

Learning For The Next Generation: Predicting The Usage Of Synthetic Learning Environments

2010

Arthur Evans
University of Central Florida

Find similar works at: <http://stars.library.ucf.edu/etd>

University of Central Florida Libraries <http://library.ucf.edu>

 Part of the [Psychology Commons](#)

STARS Citation

Evans, Arthur, "Learning For The Next Generation: Predicting The Usage Of Synthetic Learning Environments" (2010). *Electronic Theses and Dissertations*. 4211.
<http://stars.library.ucf.edu/etd/4211>

This Doctoral Dissertation (Open Access) is brought to you for free and open access by STARS. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of STARS. For more information, please contact lee.dotson@ucf.edu.

LEARNING FOR THE NEXT GENERATION:
PREDICTING THE USAGE OF SYNTHETIC LEARNING ENVIRONMENTS

by

ARTHUR WILLIAM EVANS III
M.A. University of Central Florida, 2008
B.S. University of Central Florida, 2000

A dissertation submitted in partial fulfillment of requirements
for the degree of Doctor of Philosophy
in the Department of Psychology
in the College of Sciences
at the University of Central Florida
Orlando, Florida

Spring Term 2010

Major Professor: Florian Jentsch

© 2010 Arthur William Evans III

ABSTRACT

The push to further the use of technology in learning has broadened the attempts of many to find innovated ways to aid the new, technologically savvy generation of learners, in acquiring the knowledge needed for their education and training. A critical component to the success of these initiatives is the proper application of the *science of learning* (Cannon-Bowers and Bowers, 2009). One technological initiative that can benefit from this application is the use of *synthetic learning environments* (SLEs). SLEs are instructional systems embedded within virtual worlds. These worlds can be simulations of some task, for instance a simulation that may be completed as part of a military training to mimic specific situations, or they could be in the form of a video game, for example, a game designed to maintain the attention of school children while teaching mathematics. The important components to SLEs are a connection to the underlying task being trained and a set of goals for which to strive toward.

SLEs have many unique characteristics which separate them from other forms of education. Two of the most salient characteristics are the instructorless nature of SLEs (most of the learning from SLEs happens without instructor interaction) and the fact that in many cases SLEs are actually fun and engaging, thus motivating the learner to participate more and allowing them to experience a more immersive interaction. Incorporating the latter of these characteristics into a model originally introduced by Davis (1989) and adapted by Yi and Hwang (2003) for use with web applications, an expanded model to predict the effects of enjoyment, goal orientation, ease of use, and several other factors on the overall use of SLEs has been created. Adapting the Davis and Yi and Hwang models for the specific use of SLEs provides a basis understanding how each of the critical input variables effect the use and thus effectiveness of learning tools

based on SLEs. In particular, performance goal orientation has been added to the existing models to more accurately reflect the performance characteristics present in games.

Results of this study have shown that, in fact, performance goal orientation is a significant factor in the SLE Use and Learning model. However, within the model it is important to distinguish that the two varieties of performance goal orientation (prove and avoid) play different roles. Prove performance goal orientation has been shown to have significant relationships with several other critical factors while avoid performance goal orientation is only accounted for in its significant correlation with prove performance goal orientation.

With this understanding, training developers can now have a better understanding of where their resources should be spent to promote more efficient and effective learning. The results of this study allow developers to move forward with confidence in the fact that their new learning environments will be effective in a number of realms, not only limited to classroom, business, or military training.

ACKNOWLEDGMENTS

I would like to begin by thanking my parents. You have instilled in me a sense of pride and responsibility that makes me want to do everything in my life to my fullest ability. You have always been understanding of my faults and encouraged me to be more than I am.

Next I would like to thank my friends. You all have been a huge support system for me that have not only provided stress relief, but also grand perspective on what life is. Without all my friends in my life, I would be lost. It is because of you that I have the courage to live out so many incredible adventures.

To my colleagues at TPL, so much of what I have had the chance to do is because of you and how well you have all become so efficient at your jobs. And though you all have different skill sets which set you apart from one another, make no mistake that it is your superior personalities that allow you to rise above the competition, and create the greater-than-the-sum-of-their-parts atmosphere within the lab.

Of course Dr. Clint Bowers warrants individual mention. You gave me a chance to be more, when few would have. You had the foresight to look past the numbers and see the person behind them, a characteristic that has always made you a great man. But, it has always been your motivation that has helped push me to be all that you believed I could be.

Last and most certainly not least, I want to thank Dr. Florian Jentsch, my teacher, my advisor, my boss, and most importantly my friend. You have taught me so much, not only about being a good researcher and good Ph.D., but about being a good leader. All of the lessons I have learned from you are hard to quantify, but make no mistake that you have had what will surely be a lasting impact on both my professional and personal life.

TABLE OF CONTENTS

LIST OF FIGURES	x
LIST OF TABLES	xi
CHAPTER ONE: INTRODUCTION	1
CHAPTER TWO: LITERATURE REVIEW	5
Goal Orientation.....	8
Learning Goal Orientation	9
Performance Goal Orientation	10
Prove-Performance Goal Orientation	10
Avoid-Performance Goal Orientation.....	11
Davis Model.....	12
Yi and Hwang Model.....	12
CHAPTER THREE: RESEARCH MODEL AND HYPOTHESES:.....	15
Yi and Hwang’s Prediction Model for Web-Based Systems.....	15
Expanding Yi and Hwang’s Model.....	18
Learning Goal Orientation	20
Performance Goal Orientation	20
Enjoyment.....	21
Application-Specific Self-Efficacy.....	22

Ease of Use, Usefulness, and Behavioral Intention	23
CHAPTER FOUR: METHODOLOGY	24
Bio-data and Training	24
Performance Task	25
Post Performance Testing and Survey	26
Usefulness	27
Ease of Use	28
Behavioral Intention.....	28
Application Specific Self-Efficacy	28
Enjoyment	29
Learning Goal Orientation	29
Prove Performance Goal Orientation.....	29
Avoid Performance Goal Orientation	30
Participation Study Completion.....	30
CHAPTER FIVE: RESULTS	31
Biographical Data Analysis	32
Learning Assessment Scores.....	33
Attitude Survey Internal Consistencies.....	33
Step 1 a: Exploratory Factor Analysis	34
Step 1b: Confirmatory Factor Analysis (CFA).....	37
Step 2: Structural Equation Modeling.....	42

CHAPTER SIX: DISCUSSION	47
Learning Goal Orientation	47
Performance Goal Orientation	48
Enjoyment.....	49
Application-Specific Self-Efficacy.....	50
Ease of Use, Usefulness, and Behavioral Intention	50
APPENDIX A. DAVIS’ (1989) TECHNOLOGY ACCEPTANCE MODEL (TAM)	55
APPENDIX B. YI AND HWANG’S (2003) WEB-BASED USE PREDICTION MODEL.....	57
APPENDIX C. PROPOSED SLE USE PREDICTION MODEL	59
APPENDIX D: BIO-DATA FORM	61
APPENDIX E: SCREENSHOTS OF THE U.S. NAVY INSIGNIA TRAINER PROGRAM....	63
APPENDIX F: POST-TEST TO ASSESS LEARNING OF RANK INSIGNIAS	66
APPENDIX G: SURVEY QUESTIONS.....	75
APPENDIX H: CORRELATION TABLE MEANS AND STANDARD DEVIATIONS	78
APPENDIX I: CORRELATION TABLE	80
APPENDIX J: CONFIRMATORY FACTOR ANALYSIS MODEL	83

