tests at time T1, T2 and T3 are combined and shown in Figure 50.

Figure 50: Research Model Path Coefficients at Times T1, T2 and T3



The data analysis and results presented demonstrate that all of the factors in the model are significant within the WBH learning environment. Thus, the data suggests that the answer to research question one, "What are the factors in the WBH learning environment" is: mastery motives, engagement, locus of control, performance goals, self-efficacy, technical-efficacy, usefulness, lazy user, frustration, cooperative learning, perceived ability and GPA. This is summarized in Table 40.

Table 40: Significant Factors in the WBH Learning Environment

Significant Factors in the WBH Learning Environment		
Construct	**Significance**	**Support**
Feedback	Not significant	Figures 14, 15, 16
Engagement	Significant, T1, T2 & T3	Figures 40, 41, 42
Mastery	Significant, T1, T2, & T3	Figures 40, 41, 42
Discovery	Significant but low Cronbach's alpha (dropped from further analysis)	Tables 10, 11, 12 Figures 14, 15, 16
Mastery	Significant, T1, T2 & T3	Figures 40, 41, 42
Locus of Control	Significant, T1, T2 & T3	Figures 40, 41, 42
Performance Goals	Significant, T1, T2 & T3	Figures 40, 41, 42
Perceived Ability (LOC56)	Significant, T3	Figure 47
Self-Efficacy	Significant, T1, T2 & T3	Figure 47
Usefulness	Significant, T2, T3	Figure 47
Technical-Efficacy	Significant, T1, T2 & T3	Figure 47
Lazy User	Significant, T1, T2 & T3	Figure 47
Frustration	Significant, T3	Figure 47
Cooperative Learning	Significant, T1, T2 & T3	Figure 47
Humanistic Learning	Not significant	Figures 40, 41, 42
Student Centered Control	Not significant	Figures 40, 41, 42
GPA	Significant, T1, T2 & T3	Figure 47

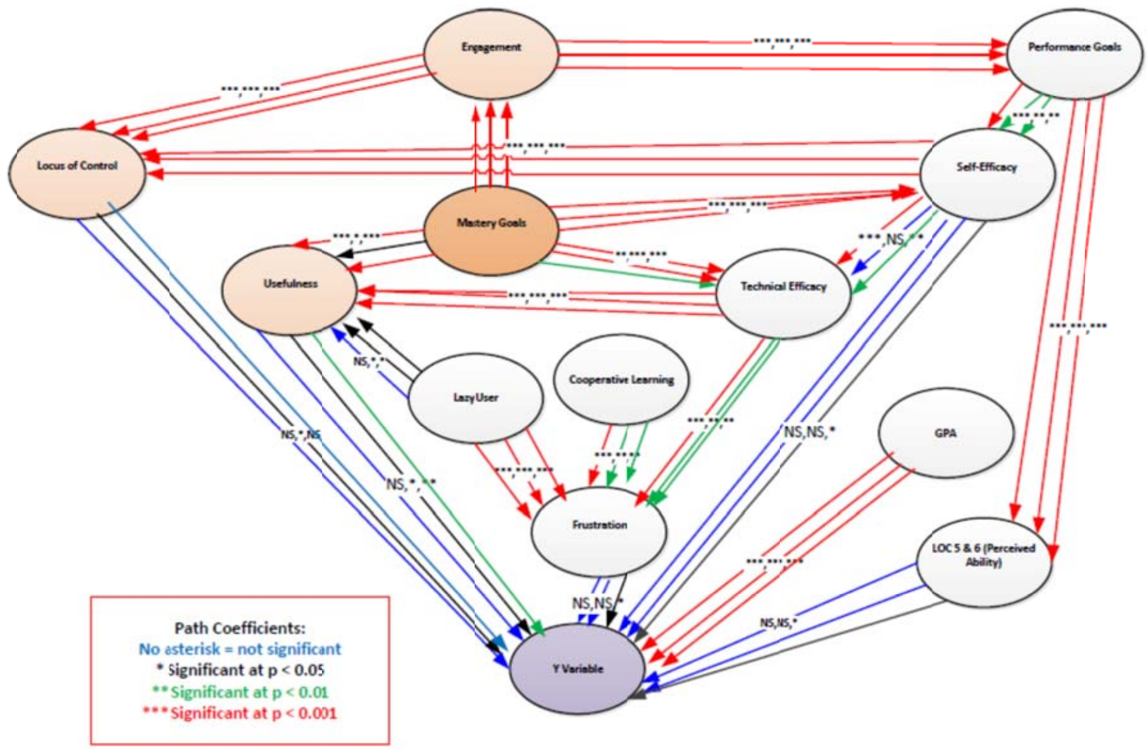
The second research question was: "How do these factors relate to each other?" The answer appears to be that there are many significant relationships. Table 28 (reproduced as Table 41) presents the direct and indirect effects captured by SmartPLS when the model is run using the data set from time T1, T2 and T3.

Table 41: Showing the Relationships between the Factors in the WBH Learning Environment

Total Effects: Direct (Bold) and Indirect Effects (Italicized)									
	Frust	LOC	LOC 5-6	Tech	Useful	Engage	Perform	Self-eff	Y Variable
Mastery	*-0.0731*	*0.3565*	*0.1233*	**0.3928**	**0.4185**	**0.6155**	*0.3308*	**0.4628**	**-0.1118**
Coop	**0.1808**								*0.023*
Frust									**0.1271**
GPA									**-0.3301**
LOC									**-0.1346**
LOC 5-6									**-0.0575**
Lazy	**0.3665**				**0.112**				*0.0579*
Tech	**-0.1862**				**0.459**				*0.0229*
Useful									**0.1014**
Engage	*-0.0041*	**0.3157**	*0.2003*	*0.022*	*0.0101*		**0.5375**	*0.1248*	*-0.0777*
Perform	*-0.0076*	*0.0976*	**0.3727**	*0.0409*	*0.0188*			**0.2323**	*-0.0787*
Self-eff	*-0.0328*	**0.4202**		**0.1763**	*0.0809*				**-0.2466**

The third research question was: "Do these relationships change significantly over time?" As discussed in Chapter 5, it appears that many relationships change significantly at times T1, T2 and T3 as presented in Figure 51.

Figure 51: Research Model Path Coefficients at Times T1, T2 and T3



Discussion

Simon (1967) cites Reitman (1963) who observed that:

a. “Human thinking always takes place in, and contributes to, a cumulative process of growth and development;

b. Human thinking begins in an intimate association with emotions and feelings which is never entirely lost;

c. Almost all human activity, including thinking, serves not one but a multiplicity of motives at the same time” (Simon, 1967, 1).