APPENDIX K: CONFIRMATORY FACTOR ANALYSIS WITH AVOID PERFORMANCE

GOAL ORIENTATION LINKS REMOVED 85

APPENDIX L: NEW SLE USE AND LEARNING MODEL 87

LIST OF REFERENCES 89

LIST OF FIGURES

<i>Figure 1.</i> Davis et al.'s (1989) Technology Acceptance Model (TAM).....	16
<i>Figure 2.</i> Yi and Hwang's (2003) use prediction model for web-based systems (including R ² and β values).....	17
<i>Figure 3.</i> Proposed model updating Yi and Hwang's model to include performance goal orientation measures (avoid and prove performance goal orientation). Also found in Appendix C.	19
<i>Figure 4.</i> Sample screenshot of the RETRO Lab Insignia Trainer program. Here, the correct response would have been 'Utilitiesman.'	26
<i>Figure 5.</i> New model for SLE Use and Learning. Also found in Appendix L.....	46

LIST OF TABLES

Table 1. Biographical Data Results	32
Table 2. Means, Standard Deviations, and Internal Consistency Estimates for Latent Factors	34
Table 3. Pattern Matrix for the Components after Principal Components Extraction and Promax Rotation.....	35
Table 4. Factor Loadings from Initial Confirmatory Factor Analysis.....	38
Table 5. Factor Loadings with Insignificant Paths Removed	40
Table 6. Goodness-of-Fit Indicators of Models for SLE Use and Learning.....	42
Table 7. New SLE Use and Learning model Fit Indices	45

CHAPTER ONE: INTRODUCTION

Joshua: "Shall we play a game?"
David Lightman: [*typing*] "What is the primary goal?"
Joshua: "To win the game."

- *War Games* (MGM, 1983)

Matthew Broderick's character in the motion picture "War Games" was in some serious trouble when he learned that he had been interacting with a computer program, designed to test the United States' military defenses. However, the above quote gets at one of the core principles of serious games and synthetic learning environments: part of the success of training aides, based on synthetic learning environments, is due in part to the competitive nature of games. As one NFL coach (Edwards, 2002) famously said, "You play to win the game!"

Serious games (or synthetic learning environments (SLEs) as they will be referred to in this dissertation) have been around long before the computer age, first appearing in Abt's (1970) book named *Serious Games*. Much more recently, however, in 2002, SLEs have been pushed back to the forefront of our education and training lexicon via the Serious Games Initiative (Seriousgames.org, 2009) launched out of Washington D.C. As such, the Serious Games Initiative website describes their goals as the following (Seriousgames.org, 2009):

The goal of the initiative is to help usher in a new series of policy education, exploration, and management tools utilizing state of the art computer game designs, technologies, and development skills.

As part of that goal the Serious Games Initiative also plays a greater role in helping to organize and accelerate the adoption of computer games for a variety of challenges facing the world today. (¶ 2)

In short, the serious games initiative believes that SLEs can have a significant contribution, not only in teaching our youth, but also facilitating learning in professional business settings, as well as, in military contexts.

Distinguishing SLEs from Other Techniques

With SLEs becoming more popular, many uses have been explored with the hopes of expanding SLEs effects, such as in the classroom, for learning business strategies, and facilitating better training of military procedures. With this expansion in mind, it is important to specify what distinguishes SLEs from other games and educational techniques.

Abt (1970), in his book *Serious Games*, gave the following detailed definition, laying out the difference between a game and a ‘serious’ game:

Reduced to its formal essence, a game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context. A more conventional definition would say that a game is a context with rules among adversaries trying to win objectives. We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement. (p. 6)

This definition clearly states the educational underpinning of serious games, noting that amusement is not the primary goal. This is not to say that amusement does not play a role in the use of serious games and SLEs, simply that this effect is secondary to learning, and more of a surface characteristic than learning. As well, it is notably top point out that across all games, entertainment and serious, one of the user’s primary surface level goals is winning. This is an idea associated with the personality construct of performance goal orientation, a concept that will be explored further as this dissertation continues.

Thus far, the definition of a serious game only explains the difference between a game and a serious game, which does not require the use of technology as an enabler. SLEs, on the other hand, have grown from technology and simulation. In Abt's era, serious games would have been compared to board games or card games, but today, SLEs' natural counterparts would surely be video games. In fact, more recently, Zyda (2005) has put forward several definitions pertaining to games, video games, and serious games, which include stipulations for technology use. Zyda defined a game as "a physical or mental contest, played according to specific rules, with the goal of amusing or rewarding the participant" (Zyda, p. 25). The similarities between Zyda and Abt's definitions of a game are fairly evident and the term 'rewarding the participant' in Zyda's definition is synonymous with winning. In the interest of modern technology, Zyda goes on to define a video game as "a mental contest, played with a computer according to certain rules for amusement, recreation, or winning a stake" (Zyda, p. 25). This definition closely resembles that of a game, with the phrase 'played with a computer' being the only real difference. I would posit that 'computer' in the above definition should be either understood to include all manner of electronics capable of playing games (i.e., computers, consoles, smart phones, etc.) or that all of those various electronic should be included within the definition. Finally, Zyda's definition of a serious game is "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (Zyda, p. 25). From this, one can see that SLEs are in fact expected to influence training and learning in many private and public professional

settings. Where I see this definition falling short is in the incorporation of an ultimate goal for which to strive. Clearly the definitions used early for games state that games are played with the intent of winning or obtaining some reward. As such, I believe Zyda's definition of a serious game should be modified to include a stipulation for achieving a performance level which lets the player win or be rewarded for their efforts.

SLEs Role in the Future of Education and Training

One of the key interests listed by the Serious Games Initiative on their website (Seriousgames.org, 2009) is "How can we quickly expand the application of computer-based games to a much wider range of key challenges facing our government and other public or private organizations?" This is a challenge facing every researcher in the field. Certainly, a goal of research in this area is to expand the audience of individuals who are able to effectively utilize SLEs to achieve their educational and training needs. However, what does this really mean?

Games can be developed that incorporate a large learning component, but is this the only requirement for being successful? I would argue that given the definitions in the previous sections, the answer must be "no." For SLEs to truly have a positive influence and effect on users, their programming must go beyond simply teaching new material. SLEs must be engaging and, perhaps more importantly, enjoyable, if they are expected to have staying power in the education and training community. Performance using SLEs needs to be encouraged through rewards, as stated by Zyda's (2005) definition of games. It is this effect of performance goal orientation that will play a significant role in this dissertation.

CHAPTER TWO: LITERATURE REVIEW

The push to further the use of technology in learning has broadened the attempts of many to find innovated ways to aid the new, technologically savvy generation of learners in acquiring the knowledge needed for their education and training. This new generation of learners exists, not only in schools as students, but in businesses as managers, and in the military as soldiers. More and more, members from each of these groups were not yet alive during a time when computers were not prevalent in daily life. Instead, they learned to type on keyboards, not typewriters. They have written countless emails and few, if any, handwritten letters. Researching a new topic for these individuals means minutes on the internet, not hours in a library; and for many, countless hours have been spent playing video games, and not board or table games. It is because of this permeation of technology throughout our lives that the push to include more technology in learning and teaching now exists. Technology is now a readily available inexpensive resource in many cases, often designed with adaptability and upgradeability in mind. Further, because so many systems are both in regular use and have similar functional structure, limited or zero training is often required to effectively use new technologies. However, these positive factors alone are not enough to ensure that new learning tools based on modern technologies will be successful in the ultimate goal of teaching. In addition to the standard test scores which may be used to evaluate the success of a new training measure, an understanding of potential attitudes toward new technologies will provide knowledge about acceptance and perceived usefulness of new systems. In this dissertation, the specific type of system to be investigated is the *synthetic learning environment* (SLE). A critical component to the success of

these initiatives is the proper application of the *science of learning* (Cannon-Bowers & Bowers, 2009). Specifically, the proper application of SLEs will lead to a reduced rate of systems being abandoned early on in their implementation simply because the systems were not being applied correctly.

Defining Synthetic Learning Environments

Chapter One described some of the formal definitions for both games and SLEs. The following, however, will help to further explain SLEs, coupled with examples of how these systems might come about in practical use. First, SLEs are instructional systems embedded within virtual worlds. These worlds can be simulations of some task or event. For example, a simulation that may be completed as part of a military training may mimic specific procedures, such as the proper deployment of an unmanned ground vehicle for use in bomb disposal. Another example, from the business world, could include the use of scripted situations in which potentially legal or illegal outcomes could occur. Trainees' role in these situations would be to determine the appropriate *legal* course of action to take. SLEs could also be in the form of a video game, perhaps masked by some more intrinsically entertaining characteristic. For example, a game designed to maintain the attention of school children while teaching mathematics by conducting a virtual automobile race, in which students cars move forward with each correct answer given. The most important components of learning for SLEs are a connection to the underlying task being trained and a set of goals for which to strive toward.

Separating SLEs from Other Education Techniques

Chapter One, also discussed some of the core definitions that separate SLEs from other training techniques. In addition, successful and effective SLEs have many unique characteristics which separate them from other forms of education. Two of the more salient characteristics are, first, the instructorless nature of SLEs (most of the learning from SLEs happens without instructor interaction) and, second, the fact that in many cases, successful SLEs are actually fun and engaging, thus motivating the learner to participate more and experience a more immersive interaction (Cannon-Bowers & Bowers, 2009).

The instructorless nature of SLEs can help to alleviate some of the labor cost associated with traditional teaching methods. This is not, however, the only benefit to instructorless training. In the absence of an instructor, students or trainees are able to proceed at their own, comfortable pace and not the pace of the instructor or class. This allows for training schedules to quickly and intuitively adapt to the individual learner, thus creating an environment more conducive to individuals' learning styles. For example, in the classroom, each section of material to be taught might be given equal time by the instructor, however some of the sections may be easier for some students and some more difficult for others. Due to the presence of the instructor dictating scheduling, some students may become bored with the material while others struggle to keep up with the class. In an instructorless scenario, the students who need less time on certain sections can move ahead to areas that interest them more and the students that need a little more time can freely take it, until they have a firm grasp of the material.

Making SLEs fun and engaging relates much closer to the role of motivation, which can in turn be quickly linked with a competitive desire and the need for performance measures.

The Importance of Performance Measures

Performing well at a task can bring a sense of enjoyment to an individual, and reduce anxiety about performance (Sarason, 1975). Incorporating these sensations into SLEs means utilizing the video game mechanics of scoring and achievements. This type of externalized reward information has been found to be useful at increase intrinsic motivation, especially for difficult tasks (Reeve & Deci, 1996). In addition to providing a sense of competency, supplying these factors gives students the opportunity to set goals for which to strive, such as a high score, completing a difficult game level, or simply scoring higher than a friend. Epstein and Harackiewicz (1992) also found that when the user begins to develop a sense of importance in doing well, that competitiveness grows and increases the personal meaningfulness of the task in the user, tapping into a natural desire to perform well and/or win.

Goal Orientation

In particular this meaningfulness has been found to manifest itself in some specific ways within the user. Goal orientation is a concept that was first developed in an educational model to help interpret how individuals respond to achievement situations (Dweck, 1986; Deshon & Gillespie, 2005; Elliot & Dweck, 1988; Yarbrough, 2007) and included components for learning goal orientation and performance goal orientation. Originally, a single continuum believed to include both, learning and performance goal orientation, more recent research has suggested that

the two exist as individual dimensions of goal orientation (Brophy, 2005; Button, Mathieu, & Zajac, 1996; VandeWalle, 1997).

Learning Goal Orientation

Dweck (1986) has defined learning goal orientation as a desire to acquire and master new knowledge and skills. That is to say that individuals who have a high amount of learning goal orientation are primarily concerned with the mastery of new knowledge to help increase their potential rather than to defeat an opponent. Those individuals with high learning goal orientation believe that success comes from hard work (Ames & Archer, 1988), have better attitudes toward coursework (Gelbach, 2006), and often have a preference for challenging tasks (Ford, Smith, Weissbein, Gully, & Salas, 1998). Dweck also stated that high learning goal orientation individuals are less negatively affected by failures and remain persistent in working toward their goals.

In terms of SLEs, learning goal oriented individuals should be more interested in the use of new technology to increase their knowledge and less likely concerned with the ‘gaming’ aspects of the system. These individuals will be motivated to use SLEs to more effectively increase their probability for success in a given task. At the same time, defeating a particular opponent in competition, while still a potential outcome, is probably not the primary objective of their learning priorities.

Performance Goal Orientation

Dweck (1986) originally proposed performance goal orientation as a single factor in the goal orientation model. However, VandeWalle (1997) and Elliot and Harackiewicz (1996) have since shown that a more appropriate model breaks performance goal orientation down into two separate factors; prove-performance goal orientation and avoid-performance goal orientation.

Prove-Performance Goal Orientation

Individuals with a desire to show their competence in a given task are said to have prove-performance goal orientation (VandeWalle, 1997). These individuals seek out situations that allow them to display their skills even though their learning may only take place on a surface level (i.e., through memorization). As such only a weak correlation exists between prove-performance goal orientation and deeper learning strategies that are utilized by individuals high on learning goal orientation.

When incorporating this into SLE use, prove-performance goal orientation individuals are likely to focus a great deal on the outcome values of score and achievements. Much of their focus will be on obtaining a high score and beating other individuals' scores. Prove-performance goal orientated individuals are likely to seek out those tasks which allow them to showcase their abilities, with little concern of gaining mastery of the underlying principles of the task. However, in the case of properly implemented SLEs, these individuals will likely find the task both engaging and enjoyable and thus should be more likely to continue use of the system, resulting in a repetitive learning task environment that should benefit these individuals understanding of the processes being trained.

Avoid-Performance Goal Orientation

As one might expect, avoid-performance goal orientation is the opposite of prove-performance goal orientation. It is characterized by a desire to remove oneself from tasks and situations where a lack of competence might be revealed to others (VandeWalle, 1997). Those high on avoid-performance goal orientation are likely to only engage learning at a surface level like their prove-performance goal orientation counterparts, however, they are less likely to seek and feedback or confirmation of their outcomes (Payne, Youngcourt, & Beaubien, 2007). Individuals scoring high on avoid-performance goal orientation for a task have been found to enjoy the task less than those without the characteristic. Overall, a high presence of avoid-performance goal orientation is considered detrimental to both learning and task performance (Elliot & Harackiewicz, 1996).