Simon discussed two assumptions that were made about the “motivation” of behavior: (a) the central nervous system operates in a serial manner and (b) the course of behavior is “motivated by an organized hierarchy of goals” (1967, 30). He writes that people can only pay attention to a limited number of items at any given time. The motivation that is behind their pursuit of a goal changes. He listed the four reasons that would affect the pursuit of a goal.

a. Aspiration achievement - meaning the goal had been attained
b. Satisficing – meaning a person got close enough to the goal
c. Impatience – meaning the person had enough
d. Discouragement – meaning a person tried and failed for whatever reason

If the findings presented in this chapter are examined from Simon’s point of view, it appears that the models from student responses at times T1, T2 and T3 illustrate the change behavior as the semester progresses. For example, Mastery Motives is and remains a strong predictor of Engagement, Self-efficacy, Technical-efficacy and Usefulness. Aspiration, achievement and satisficing can aid in understanding the continued strong relationship of Mastery Motives with cognitive engagement and perceptions of personal and technical efficacy. In addition, this relationship is also indicative of discouragement when the perception of personal and technical efficacy is low. Impatience is related to frustration, which in our study increased at time period T3, toward the end of the semester. Figure 51 could be viewed as representing a change of focus depicting a multiplicity of motives over time as well as Reitman’s process of growth and development. For example, the Locus of Control and Perceived Ability constructs at time T1 are not significant. Perhaps the student does not have enough information about the WBH learning environment to make a determination. However, by time T2, Locus of Control has grown to a significant level. At time T3, Perceived Ability is significant and Locus of Control has subsided. Perhaps by time T2 experience has given the student the confidence to believe he has some control over the class and the WBH learning environment, and this feeling is later reflected in his beliefs in his own ability.

Then again, the same figure could be seen as a picture of a learning pattern. For example, the Self-efficacy construct is not significant at times T1 or T2 but is significant by time T3. It is conceivable that it takes time and practice for the student to develop confidence in his effectiveness in the WBH learning environment. This is also consistent with a pattern of growth and development.

While this study cannot attempt to explain every behavioral aspiration, it does seem to show that frustration inherent in the WBH learning environment could be detrimental to student success. If Reitman's second observation about human thinking being tied to emotions is combined with Simon's belief that discouragement, an emotion, could cause a person to quit before attaining a goal, it could suggest that frustration in the WBH learning environment could be injurious to a student's progress (and by T3, Frustration has grown to have a significant effect on the Y variable). Frustration, or discouragement, is an emotional event that impedes one's growth. However, one aspect not included by Simon could be that cooperation and help from others offset feelings of frustration. Another surprise is that students do not appear to be aware of this. Their responses to one question in the Cooperative Learning construct show a significant change during the semester. The responses imply that at the beginning of the term students are neutral about working with others; but, as the term progressed, they began to recognize that working with other students can be helpful.

After a diligent literature review, it appears that the relationship between the Lazy User characteristics and Frustration has not been investigated empirically. This study was able to find a significant relationship between the two constructs. The relationship is very strong as Lazy User characteristics explain almost 37% of the variance in the Frustration construct, and Frustration explains almost 13% of the variance in the Y variable, student performance.

Usefulness is an important construct in Information Systems studies. Bagozzi, Davis and Warshaw (1992) wrote:

> Because new technologies such as personal computers are complex and an element of uncertainty exists in the minds of decision makers with respect to the successful adoption of them, people form attitudes and intentions toward trying to learn to use the new technology prior to initiating efforts directed at using. (Bagozzi et al., 1992)

The model shows that Self-efficacy is a significant antecedent of Technical-efficacy and Usefulness. Technical-efficacy seems to be a sub-form of Self-efficacy (Santhanam et al., 2008). It is logical to think that people who are self confident in their ability to achieve their goals would also feel confident in their ability to operate a computer and software. Averaged over the course of the semester, technical efficacy explained 45.9% of the variance in Usefulness perceptions.

Mastery Goals are a powerful antecedent of Usefulness. This has been studied in the theory of Task-Technology Fit where motive, such as using technology to complete a task, is a significant antecedent to actual use. However, the path from the Lazy User to Usefulness is not significant at time T1. Perhaps the user does not think it will be useful, but this relationship changes as the semester progresses. Also, perhaps as another indicator of a learning curve, it can be seen that the relationship between Useful and the Y-variable at time T1 is not significant, but by time T2 it is significant, and by T3 it is close to being significant at the next level. This could demonstrate that students have decided that WBH is useful in their study of accounting.

At time T3, the only non-significant paths are from Self-Efficacy to Technical Efficacy and Locus of Control to the Y variable. The most influential path is from Mastery to Engagement. Why would Mastery increase so much at the end of the course? It would be more logical for Mastery to be this strong at the beginning of the course. This may imply that learning a little about the subject increases interest and motivation. Simon suggests behavior is motivated by many emotions and goals and that people think in a linear manner and follow a hierarchy of goals, but that does not explain why mastery motives increased so strongly by time T3. It is possible that knowledge increases motivation. Mayer and Sims (1994) developed the theory of multimedia learning out of an attempt to combine educational technology and educational theory. They state that multimedia learning occurs when students are given information in two or more formats so multiple senses are used. In this study, did the use of the WBH learning environment increase the student's mastery feelings and perceptions? Or, was it more a reflection of their delight at passing the course and finishing the semester successfully?

Finally, an examination of the Mastery and Frustration constructs reveals an interesting item. People who have high mastery goals responded with a "1" or "2" on the survey. People who experienced high frustration levels responded with a "1" or "2". Therefore, since the relationship is negative, this may mean that people with high intrinsic mastery motives report less frustration. This could be reflective of the research performed by Greene and Miller (1996) who wrote that children who wanted to achieve and learn did not view failure as anything more than a challenge. Perhaps people who have difficulties with the software do not become frustrated because they view the technical issues as problems to solve.

Limitations

There are several limitations in this study. The study uses theory to derive concepts that are used as constructs in the exploration of factors that influence student performance in the WBH learning environment. Theory provides useful guidance in the identification of these factors. However, this study does not incorporate a complete view of the theoretical foundations from which the concepts and constructs are derived. In doing so, the current study is limited by an incomplete view of the theoretical foundations on which it is based. A more nuanced examination of the underlying theoretical concepts would enhance the richness of the theory-guided examination of the factors in the WBH learning environment that impact student performance.

The models are based on responses from the students at one university. It is possible that other students would not answer the same way. The same person acted as the teacher to all students involved in this study. They could have responded in a manner calculated to earn the attention of the teacher, thus hoping to increase their grade in the course.

There is normally a 25% D, W, or F rate for these classes. That could mean that the students who remained for the entire study are more persistent or more motivated which would have skewed the data. There could have been some common factor responsible for causing those particular students to drop the course. It is also unknown if there were treatment effects resulting from the use of different publisher's software packages that confounded the results. The research design used in this study is not able to determine answers to these relevant questions. This is a limitation of this study which will be investigated further in future research.

This study is limited in its exploration by the theoretical foundations that are used to derive concepts. Further exploration, guided by additional theory, as well as more nuanced exploration of the current theoretical foundations, may yield additional concepts that are significant in the WBH learning environment.

Since this is an exploratory study, some questions that were included in the survey did not load and were discarded. Another study would need to increase the number of questions included in each construct used.

Finally, people are complicated. One model cannot explain human behavior; however, it does appear to support and be supported by Simon's views on human behavior. From this perspective, it appears that the students began the semester with good intentions, things happened, and goals changed.