Obviously, rating high on avoid-performance goal orientation is detrimental to the success and effectiveness of SLEs, just as it would be with any performance oriented task or skill. As such it is important for the complete success of an SLE system to ensure that users feel comfortable with the task they are being presented. Further, it is important for users to be able to firmly grasp an understanding of the material and knowledge being given. In part, this could be achieved by carefully monitoring the pressure placed on users to accomplish high scores and great results.

How SLE System Use is Effected by These Factors

Incorporating these characteristics into a model originally introduced by Davis (1989) and adapted by Yi and Hwang (2003) for use with web applications, I propose a revised model that should be able to predict the effects of enjoyment, goal orientation, ease of use, and several other factors on the overall use of SLEs. Adapting the Davis and Yi and Hwang models specifically for the use of SLEs and incorporating components of performance goal orientation will provide a basis understanding how each of the critical input variables effect the use and thus effectiveness of learning tools based on SLEs.

Davis Model

The Technology Acceptance Model, or TAM, was introduced in 1989 by Davis. The basis for this model is the understanding of what factors contributed to the successful use of technology. Davis posited that behavioral intention directly affected the success use of a technology and that perceived usefulness and perceived ease of use both directly affected behavioral intention. This model proved useful; however, it did not have any stipulations for considering enjoyment or self-efficacy.

Yi and Hwang Model

In 2003, Yi and Hwang expanded the TAM with specific intention toward web-based system use. Performing a study that utilized the web-based classroom aid, Blackboard, Yi and Hwang included factors for enjoyment, self-efficacy (the belief that one has the ability to perform a given task), and learning goal orientation. This model along with the original TAM

will be discussed in detail in Chapter Three, but it is important for the purposes of this dissertation to point out here that while Yi and Hwang did include learning goal orientation as a new factor, there was still no accounting for performance goal orientations' effect on system usage.

Problem Statement

SLEs are an up-and-coming new technology that could have far reaching effects in education, business, civil service (e.g., police, firefighting), and military training. The lynchpin to their success resides in the proper implementation of these systems. SLEs need to not only supply users with the tools to learn the presented material, but they need to remain engaging enough that users will enjoy the process of learning. On top of all this, SLEs need to instill a sense of confidence in users that they do, in fact, have the ability to learn and complete the given tasks. With this understanding, training developers will have a better understanding of where their resources should be spent to promote more efficient and effective learning. In the case of the Yi and Hwang model, its authors found that web-based applications with an emphasis on self-efficacy, enjoyment, and goal orientation provided for the most relevant effects on usage and learning. Each of these three factors contributed to the overall learning experience in unique manners, affecting various other factors. Further, collectively, the factors had a positive effect on usage. Extending this finding to SLEs, it is likely that many of the same effects will be present in a new model based on the *serious games*. In addition, a model needs to be developed that not only takes into account learning goal orientation as a goal orientation factor. Performance goal orientation is expected to be a significant factor in SLE use given the

similarities to entertainment based video games. Confirming these results will allow developers to move forward with confidence in the fact that their new learning environments will be effective in a number of realms, not only limited to classroom, business, or military training.

CHAPTER THREE: RESEARCH MODEL AND HYPOTHESES:

Research Models

Yi and Hwang's Prediction Model for Web-Based Systems

Technology Acceptance Model. Yi and Hwang (2003) created a model to predict the use of web-based information systems based on a previous model created by Davis (1989) and Davis, Bagozzi, and Warshaw (1989). Davis et al.'s model, termed the Technology Acceptance Model (TAM), proposes that technological system usage is based on an individual's behavioral intention, which is heavily influenced by perceived ease use and usefulness of a particular system. Davis et al. further defined behavioral intention as the extent to which an individual intends to perform a given, specific behavior. They continued to state that perceived ease of use is the extent to which using a specific technology will be free of effort and that perceived usefulness is defined as the extent to which an individual believes their performance will be enhanced through the use of a particular technological system. The Davis et al. original TAM model can be found in Figure 1 and in Appendix A.

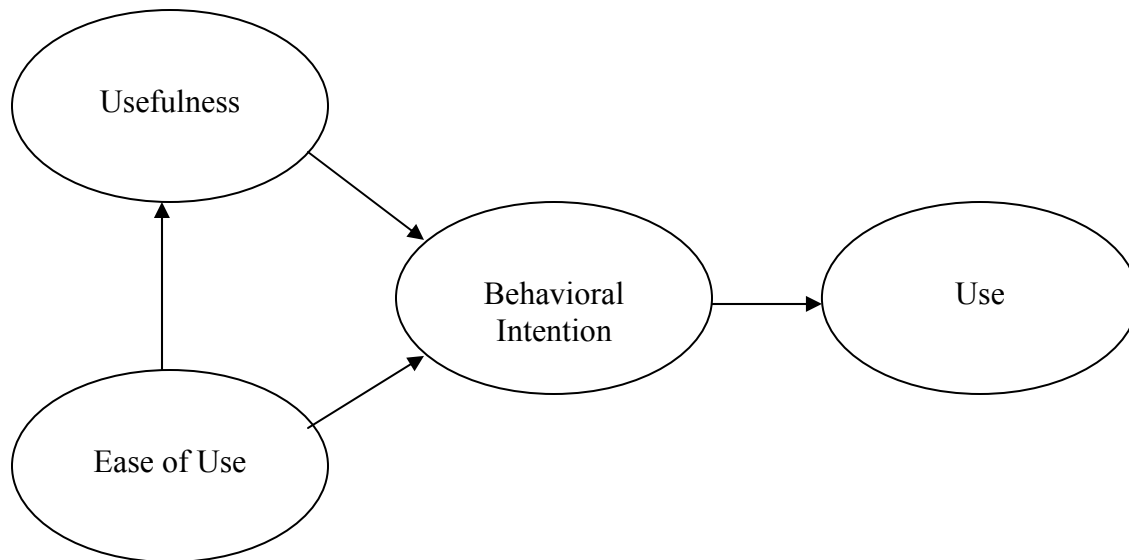


Figure 1. Davis et al.'s (1989) Technology Acceptance Model (TAM)

Yi and Hwang's model expanded the original TAM model, to include provisions for self-efficacy, learning goal orientation, and enjoyment. Self-efficacy was defined as the degree to which an individual believes that they have the ability to perform and complete a given task. It is important to point out that this definition, of self-efficacy, is based on perceived ability as opposed to the definition of self-esteem, which focuses on self-worth or value. Therefore, Yi and Hwang believed that self-efficacy plays a direct role in the use of a technology based on an individual's perceived ability that they may be able to perform the task.

Influencing self-efficacy is learning goal orientation. As stated above, learning goal orientation (Nicholls, 1984) refers to an individual's desire to learn new skills and acquire new knowledge. Using this definition, it stands to reason that the higher an individual's learning goal orientation is, the higher will be their self-efficacy of a specific task or use of a specific technology. Learning goal orientation, however, is only one type of goal orientation. I discuss

later the proposed addition of performance goal orientation to the model, another factor which should positively influence self-efficacy.

Yi and Hwang (2003) also introduced the concept of enjoyment to the model. They believed that an individual's level of enjoyment has a direct positive effect on self-efficacy, perceived ease of use, and perceived usefulness. At the same time, they believed that learning goal orientation would have a direct positive effect on enjoyment, meaning that those individual who value learning would find enjoyment in the use of technology that helps them to reach those goals. The Yi and Hwang model can be found in Figure 2 and Appendix B.

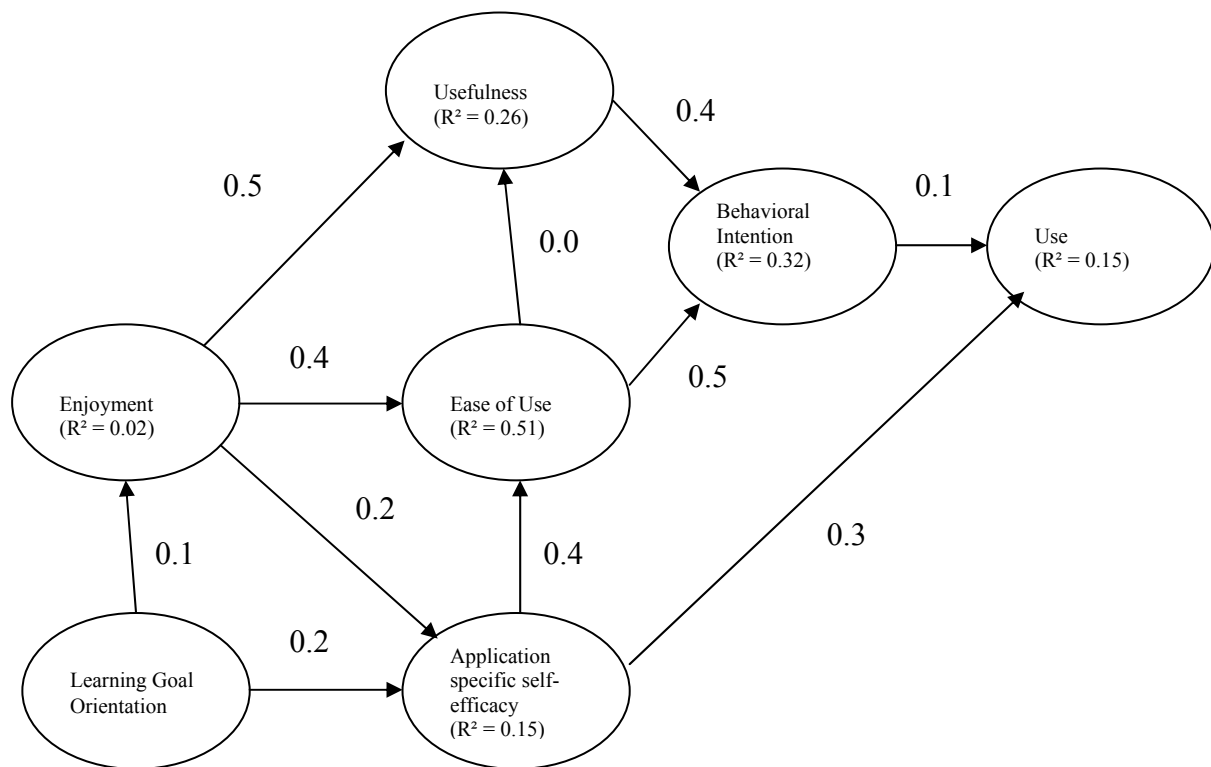


Figure 2. Yi and Hwang's (2003) use prediction model for web-based systems (including R² and β values).

Expanding Yi and Hwang's Model

Learning goal orientation, as included in Yi and Hwang's model, is not the only type of goal orientation that has gained attention in the research literature. A dissertation by Yarbrough (2007) investigated performance goal orientation as it relates to both performance and learning goal orientation. That study revealed that prove-performance goal orientation, the positive side encompassing a desire to perform well, was highly correlated to learning goal orientation. This relationship suggests that those individuals with a desire to perform well on a give task are willing to invest effort into learning the skills required to do so. Adding this factor of performance goal orientation to Yi and Hwang's model creates relationships with learning goal orientation as Yarbrough found, as well as with enjoyment and self-efficacy, in the same way that learning goal orientation is related to those factors. Including these relationships, results in the following proposed update to Yi and Hwang's manipulation of the TAM model, labeled Figure 3. I will call this proposed model the SLE Use Prediction Model, in the remainder of this dissertation. Notably, the outcome variable of actual system use has been modified to include learning. This modification has been made to incorporate the fact that participants should successfully learn the material presented in the SLE. From this point forward, Use should be understood to include learning performance.

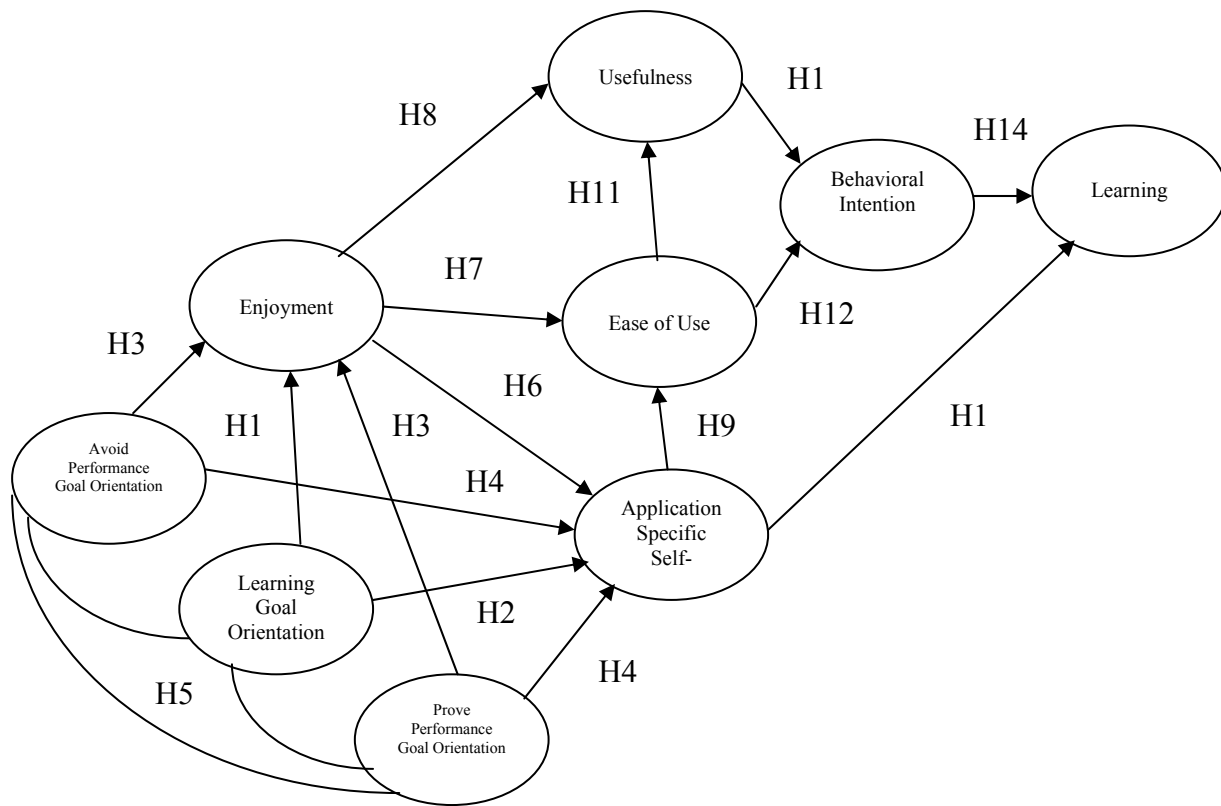


Figure 3. Proposed model updating Yi and Hwang's model to include performance goal orientation measures (avoid and prove performance goal orientation). Also found in Appendix C.