Future Research

Future plans include testing the model by dividing the data into online student data and in-person student data. Further research of the responses to the questionnaire should also provide some useful information. Finally, an in-depth examination of these constructs in addition to a persistence construct and/or other emotional constructs might prove beneficial.

REFERENCES

Agarwal, R. and Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage, *MIS quarterly,* 24(4), 665-694.

Ajzen, I. and Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior.* Prentice-Hall, Englewood Cliffs, NJ.

Alavi, M. (1994). Computer-mediated collaborative learning: An empirical evaluation, *MIS Quarterly, June,* 159-174.

Anderson, J.C. and Gerbing, D.w. (1988). Structural equation modeling in practice: a review and recommended two-step approach. *Psychological Bulletin* 103(3), 411-423.

Andreev, P., Heart, T., Maoz, H. and Pliskin, N. (2009). Validating formative partial least squares (PLS) models: methodological review and empirical illustration, *ICIS 2009 Proceedings, Thirtieth International Conference on Information Systems,* Phoenix, Arizona.

Appleton, J., Christenson, S., and Furlong, M. (2008). Student engagement with school: critical conceptual and methodological issues of the construct, *Psychology in the Schools,* 45(5), 369-386.

Baan, J., van Ballegooij, A., Geusebroek, J-M, Hiemstra, D., den Hartog, J., List, J., Snoek, C., Patras, I., Raajimakers, S., Todoran, L., Vendrig, J., de Vries, A., Westerveld, T. and Worring, M. (2001). Lazy users and automatic video retrieval tools in (the) Lowlands. In Proceedings of the 10^{th} Text Retrieval Conference (TREC), November.

Bagozzi, R., Davis, F. and Warshaw, P. (1992). Development and test of a theory of technological learning and usage, *Human Relations,*45(7), 659-686.

Bahr, S.J. (1983). From mainframes to micros: Effects on workshop delivery, *Association for Computing Machinery,* 116(4), 169-173.

Baker, N. (2010). Employee feedback technologies in the human performance system, *Human Resource Development International, 13(4), 477-485.*

Baker, S.B., Corbett, A.T., Koedinger, K.R., and Wagner, A.Z. (2004). Off-task behavior in the cognitive tutor classroom: When students "Game the System", Conference on Human Factors in Computing Systems, Proceedings of the SIGCHI conference on Human factors in computing systems, 383-390.

Baldwin T. and Kar, K. (1987). "The Development and Empirical Test of a Measure for Assessing Motivation to Learn in Management Education," in Academy of Management Best Paper Proceedings, F. Hoy (ed.), Academy of Management, New Orleans, LA, pp. 117-121.

Bandura, A. (1974). Behavior theory and the models of man, *American Psychologist*, 29:859-69.

_________. (1977). Self-efficacy: Toward a unifying theory of behavioral change, *Psychological Review,* 84(2), 191-215.

_________. (1982). Self-efficacy mechanism in human agency, *American Psychologist,* 37, 122-147.

Bates, H.L. and Waldrup, B.E. (2006). The effect of teaching technology on the performance and attitudes on accounting principles students, *Academy of Educational Leadership Journal,* 10(3), 79-91.

Bessiere, K., Ceaparu, I., Lazar, J., Robinson, J. and Schneiderman, B. (2002), Social and psychological influences on computer user frustration, in Bucy, E. and Newhagen, J. (Eds), Media Access: Social and Psychological Dimensions of New Technology Use, Lawrence Erlbaum Associates, Mahwah, NJ, 169-92.

Bostrom, R.P., Olfman, L., Sein, M.K. (1990). "The Importance of Learning Style in End-User Training," *MIS Quarterly*, 14(1), March, pp. 101-119.

Bovy, R.C. (1981). "Successful Instructional Methods:A CognitiveI nformationP rocessing Approach," *ECTJ*, 29(4), Winter, pp. 203-217.

Bower, G.H. and Hilgard, E.R. (1981). *Theories of Learning*, 5th ed., Prentice-Hall, Englewood Cliffs, New Jersey.

Bonham, S., Beichner, R. & Deardorff, D. (2001). Online homework: Does it make a difference?, *The Physics Teacher,* 29, 292-296.

Bonham, S.W., Deardorff, D.L. & Beichner, R.J. (2003). Comparison of student performance using web and paper-based homework in college-level physics. *Journal of Research in Science Teaching,* 40(10), 1050-1071.

Brown, S.A., Massey, P., Montoya-Weiss, M.M. and Burkman, J.R. (2002). Do I really have to? User acceptance of mandated technology, *European Journal of Information Systems,* 11, 283-295.

Bruner, J.S. and Postman, L. (1949). Perception, cognition, and behavior, *Journal of Personality,* 18910, 14-31.

Bruner, J.S. (1985). Models of the learner, *Educational Researcher,* 14(6), 5-8.

Bruning, I.L. (1983). "An Information Processing Approach to a Theory of Instruction," *ECTJ,* 31(2), Summer, pp. 91-101.

Bruque, S., Moyano, J. and Eisenberg, J. (2008-9). Individual adaptation to IT-induced change: The role of social networks, *Journal of Management Information Systems,* 25(3), 177-206.

Burge, L. (1988). Beyond andragogy: Some explorations for distance learning design, *Journal of Distance Education.*

Canter, L. and Hausner, L. (1987). *Homework Without Tears.* Canter and Associates, Inc., New York.

Caruso, J.B. (2004). ECAR study of students and information technology, 2004: Convenience, connection, and control. EDUCAUSE, http://www.educause.edu/ir/library/pdf/ERS0405/ekf0405.pdf , UNCG library, viewed December 30, 2009.

Ceaparu, I., Lazar, J., Bessiere, K., Robinson, J. and Shneiderman, B. (2004). Determining causes and severity of end-user frustration, *International Journal of Human-Computer Interaction,* 17(3), 333-356.

Cennamo, K.S., Saveny, W.C., and Smith, P.L. (1991). "Mental Effort and Video-Based Learning: The Relationship of Preconceptions and the Effects of Interactive and Covert Practice," *Educational Technology Research and Development*, 39(1), pp. 5-16.

Chase, J.D. and Okie, E.G. (2000). Combining cooperative learning and peer instruction in introductory computer science, ACM SIGCSE Bulletin, 372-376.

Chen, C. and Stevenson, H.W. (1989). Homework: A cross-cultural examination, *Child Development,* 60(3), 551-561.

Chen, N., Lin, K, and Kinshuk (2008). Analysing users' satisfaction with e-learning using a negative critical incidents approach, *Innovations in Education and Teaching International,* 45(2), 115-126.

Cheng, K.K., Thacker, B.A., Cardenas, R.L., and Crouch, C. (2004). Using an online homework system enhances students' learning of physics concepts in an introductory physics course, *American Association of Physics Teachers,* 72(11), 1447-1453.

Chin, W.W. (1995). On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution. *Management Information Systems Quarterly,* June, 237-245.

_________. (1998). Issues and opinion on structural equation modeling. *Management Information Systems Quarterly,* 22(1), 1-3.

Cohen, J. (1992). A power primer, *Psychological Bulletin,* 112(1), 155-159.