Hypotheses

In, the following section, I will outline each of the hypotheses flowing from the proposed model. Each of the factors used in the model will be presented with a brief explanation of the relationships expressed concerning that factor, which is a parallel of previously discussed issues

and relationships from Chapter 2. Following the brief explanation for each factor, the hypotheses associated with each will be presented explicitly.

Learning Goal Orientation

Taken from the Yi and Hwang model, learning goal orientation has been linked to efficacy, interest, effort, and persistence (Printrich, 2000), as well as having shown that high learning orientated individuals react to challenges with pride and intrinsic motivation behaviors (Dweck & Leggett, 1988). In line with the findings of Yi and Hwang, positive, though only significant in regards to the effect on self-efficacy, it is reasonable to believe that these relationships will persist from web-based systems to SLEs. Thus;

H1a: Learning goal orientation will have a positive effect on enjoyment.

H1b: Learning goal orientation's positive effect on enjoyment will be less than that of avoid and prove performance goal orientation.

H2a: Learning goal orientation will have a positive effect on application specific self-efficacy.

H2b: Learning goal orientation's effect on application specific self-efficacy will be greater than that of avoid and prove performance goal orientation.

Performance Goal Orientation

For the purposes of this model performance goal orientation will be represented by both avoid performance goal orientation and prove performance goal orientation. Hypotheses for performance goal orientation will thusly be expressed with -.1 and -.2 components representing the two components of performance goal orientation, as they share identical relationships with

other constructs, in the proposed model. Performance goal orientation is closely related to its learning-based counterpart, and thus shares many of the same relationships. However, given that performance goal orientation is more concerned with outcome than process, it stands to reason that these relationships will be somewhat different than that of learning goal orientation. Since SLEs contain competitive elements found in traditional video games, such as score multipliers and speed bonuses, and success and enjoyment in video games can be directly related to scoring, the relationship between performance goal orientation and enjoyment is expected to be stronger than that of learning goal orientation and enjoyment. Conversely, performance goal orientation's relationship with application specific self-efficacy will likely be somewhat lower than learning goal orientation's relationship. As well, the positive relationship, described by Yarbrough (2007), between performance and learning goal orientation should also continue. Thus;

H3.1 & .2: Performance goal orientation will have a positive effect on enjoyment.

H4.1 & .2: Performance goal orientation will have a positive effect on application specific self efficacy.

H5.1 & .2: Performance goal orientation will have a positive relationship with learning goal orientation.

Enjoyment

Based on research by Venkatesh and Speier (2000), which compared so-called 'gold standard,' traditional training methods to game-inspired counterparts, game-based training resulted in an increase in both enjoyment and perceived ease of use. Understandably, a similar effect, for participants, is expected when using the SLE in this study. This should result in a positive relationship for enjoyment and perceived ease of use. In addition, Yi and Hwang (2003)

found enjoyment to be similarly connected to perceived usefulness when using web-based systems and that relationship is also expected to continue.

Enjoyment's relationship with self-efficacy is expected to be somewhat different. Based on the definition, self-efficacy is reliant on the belief that one is able to perform a given task well. Because it is hard to image enjoying a task that one cannot perform well as much as a task that one excels at, I believe that enjoyment and application specific self-efficacy will have a positive relationship. Yi and Hwang's model also supported this relationship, first with a significant positive relationship between enjoyment and self-efficacy and followed by a lack of significance for learning goal orientation on enjoyment (though a positive effect did exist). Thus I propose the following;

H6: Enjoyment will have a positive effect on application specific self-efficacy.

H7: Enjoyment will have a positive effect on ease of use.

H8: Enjoyment will have a positive effect on usefulness.

Application-Specific Self-Efficacy

Yi and Hwang's incorporation of application-specific self-efficacy into their model was based on several factors. First, the use of application-specific self-efficacy, as opposed to general self-efficacy, was the result of research conducted by Agarwal, Sambamurthy, and Stair (2000), which indicated a much stronger relationship for the former to perceived ease of use. This positive relationship found for web-based systems is also expected for SLEs. Second, Yi and Hwang applied Bandura's (1977, 1986) social cognitive theory to Davis' 1989 TAM model. Bandura proposed that self-efficacy is a direct determinant of individual behavior, and the TAM

model has supported behavioral intention as a direct influence on system use. Therefore, combining these ideas, Yi and Hwang postulated that self-efficacy would also have a direct effect on actual system use. Thus;

H9: Application-specific self-efficacy will have a positive effect on ease of use.

H10: Application-specific self-efficacy will have a positive effect on use of the SLE.

Ease of Use, Usefulness, and Behavioral Intention

Davis' TAM model (1989) validated the belief that actual system use is determined by behavioral intention and that behavioral intention is heavily influenced by both perceived ease of use and perceived usefulness of the technology. Yi and Hwang revalidated these findings in their 2003 study and these factors implementation in this study will only serve to revalidate these findings again when applied to SLEs. Thus;

H11: Ease of use will have a positive effect on usefulness.

H12: Ease of use will have a positive effect on behavioral intention.

H13: Usefulness will have a positive effect on behavioral intention.

H14: Behavioral intention will have a positive effect on use of the SLE.

CHAPTER FOUR: METHODOLOGY

Participants

Participants in this study were 275 university students from the University of Central Florida, who each participated for extra course credit using the university's SONA System. Yi and Hwang (2003) were able to find significant results with 42 participants, and this study includes at least 5X that amount, and leans support to their findings. Participants in this study were an average age of 19, and included 86 males and 189 females. Participants in this study also provided information about their average computer and video game use which was included in the collected data and will be discussed later.

Procedures

Bio-data and Training

Participants in this study first had to access their accounts on UCF's SONA System, as participation was entirely completed online. After completing all informed consent requirements, participants were presented with a form to establish their background information, including age, gender, and any military background (only 4 out of 275 participants had any prior military experience), as well as, GPA, class level (freshman – senior), and computer experience. This form can be found in Appendix D. Once these tasks were completed, the training for the

performance portion of the experiment began, using the RETRO lab's insignia trainer which was created for the U.S. Navy.

Participants were then given an opportunity to review the instructions for use of the insignia trainer program before they began the performance portion of the study. These instructions reviewed the procedures required to complete the program, including information on how to answer the prompts from the program, the number of rounds involved with the program, and the scoring system that was employed while completing the insignia trainer.

Performance Task

As mentioned above, the performance portion of the study involved completing the U.S. Navy insignia trainer program developed by UCF's RETRO Lab. Example screenshots of this program can be found in Appendix E as well as a single example in Figure 4. In Figure 4, one can see the basic setup of the program. Users are presented with an insignia, abbreviation, or rank name from a silhouetted player character. The servicemen in the crowd in return present three potential matches for that insignia, abbreviation, or rank name, which are also in the form of insignias, abbreviations, and rank names. The users 'plays' the game by then choosing the correct match as quickly as possible. This is done by simply clicking on the correct answer's "bubble" with a mouse. Points are awarded for correct answers and taken away for incorrect answers. In addition, there are bonuses available, in the form of point multipliers, achieved when correct answers are given in succession.

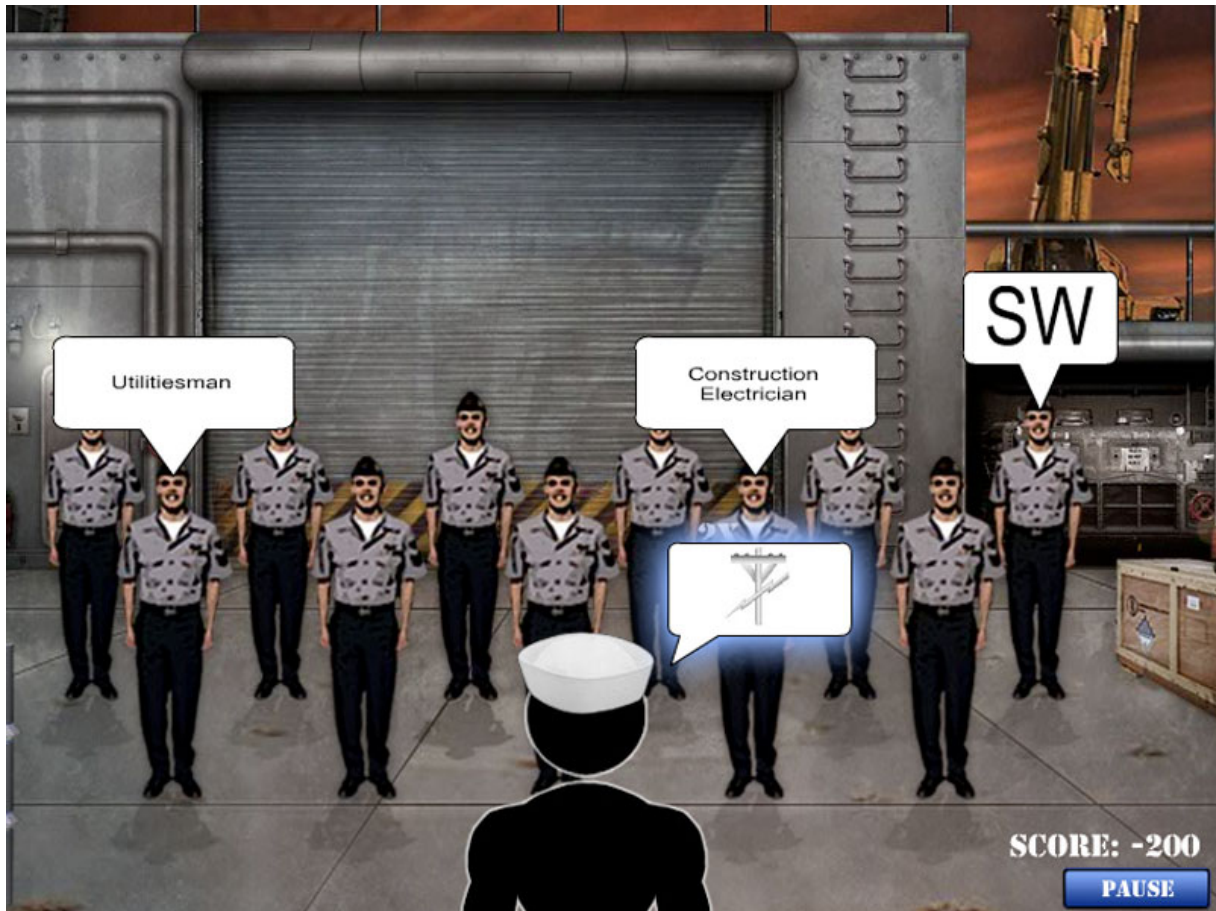


Figure 4. Sample screenshot of the RETRO Lab Insignia Trainer program. Here, the correct response would have been ‘Utilitiesman.’

Post Performance Testing and Survey

Following completion of the Insignia Trainer program, participants were asked to complete a post-test, to assess their learning, and a survey designed to assess their opinions on the input factors described in the earlier discussed research model (found on page 19). The post-test consisted of 20 multiple-choice questions about the material from the insignia trainer program. The full test can be found in Appendix F. Scores from this test were used to insure that participants had achieved at least a minimum level of learning using the Insignia Trainer Program, all of which will be addressed in the results section.

Following the post-test, participants completed a survey intended to gather data regarding their opinions on the seven input factors from the SLE Use Prediction Model from the previous chapter (enjoyment, usefulness, ease of use, learning goal orientation, performance goal orientation, self-efficacy, and behavioral intention). The following section outlines the survey questions for each of those factors on an individual basis, and a complete list of the survey questions as they were presented to participants can be found in Appendix G. The majority of the survey questions were modified from those used in Yi and Hwang's (2003) study for web-based systems, so that they would more accurately reflect the use of synthetic learning environments. Those survey questions concerning performance goal orientation are, however, taken from those used by Yarbrough (2007), and include questions relating to both prove performance goal orientation and avoid performance goal orientation on an individual basis. Internal consistencies of at least $\alpha = .87$ (Yi and Hwang) and $\alpha = .72$ (Yarbrough) were found for all of the original survey questions used (for specific levels see Yi and Hwang, 2003 and Yarbrough, 2007). All of the survey questions were designed to be answered using an 11-point Likert-type scale; 0 = "completely disagree"; 5 = "neither agree nor disagree"; 10 = "completely agree."

Usefulness

Survey questions designed to assess usefulness are as follows; "Using the Insignia Trainer program would improve my performance in this task," "Using the Insignia Trainer program would increase my productivity while engaging in this task," "Using the Insignia

Trainer program would enhance my effectiveness while engaging in this task,” and “I find the Insignia Trained program to be useful for learning this task.”

Ease of Use

Survey questions designed to assess ease of use are as follows; “Learning to use the Insignia Trainer program is easy for me,” “I find it easy to get the Insignia Trainer program to do what I want it to do,” “My interaction with the Insignia Trainer Program is clear and understandable,” and “I find the Insignia Trainer program easy to use.”

Behavioral Intention

Survey questions designed to assess behavioral intention are as follows; “If tasked with learning rank insignias, I would intend on using the Insignia Trainer program frequently,” “If tasked with learning rank insignias, I would intend on using the Insignia Trainer program as a competitive tool/game with other classmates.”

Application Specific Self-Efficacy

Survey questions designed to assess application specific self-efficacy are as follows; “I believe I have the ability to access the Insignia Trainer program myself,” “I believe I have the ability to operate the functions of the Insignia Trainer program myself,” “I believe I have the ability to understand the scoring output of the Insignia Trainer program myself,” and “I believe I have the ability to complete the Insignia Trainer program’s game myself.”