Cole, R.S. and Todd, J.B. (2003). Effects of web-based multimedia homework with immediate rich feedback on student learning in general chemistry, *Journal of Chemical Education,* 80(11), 1338-1343.

Collan, M. (2007). Lazy User Behavior, Viewed online http://mpra.ub.uni-muenchen.de/4330/ January 2, 2010.

Cooper, H. (1989). Synthesis of research on homework, *Educational leadership, November,* 85-91.

Cooper, P. A. (1993). Paradigm shifts in designed instruction: From behaviorism to cognitivism to constructivism, *Educational Technology*, May, 12-19.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests, *Psychometrika,* 16(3), 297-334.

Crowther, M.S., Keller, C.C, and Waddoups, G.L. (2004). Improving the quality and effectiveness of computer-mediated instruction through usability evaluations, *British Journal of Educational Technology,* 35(3), 289-303.

Davenport, J. and Davenport, J.A. (1985). A chronology and analysis of the andragogy debate, *Adult Education Quarterly,* 35(3), 71-78.

Davidson, G.V., (1990). "Matching Learning Styles with Teaching Styles: Is it a Useful Concept in Instruction?" *Performance and Instruction Journal*, pp. 36-38.

Davis, F.D., Bagozzi, R.P. and Wwarshaw, P.R. (1989). User acceptance of computer technology: A comparison of two theoretical models, *Management Science,* 35(8), 982-1003.

DeBerard, M.S., Spielmans, G.I., and Julka, D.C. (2004). Predictors of academic achievement and retention among college freshmen: A longitudinal study, *College Student Journal,* 38(1), 66-80.

Demirci, N. (2007). University students' perceptions of web-based vs. paper-based homework in a general physics course, *Eurasia Journal of Mathematics, Science & Technology Education,* 3(1), 29-34.

Dewey, J. (1913). Democracy in education, *The Elementary School Teacher,* 4(4), 193-204.

_______. (1916). Democracy and Education: an Introduction to the Philosophy of Education, Kessinger Publishing.

Dillard-Eggers, J., Wooten, T., Childs, B., and Coker, J. (2008). Evidence on the effectiveness of on-line homework, College Teaching Methods & Styles Journal, 4(5), 9-15.

Dishaw, M.T. and Strong, D.M. (1999). Extending the technology acceptance model with task-technology fit constructs, *Information & Management,* 36(1), 9-21.

Dowson, M. and McInerney, D. (2004). The development and validation of the goal orientation and learning strategies survey, *Educational and Psychological Measurement,* 64(2), 290-310.

Dweck, C. S. and Leggett, E.L. (1988). A social-cognitive approach to motivation and personality, *Psychological Review,* 95(2), 256-273.

Elliott, E.S. and Dweck, C.S. (1988). Goals: An approach to motivation and achievement, *Journal of Personality and Social Psychology,* 54(1), 5-12.

Eskew, R.K. and Faley, R.H. (1988). Some determinants of student performance in the first college-level financial accounting course, *The Accounting Review,* LXIII(1), 137-147.

Fornell, C. and Larcker, D. (1981). Evaluating structural equation models with unobservable variables and measurement error, *Journal of Marketing Research,* 18(1), 39-50.

Fourqurean, J.M., Meisgeier, C., and Swank, P.(1990). The Link Between Learning Style and Jungian Psychological Type: A Finding of Two Bipolar Preference Dimensions, *Journal of Experimental Education*, Spring, pp. 225-237.

Gagné, R.M. (1970). *The Conditions of Learning,* Rev. Ed., New York: Holt, Rinehart & Winston.

_________. (1973). Learning and instructional sequence, *Review of Research in Education,* 1(3), 3-28.

Gengerelli, J.A. (1930). The principle of maxima and minima in animal learning, Journal of Comp *Psychology,* 11, 193-236.

Gerbing, D. and Anderson, J. (1988). An updated paradigm for scale development incorporating unidimensionality and its assessment, *Journal of Marketing Research,* 25(2), 186-192.

Gibbons, H.S. and Wentworth, G.P. (2001). Andrological and pedagogical training differences for online instructors, *Journal of Distance Learning Administration*, *IV(III), 1-4.*

Goldin, C. (1999). A brief history of education in the United States, Historical Paper 119, National Bureau of Economic Research, August, JEL No. I2, N3, Development of the American Economy.

Goodhue, D.L. & Thompson, R.L. (1995). Task-technology fit and individual performance, *MIS Quarterly,* 19(2), 213-236.

Greene, B.A. and Miller, R.B. (1996). Influences on achievement: Goals, perceived ability, and cognitive engagement, *Contemporary Educational Psychology,* 21, 181-192.

Greenlaw, S.A. (1999). Using groupware to enhance teaching and learning in undergraduate economics, *Journal of Economic Education,* Winter, 33-42.

Grusec, J.E., 1992. Social Learning Theory and Developmental Psychology: The Legacies of Robert Sears and Albert Bandura, *Developmental Psychology* 28(5) pp. 776-786.

Gunawardena, C.N. and Duphorne, P.L. (2000). Predictors of learner satisfaction in an academic computer conference, *Distance Education,* 21(1), 101-117.

Halliday, J. (1998). Technicism, reflective practice and authenticity in teacher education, *Teaching and Teacher Education,* 14(6), 597-605.

Hambree, R. (1992). Experiments and Relational Studies in Problem Solving: A Meta-Analysis, *Journal for Research in Mathematics Education,* 23(3), pp. 242-273.

Hauk, S. and Segalla, A. (2005). Student perceptions of the web-based homework program WeBWork in moderate enrollment college algebra classes, *Journal of Computers in Mathematics and Science Teaching,* 24(3), 229-253.

Hedman, L. and Sharafi, P. ( ). Early use of internet-based educational resources: effects on students' engagement modes and flow experience, *Behaviour & Information Technology,* 23(2), 137-146.

Henseler, J., Ringle, C. and Sinkovics, R. (2009). The use of partial least squares path modeling in international marketing, *Advances in International Marketing,* 20, 277-319.

Heyman, G.D., Dweck, C.S. and Cain, K.M. (1992). Young children's vulnerability to self-blame and helplessness: Relationship to beliefs about goodness, *Child Development,* 63, 401-415.

Hidi, S. (1990). Interest and Its Contribution as a Mental Resource for Learning, *Review of Educational Research,* 60(4), Winter, pp. 549-571**.**

Hubona, G. (2010). SmartPLS workshop, Jan. 5-6.

Isenberg, S. (2007). *Applying Andragogical Principles to Internet Learning*, Campria Press, Youngstown, N.Y.

James, W. (1890). *The Principles of Psychology*. New York: Holt.

John Wiley & Sons, 2009 Annual report, viewed online http://www.wiley.com/legacy/annual_reports/ar_2009/ on September 26, 2010.

Jonassen, D.H. (1990). Thinking technology: Toward a constructivist view of instructional design, *Educational Technology*, September, 32-34.

Jones, C.G. (2008). Student perceptions of the impact of web-based homework on course interaction and learning in introductory accounting, *Issues in Information Systems,* IX(1), 223-232.

Knowles, M. (1968). Andragogy, not pedagogy! *Adult Leadership,* 16, 350-352.

_________. (1973). *The Adult Learner: A Neglected Species,* Gulf Publishing Company, Houston, Texas.

Kock, N. (2010). WarPLS User Manual. ScriptWarp Systems, Laredo, Texas.

Kolb, A.Y. and Kolb, D.A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education, *Academy of Management Learning & Education,* 4(2), 193-212.

Kralovec, E. and Buell, J. (2000). The End of Homework: How Homework Disrupts Families, Overburdens Children, and Limits Learning. Beacon Press, Boston.

Kulhavy, R.W. (1977). Feedback in written instruction, *Review of Educational Research,*47(1), 211-232.

Laird, T. and Kuh, G. (2005). Student experiences with information technology and their relationship to other aspects of student engagement, *Research in Higher Education,* 46(2), 211-233.

Leidner, D.E. and Jarvenpaa, S.L. (1995). The use of information technology to enhance management school education: A theoretical view, *MIS Quarterly,* 19(3), 265-291.

Lenard, M.J., Wessels, S. and Khanlarian, C. (2010). Gender differences in attitudes toward computers and performance in the accounting information systems class, *American Journal of Business Education,* 3(2), 23-29.

Libbey H. (2004). Measuring student relationships to school: Attachment, bonding, connectedness and engagement, *Journal of School Health,* 74(7), 1-10.

Lippincott, B., Matulich, E., and Squire, K. (2006). To learn or not to learn: The effect of educational technology on learning in accounting courses, *Journal of College Teaching & Learning,* 3(12), 55-60.

Locke, E.A. and Latham, G.P. (1990). Work motivation and satisfaction: Light at the end of the tunnel, *Psychological Science*, 1(4), 240-245.

______.(2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey, *American Psychologist,* 57(9), 705-717.

Martoochie, J.J. & Webster, J. (1992). Effects of feedback and cognitive playfulness on performance in microcomputer software training, *Personnel Psychology,* 45(3), 553-578.

Maslow, A.H. (1943). A theory of human motivation, *Psychological Review,* 50, 370-396.

Mayer, R.E. and Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning, *Educational Psychologist,* 38(1), 43-52.

Mayer, R.E. and Sims, V.K. (1994). For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning, *Journal of Educational Psychology,* 86(3), 389-401.

McGraw-Hill Inc. 2009 Annual Report, http://www.mcgraw-hill.com/about/annual_report/ar2009.pdf viewed September 26, 2010.

Means, B., Toyama, Y., Murphy, R., Bakia, M., and Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies, U.S. Department of Education, Office of Planning, Evaluation, and Policy Development, Policy and Program Studies Service. Center for Technology in Learning.

Mendoza, V. and Novick, D.G. (2005). Usability over time, *Proceedings of SIGDOC,* Coventry, UK, 151-158.

Merriam, S.B. (2001). Andragogy and self-directed learning: Pillars of adult learning theory, *New Directions for Adult and Continuing Education,* 89, 3-13.

Miller, P.H. (1983). *Theories of Developmental Psychology*, W.H. Freeman and Company, San Francisco.

Mower, R.R. and Klein, S.B. ed., (2001). *Handbook of Contemporary Learning Theories,* Lawrence Erlbaum Associates, Mahway, New Jersey.

Mowrer, O.H. (1960). *Learning Theory and Behavior,* John Wiley & Sons, Inc., New York.

Mowshowitz, A. (1981). On approaches to the study of social issues in computing, *Communications of the ACM,* 24(3), 146-155.

Ngyyen, D.M. and Kulm, G. (2005). Using web-based practice to enhance mathematics learning and achievement, *Journal of Interactive Online Learning*, 3(3), 1-16.

Ocker, R.J. and Yaverbaum, G.J. (1999). Asynchronous computer-mediated communication versus face-to-face collaboration: Results on student learning, quality and satisfaction, *Group Decision and Negotiation,* 8, 427-440.

Palocsay, S.W. and Stevens, S.P. (2008). A study of the effectiveness of web-based homework in teaching undergraduate business statistics, *Decision Sciences Journal of Innovative Education,* 6(2), 213-343.

Pascarella, A.M. (2004). The influence of web-based homework on quantitative problem-solving in a university physics class, *Proceedings of the National Association for Research in Science Teaching, 2004 Annual Meeting, Vancouver, BC, Canada.*

Pavlov, I. (1927). Conditioned Reflexes, translated by G.V. Anrep (Oxford University Press, London, 1927).

Peltier, G.L., Laden, R. and Matranga, M. (1999). Student persistence in college: a review of research, *J.College Student Retention,* 1(4), 357-375.

Peng, J.C. (2009). Using an online homework system to submit accounting homework: Role of cognitive need, computer efficacy, and perception, *Journal of Education for Business,* May/June, 263-268.

Piaget, J. and Inhelder, B. (1969). *The Psychology of the Child*, Basic Books, Inc., New York.

Picciano, A.G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course, *Journal of Asynchronous Learning Networks,* 6(1), 21-40.

Piccoli, G., Ahmad, R. and Ives, B. (2000). Knowledge management in academia: A proposed framework, *Information Technology and Management,* 1(4), 229-245.

Piccoli, G., Ahmad, R. and Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training, *MIS* Quarterly, 25(4), 401-426.

Pintrich, P.R. and DeGroot, E.V. (1990). Motivational and self-regulated learning components of classroom academic performance, *Journal of Educational Psychology,* 82(1), 33-40.

Pituch, K.A. and Lee, Y. (2006). The influence of system characteristics on e-learning use, Computers & *Education,* 47, 222-244.

Pratt, D.D. (1988). Andragogy as a relational construct, *Adult Education Quarterly,* 38(3), 160-172.

Premkumar, G., and Bhattacherjee, A. (2006). Explaining information technology usage: a test of competing models, *The International Journal of Management Science,* 36, 64-75.

Pressey, S.L. (1962). Basic unresolved teaching machine problems, *Theory into Practice,* 1(1), 30-37.

Random House Dictionary (2009). Random House, Inc.

Rankin, E.L. and Hoaas, D.J. (2001). The use of PowerPoint and student performance, *Atlantic Economic Journal,* 29(1), 113.

Ravenscroft, S.P. and Buckless, F.A. (2002). The effect of grading policies and student gender on academic performance, *Journal of Accounting Education,* 10(1), 163-179.

Reitman, W. (1965). *Cognition and Thought: an information-processing approach.* John Wiley & Sons, Inc. New York.

Rogers, C.R. (1951). *Client-Centered Counseling,* Boston: Houghton-Mifflin.

_________. (1979). The foundations of the person-centered approach, Unpublished manuscript, http://www.if-development.co.uk/Facilitation/Person%20centered%20approach.pdf viewed online through UNCG, January 4, 2010.

Roth, V., Ivanchenko, V. and Record, N. (2008). Evaluating student response to WeBWorK, a web-based homework delivery and grading system. *Computers and Education,* 50, 1462-1482.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement, *Psychological Monographs,* (80)1, Whole no. 609.

________. (1954). 'Locus of Control', in C.Carver & M. Scheier (eds) Perspectives on Personality, 371-2. New York: Allyn and Bacon, 1996.

________. (1975). Some problems and misconceptions related to the construct of internal versus external control of reinforcement, *Journal of Counseling and Clinical Psychology*, 43(1), 56-67.

Saadé, R.G. and Kira, D. (2004). Effectiveness of an interactive application to assist learning: A test case, *Journal of Information Systems Education,* 15(4), 357-363.

Santhanam, R., Sasidharan, S. and Webster, J. (2008). Using self-regulatory learning to enhance e-learning-based information technology training, *Information Systems Research,* 19(1), 26-47.

Schommer, M. and Walker, K. (1997). Epistemological beliefs and valuing school: Considerations for college admissions and retention, *Research in Higher Education,* 38(2), 173-184.

Schunk, D. (1991). Self-efficacy academic motivation, *Educational Psychologist,* 26(3), 207-231.

Seligman, M. (1972). Learned helplessness, *Annual Review of Medicine,*23, 407-412.

Simon, H.A. and Feigenbaum, E.A. (1964). An information-processing theory of some effects of similarity, familiarization, and meaningfulness in verbal learning, *Journal of Verbal Learning and Verbal Behavior,* 3(5), 385-396.

Simon, H.A. (1967). Motivational and emotional controls of cognition, *Psychological Review,* 74, 29-39.

Simon, H.A. (1991). Bounded rationality and organizational learning, *Organization Science*, 2(1), 125-134.

________. (2002). Cooperation between educational technology and learning theory to advance higher education, in *Technology Enhanced Learning: Opportunities for Change,* edited by P.S. Goodman, Lawrence Erlbaum Associates, Mahwah, New Jersey.

Sitzmann, T., Ely, K., Bell, B. and Bauer, K. (2008). A multilevel analysis of the effects of technical interruptions on learning and attrition from web-based instruction, CAHRS Working Paper Series, Cornell University ILR School. Working paper 08-11.

Skinner, B.F. (1950). Are theories of learning necessary? *Psychological Review*, *57*, 193-216.

__________. (1954). The Science of Learning and the Art of Teaching, *Harvard Educational Review*, vol. 24, 86-97.

__________. (1976). About Behaviorism, Vintage Books, New York.

__________. (1986). Programmed Instruction Revisited, *The Phi Delta Kappan,* 68(2), 103-110.

Skinner, E. and Beaumont, M.J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year, *Journal of Educational Psychology,* 85(4), 571-581.

Slavin, R.E. (1991). Synthesis of research on cooperative learning, *Educational Leadership,* February, 71-82.

Smart, K.L. and Cappel, J.J. (2006). Students' perceptions of online learning: a comparative study, *Journal of Information Technology Education,* 5, 201-219.

Soderberg, U. (2000). Competence via the web, *Behavior & Information Technology,* 19(30), 229-232.

Straub, D. W. (1989). Validating instruments in MIS research, *MIS Quarterly,* 13(1), 147-162.

Straub, D. and Karahanna, E. (1998). Knowledge worker communications and recipient availability: Toward a task closure explanation of media choice, Organization *Science*, 9(2), 160-175.

Sundaram, S., Schwarz, A., Jones, E., and Chin, W.W. (2007). Technology use on the front line: how information technology enhances individual performance, *Journal of the Academy of Marketing Science,* 35, 101-112.

Susskind, J.E. (2004). PowerPoint's power in the classroom: Enhancing students' self-efficacy and attitudes, *Computers & Education,* 45, 203-215.

Teeter, S., Madsen, S.R., Hughes, J. and Eagar, B. (2007). The perceptions and experiences of students in a paperless accounting class, *The Journal of Effective Teaching,* 7(1), 15-30.

Tenebaum, G. (1982). The Effect of Quality of Instruction on Higher and Lower Mental Processes and On the Predication of Summative Achievement, *Journal of Educational Research,* 80(2), December, pp. 105-114.

Tennyson, R.D. (1992). An Educational Learning Theory for Instructional Design, *Educational Technology*, January, pp. 36-41.,

Tobias, S. (1982). When Do Instructional Methods Make a Difference? *Educational Researcher*, April, pp. 4-9.

Thorndike, E.L. (1912). *Education, a First Book*, the Macmillan Company, NY.

Torres, V., Gross, J. and Dadashova, A. (2010-2011). Traditional-age students becoming at-risk: does working threaten college students' academic success? *J. College Student Retention,* 12(1), 51-68.

Trautwein, U. and Köller, O. (2003). The relationship between homework and achievement – Still much of a mystery, *Educational Psychology Review,* 15(2), 115-145.

United States Government. Office of Technology Assessment. (1982). Informational technology and its impact on American education, Washington, D.C., GPO stock no. 052-003-00888-2.

Uttal, W.R. (2000). *The War Between Mentalism and Behaviorism*, Lawrence Erlbaum Associates, Mahwah, New Jersey.

Walberg, H.J. and Haertel, G.D. (1992). Educational Psychology's First Century, *Journal of Educational Psychology*, 84(1), pp. 6-19.

Wang, Y. (2003). Assessment of learner satisfaction with asynchronous electronic learning systems, *Information & Management,* 41, 75-86.

Warton, P.M. (2001). The forgotten voices in homework: Views of students, *Educational Psychologist,* 36(3), 155-165.

Waters, R.H. (1937). The principle of least effort in learning, *Journal of General Psychology,* 16, 3-16.

Watson, J.B. (1913). Psychology as the behaviorist views it, Psychological Review, XX.

Weiner, B. (1972). Attribution theory, achievement motivation, and the educational process, *Review of Educational Research,* 42(2), 203-215.

________. (1994). Integrating social and personal theories of achievement striving, *Review of educational research,* 64(4), 557-573.

Wortham, S. (2003). Encyclopedia of Cognitive Science Volume 1, Edited by Lynn Nadel (New York: Nature Publishing Group, 2003), Article 563, pages 1079-1082.

Young, M.R., Klemz, B.R. and Murphy, J.W. (2003). Enhancing learning outcomes: The effects of instructional technology, learning styles, instructional methods, and student behavior, *Journal of Marketing Education,* 25(2), 130-142.

Zerr, R. (2007). A quantitative and qualitative analysis of the effectiveness of online homework in first-semester calculus, *Journal of Computers in Mathematics and Science,*26(1), 55-73.

APPENDIX A

SURVEY

1. A Survey about Web Based Homework Software

You have been asked to complete your homework using software that grades your submission immediately. I am interested in your thoughts and experiences. I am asking you to complete three short questionnaires (one now, one in March and one in May) about your use of the web based homework software.

I will add 2 points to your final exam grade for each questionnaire you complete for a total of 6 possible points. You do not have to complete the questionnaires to earn the extra credit points. Instead, you may complete additional problems and I will add 1 point per problem to your final exam grade, up to 6 points.

There is no known risk to you if you agree to complete the questionnaires. This survey should take about 10 minutes to complete. All questionnaires will be in my possession in electronic form and will be seen only by me. All data will be disposed of within three years after the research is completed.

The UNCG Institutional Review Board, which ensures that research involving people follows federal regulations, has approved the research and this consent information. If you have questions regarding your rights as a participant in this project, call Mr. Eric Allen at (336) 256-1482. I will answer questions regarding the research itself at 336-256-0126. Any new information that develops during the project will be provided to you if it might affect your willingness to continue participation in the project.

1. By typing your name below, you are affirming that you are 18 years of age or older and are agreeing to participate in the project described to you. If you are under 18, exit and email me at Khanlarian@uncg.edu

____

2. Who are you?

Tell me something about yourself.

2. What is your gender?

	Male	Female
Male or female?	○	○

3. How old are you?

	18-21	22-27	28-39	40 and up
-	○	○	○	○

4. What is your major?

	Undecided	Accounting	Business but not accounting	Not in the business school
-	○	○	○	○

5. Have you used web based homework software in any other classes?

	Yes, a previous accounting class	Yes, in a class other than accounting	Yes, in a previous accounting class AND another class	No
Select one:	○	○	○	○

6. Do you live on campus?

	Yes.	No, but close enough to walk.	No, I commute.
Select one:	○	○	○

2. Who are you?

Tell me something about yourself.

2. What is your gender?

	Male	Female
Male or female?	○	○

3. How old are you?

	18-21	22-27	28-39	40 and up
-	○	○	○	○

4. What is your major?

	Undecided	Accounting	Business but not accounting	Not in the business school
-	○	○	○	○

5. Have you used web based homework software in any other classes?

	Yes, a previous accounting class	Yes, in a class other than accounting	Yes, in a previous accounting class AND another class	No
Select one:	○	○	○	○

6. Do you live on campus?

	Yes.	No, but close enough to walk.	No, I commute.
Select one:	○	○	○

7. Have you taken an accounting course before?

	Yes, here.	Yes, but somewhere else.	No.
Select one:	○	○	○

8. Have you ever had a job operating a cash register?

	Yes, for a few months.	Yes, for more than a few months.	No.
Select one:	○	○	○

9. Have you ever had a checking account?

	Yes.	No.
Select one:	○	○

10. What grade do you think you're going to get in this class?

11. What grade do you think you're going to get on the homework in this class?

12. To record your extra credit points, I need to know:

	ACC 201 Financial online(Connect Software)	ACC 202 Managerial online(Cengage Software)	ACC 202 Managerial on campus (Cengage Software)	ACC 218 1st Intermediate (Wiley Software)
What class(es) are you taking?	☐	☐	☐	☐

3. Web based homework software

Think about completing your homework assignments for this class as you read the following statements. There are no right or wrong answers.

13. When completing homework problems, I like that software tells me instantly whether I'm right or wrong.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

14. When answering homework problems, I prefer to know WHY I'm wrong.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

15. The web based homework software allows me to finish my homework faster because it tells me if I'm right.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

16. The web based homework software slows me down when doing my homework because I can't get credit for it unless my answer is correct.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

17. Time appears to go by very quickly when I am completing homework assignments using the web based homework software.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

18. Time appears to go by very quickly when I am completing homework assignments using paper and pencil.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

19. I often spend more time using the web based homework software than I had intended.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

20. I often spend more time completing homework problems on paper than I had intended.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

21. I am able to block out most distractions while using the web based homework software.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

22. While working homework problems with paper and pencil, I am able to block out most distractions

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

4. Tell me about yourself and how you feel about different things.

23. I work hard at school because I am interested in what I am learning.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

24. I work hard using the web based homework software because it keeps me interested in what I am learning.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

25. I work hard so I can get done with the homework and do other things.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

26. I want to learn things so that I can be near the top of the class.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

27. Web based homework software helps me reach my goal of being near the top of the class.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

28. In this class, one of my primary goals is to understand the major concepts.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

29. Web based homework software helps me reach my primary goal which is to understand the major concepts.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

30. One of my primary goals in studying for this class is to acquire new knowledge.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

31. Using the web based homework software helps me reach my goal of acquiring new knowledge.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

32. I can complete homework assignments successfully.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

33. When I work accounting problems using the web based homework software, I can get the right answers.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

34. Chance or luck plays an important part in my success.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

35. Chance or luck plays an important part in my success when using the web based homework software.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

36. Doing well in school is a matter of hard work. Luck has little or nothing to do with it.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

37. Doing well on my homework using the software is a matter of hard work. Luck has little or nothing to do with it.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

38. My problem solving skills are better than those of other students in this class.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

39. My problem solving skills using the web based homework software are better then those of other students in this class.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

40. I am able to finish homework assignments by deadlines.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

41. I will be able to finish the web based homework assignments by the due date.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

42. If schoolwork is too hard for me I just don't do it.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

43. If schoolwork is too hard for me, I get friends or the teacher to help.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

44. If schoolwork is too hard for me I just work harder.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

45. I choose easy options in school so that I don't have to work too hard.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

46. Using homework software makes it easier to do my homework because I don't have to read the chapter first. (The links take me to the parts I need in the book).

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

47. I feel anxious when I run into a problem on the computer or have a problem with the web based homework software.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

48. I feel helpless when I encounter a problem on the computer or have a problem with the web based homework software.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

49. When there is a problem with a computer that I can't immediately solve, I keep trying until I have the answer.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

50. Frustrating experiences with the web based homework software severely impacted my ability to get the assignment completed.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

5. Technology

Think about the software you use to grade your homework.

51. Using web based homework software enables me to finish the homework assignment faster than if I used paper.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

52. Web based homework software has improved the quality of the work I do compared to paper homework.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

53. Web based homework software gives me greater control over my work compared to paper homework.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

54. I tried to discover new functions in the web based homework software (calculator, hints, etc?)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

55. If I heard about a new information technology, I would look for ways to experiment with it.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

56. Using a computer is an efficient way for me to learn new things.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

Is there anything you would like to add?

6. Education

Think about the schools you've attended and the ways you learn best.

57. Whenever appropriate, I prefer to work with classmates outside of class to prepare class assignments

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

58. Whenever appropriate, I prefer to work with other students on projects during class.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

59. I learn better when I work with a group to solve problems rather than by myself.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

60. Where appropriate, I have communicated with classmates online to complete academic work.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

61. I have expressed ideas to a professor via e-mail that I did not feel comfortable saying in class.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

62. I work the practice problems because they give me more control over my learning.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

63. Having access to assignments weeks in advance improves my understanding of the material since I have more time to work on them.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

64. Having access to assignments weeks in advance is efficient because I can decide when to work them.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Do you agree?	○	○	○	○	○

Is there anything you would like to add?

7. .... Thank you!

After you click "Submit", wait a day and then check Blackboard to make sure I post your extra credit points.

APPENDIX B

COVARIANCE MATRIX

Inter-Item Covariance Matrix

	t2eng7	t2eng8	t2per1	t2per2	t2mast1	t2mast2	t2mast3	t2mast4	t2self1	t2self2	t2loc3	t2loc4	t2loc5	t2loc6
t2eng7	.413	.250	.187	.209	.145	.153	.182	.177	.095	.072	.105	.121	.042	.043
t2eng8	.250	.593	.184	.269	.100	.258	.169	.261	.185	.178	.128	.167	.063	.107
t2per1	.187	.184	.650	.350	.208	.173	.250	.213	.198	.161	.182	.184	.157	.147
t2per2	.209	.269	.350	.714	.175	.345	.191	.342	.187	.242	.205	.178	.113	.134
t2mast1	.145	.100	.208	.175	.356	.156	.267	.178	.115	.085	.113	.094	.016	.009
t2mast2	.153	.258	.173	.345	.156	.555	.213	.357	.228	.251	.163	.215	.035	.108
t2mast3	.182	.169	.250	.191	.267	.213	.435	.277	.134	.111	.132	.162	.051	.038
t2mast4	.177	.261	.213	.342	.178	.357	.277	.520	.218	.217	.114	.168	.106	.160
t2self1	.095	.185	.198	.187	.115	.228	.134	.218	.390	.308	.156	.176	.132	.159
t2self2	.072	.178	.161	.242	.085	.251	.111	.217	.308	.581	.102	.146	.155	.168
t2loc3	.105	.128	.182	.205	.113	.163	.132	.114	.156	.102	.625	.384	.042	.083
t2loc4	.121	.167	.184	.178	.094	.215	.162	.168	.176	.146	.384	.511	.060	.080
t2loc5	.042	.063	.157	.113	.016	.035	.051	.106	.132	.155	.042	.060	.544	.387
t2loc6	.043	.107	.147	.134	.009	.108	.038	.160	.159	.168	.083	.080	.387	.546
t2loc7	.101	.148	.159	.180	.101	.173	.098	.155	.237	.195	.202	.171	.075	.118
t2loc8	.133	.166	.132	.166	.074	.164	.093	.124	.209	.177	.206	.180	.066	.082
t2lazy1	.071	.057	.141	.037	.151	.049	.123	.028	.086	.027	.177	.142	-.083	-.071
t2lazy4	.127	.086	.269	.198	.134	.151	.152	.148	.114	.110	.238	.181	-.014	.005
t2frus2	.033	.108	.057	.162	.084	.188	.081	.150	.182	.169	.167	.103	.005	.058
t2frus4	.080	.060	.100	.063	.083	.146	.072	.133	.206	.190	.158	.155	-.021	-.010
t2use1	.070	.152	.115	.239	-.021	.123	.009	.166	.112	.156	.109	.128	.148	.231
t2use2	.111	.223	.069	.274	.037	.197	.020	.279	.137	.128	.097	.152	.051	.140
t2use3	.084	.232	.053	.241	.035	.195	.038	.234	.164	.161	.115	.192	.042	.121
t2tech2	.039	.109	.026	.097	.050	.096	.072	.135	.072	.049	.036	.077	.021	.095
t2tech3	.093	.104	.072	.148	.073	.169	.103	.186	.126	.128	.116	.147	.054	.102
t2coop1	-.036	.043	-.003	-.065	-.079	-.078	-.072	-.049	-.033	-.082	-.095	-.061	-.064	-.040
t2coop2	.008	.051	.046	-.095	-.017	-.072	.023	-.030	.035	-.008	-.068	-.026	.061	.045
t2coop3	.018	.039	-.034	-.065	-.025	-.073	.014	-.031	-.042	-.073	-.072	-.007	-.041	-.031

	t2loc7	t2loc8	t2lazy1	t2lazy4	t2frus2	t2frus4	t2use1	t2use2	t2use3	t2tech2	t2tech3	t2coop1	t2coop2	t2coop3
t2eng7	.101	.133	.071	.127	.033	.080	.070	.111	.084	.039	.093	-.036	.008	.018
t2eng8	.148	.166	.057	.086	.108	.060	.152	.223	.232	.109	.104	.043	.051	.039
t2per1	.159	.132	.141	.269	.057	.100	.115	.069	.053	.026	.072	-.003	.046	-.034
t2per2	.180	.166	.037	.198	.162	.063	.239	.274	.241	.097	.148	-.065	-.095	-.065
t2mast1	.101	.074	.151	.134	.084	.083	-.021	.037	.035	.050	.073	-.079	-.017	-.025
t2mast2	.173	.164	.049	.151	.188	.146	.123	.197	.195	.096	.169	-.078	-.072	-.073
t2mast3	.098	.093	.123	.152	.081	.072	.009	.020	.038	.072	.103	-.072	.023	.014
t2mast4	.155	.124	.028	.148	.150	.133	.166	.279	.234	.135	.186	-.049	-.030	-.031
t2self1	.237	.209	.086	.114	.182	.206	.112	.137	.164	.072	.126	-.033	.035	-.042
t2self2	.195	.177	.027	.110	.169	.190	.156	.128	.161	.049	.128	-.082	-.008	-.073
t2loc3	.202	.206	.177	.238	.167	.158	.109	.097	.115	.036	.116	-.095	-.068	-.072
t2loc4	.171	.180	.142	.181	.103	.155	.128	.152	.192	.077	.147	-.061	-.026	-.007
t2loc5	.075	.066	-.083	-.014	.005	-.021	.148	.051	.042	.021	.054	-.064	.061	-.041
t2loc6	.118	.082	-.071	.005	.058	-.010	.231	.140	.121	.095	.102	-.040	.045	-.031
t2loc7	.520	.402	.213	.138	.204	.171	.123	.173	.201	.047	.123	.032	.089	-.009
t2loc8	.402	.502	.177	.133	.163	.158	.137	.146	.164	.038	.137	-.041	.021	-.032
t2lazy1	.213	.177	.805	.373	.315	.375	-.028	-.037	.006	.017	.071	-.093	-.016	-.043
t2lazy4	.138	.133	.373	.834	.263	.300	-.019	-.023	.000	-.079	.090	-.215	-.132	-.148
t2frus2	.204	.163	.315	.263	1.028	.556	.087	.057	.125	.055	.099	-.189	-.063	-.176
t2frus4	.171	.158	.375	.300	.556	1.030	.100	.038	.133	.057	.144	-.238	-.083	-.202
t2use1	.123	.137	-.028	-.019	.087	.100	.693	.376	.350	.183	.227	.035	.075	.040
t2use2	.173	.146	-.037	-.023	.057	.038	.376	.729	.519	.253	.222	.085	.066	.094
t2use3	.201	.164	.006	.000	.125	.133	.350	.519	.694	.226	.217	.045	.071	.059
t2tech2	.047	.038	.017	-.079	.055	.057	.183	.253	.226	.591	.261	.143	.024	.035
t2tech3	.123	.137	.071	.090	.099	.144	.227	.222	.217	.261	.399	-.017	-.002	-.012
t2coop1	.032	-.041	-.093	-.215	-.189	-.238	.035	.085	.045	.143	-.017	1.176	.762	.696
t2coop2	.089	.021	-.016	-.132	-.063	-.083	.075	.066	.071	.024	-.002	.762	1.042	.708
t2coop3	-.009	-.032	-.043	-.148	-.176	-.202	.040	.094	.059	.035	-.012	.696	.708	1.058