Enjoyment

Survey questions designed to assess enjoyment are as follows; “I have fun using the Insignia Trainer program,” “Using the Insignia Trainer program is pleasant,” “I find using the Insignia Trainer program to be enjoyable,” and “The Insignia Trainer program is entertaining.”

Learning Goal Orientation

Survey questions designed to assess learning goal orientation are, as with Yi and Hwang’s (2003) study adopted from Brett and VandeWalle (1999) and are as follows; “I often look for opportunities to develop new skills and knowledge,” “I enjoy challenging and difficult tasks where I’ll learn new skills,” “I am willing to select a challenging work assignment that I can learn from,” “For me, development of my ability is important enough to take risks,” and “I prefer to work in situations that require a high level of ability and talent.”

Prove Performance Goal Orientation

Survey questions designed to assess prove-performance goal orientation were taken from Yarbrough (2007) and are as follows; “I’m concerned with showing that I can perform better than my peers,” “I try to figure out what it takes to prove my abilities to others,” “I enjoy it when other are aware of how well I am doing,” and “I prefer to work on project where I can prove my abilities to others.”

Avoid Performance Goal Orientation

Survey questions designed to assess avoid-performance goal orientation were also taken from Yarbrough (2007) and are as follows; “I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others,” “Avoiding a show of low ability is more important to me than learning a new skill,” “I’m concerned about taking on at task if my performance would reveal that I had low ability,” and “I prefer to avoid situations where I might perform poorly.”

Participation Study Completion

After completing the post-test and survey questions, participant have completed the study and were awarded extra course credit in accordance with university rules.

CHAPTER FIVE: RESULTS

Analysis Strategy

Both traditional psychometric analyses (such as calculation of internal consistency estimates and the use of exploratory factor analyses to determine the underlying factor structure) and Structural Equation Modeling (SEM) analysis techniques were used to test the hypotheses and to compare competing models. For all analyses, PASW (SPSS) 17.0 and AMOS 17 were used, with the alpha level set at .05, unless specifically stated otherwise. Before model testing, the manifest variables were checked for normality and linearity, and internal consistency estimates were evaluated for all manifest variables representing multi-item tests.

The actual model testing proceeded in two steps. In Step 1, the factor structure of the model was tested first using an Exploratory Factor Analysis to determine whether the response items fell into the expected groupings. This was followed by a Confirmatory Factor Analysis (CFA), using a measurement model without effect paths between the constructs as the basis for the analysis. Model paths were evaluated by means of standardized residuals, parameter estimates, and measures of overall fit. Non-significant paths were then pruned, and models were re-tested until a best-fitting measurement model remained.

Provided the remaining measurement model showed satisfactory fit, the effects model was then created for further testing in Step 2. In this Step 2, the effects model was tested, i.e., the directional paths connecting the constructs in the proposed model were evaluated, again by means of standardized residuals, parameter estimates, and measures of overall fit. Since each path in the model represents a specific hypothesis (i.e., H1 through H14), competing models

could be created on the basis of the stated hypotheses, followed by re-specification of existing models for non-significant paths. Competing models were, where needed, compared using the χ^2 difference test for nested model comparisons.

Data Analysis

Biographical Data Analysis

Biographical data for all of the participants was collected as described in the previous methodology section. The results of that data collection, including means and standard deviations are presented in Table 1. Information collected regarding military experience is excluded from this table because of the negligible numbers (only 4 of 275 participants had any military experience).

Table 1.

Biographical Data Results

	Mean	S.D.
Participant Age (Years)	19.17	1.75
Average Computer Use (Hrs./Wk.)	20.11	17.64
Average Video Game Use (Hrs./Wk.)	2.76	4.97

Notes: N=275. Males = 86, Females = 189

Learning Assessment Scores

As was established earlier, the actual act of learning is the primary goal of any SLE, and the RETRO Lab Insignia Trainer was no different. As such, participants were assessed regarding their knowledge of the pertinent material, following the completion of the Insignia Trainer program. Scores from these assessments showed that participants averaged a score of 72.4% (almost 15 out of 20 questions correct). This average score was well above chance and was in line with previous data from the RETRO Lab, used to validate the program during development.

Attitude Survey Internal Consistencies

Table 2 includes the means (*M*), standard deviations (*S.D.*), and estimates for the internal consistency reliabilities (*ICR*; measured as alpha) for each of the studied constructs at the latent factor level. It is important to note that none of the *ICR*s fell below .724, all well within acceptable range. A complete listing on of means, standard deviations and correlations for individual attitude survey factors can be found in Appendices H and I.

Table 2.

Means, Standard Deviations, and Internal Consistency Estimates for Latent Factors

Constructs		<i>M</i>	<i>S.D.</i>	<i>ICR</i>
1.	Learning Goal Orientation	7.06	1.72	.936
2.	Prove Performance Goal Orientation	6.36	1.88	.883
3.	Avoid Performance Goal Orientation	4.85	1.94	.872
4.	Enjoyment	6.17	2.15	.965
5.	Self-Efficacy	6.84	2.06	.895
6.	Ease of Use	7.29	2.11	.930
7.	Usefulness	7.01	2.08	.936
8.	Behavioral Intention	7.00	2.21	.846
9.	Use and Learning	72.45	16.44	.724

Notes: $N=275$. Constructs 1-8 based on 0-10 scale with 0 as ‘completely disagree’ and 10 as ‘completely agree’. Construct 1 based on 5 items; constructs 2-7 based on 4 items each; construct 8 based on 2 items.

Step 1 a: Exploratory Factor Analysis

Table 3 is a representation of the pattern matrix as produced by a principal component analysis followed by oblique Promax rotation. This method was used as an exploratory factor analysis to identify variable groupings, independent of any biases. Each of the constructs showed a high loadings of the respective related variables (e.g., the four “Enjoyment” measures had high loadings on one of the rotated components, but much lower loadings on all others. Also, none of the other variables loaded highly together with the intended variables.) Finally,

these loadings did not stray to any unintended measures. Only in one instance did the coefficient value fall below .696 and for that particular learning goal orientation item the value was still a high .646. Still, most of the constructs coefficient values measured higher than .800. Further, the loadings for each item on other constructs never rose above .500, showing both the convergent and discriminant validity of the constructs.

Table 3.

Pattern Matrix for the Components after Principal Components Extraction and Promax Rotation

	Component						
	1	2	3	4	5	6	7
Enjoyment 1	.944	-.012	-.017	.034	-.001	-.024	.006
Enjoyment 2	.927	.086	-.001	.001	-.048	-.017	.020
Enjoyment 3	.968	-.010	.019	-.011	-.019	.009	.009
Enjoyment 4	.989	-.061	.031	-.029	.046	-.028	-.022
Ease of Use 1	.031	.870	-.016	.000	-.029	.010	.021
Ease of Use 2	-.068	.922	.023	-.034	-.060	.026	.112
Ease of Use 3	.042	.774	.049	-.006	.000	.118	-.044
Ease of Use 4	.053	.748	.117	-.009	.011	.084	.005
Learning Assessment Score (%)	-.021	.734	-.137	.134	.091	-.142	-.102
Learning Goal Orientation 1	.153	.015	.811	.011	-.034	-.012	.020
Learning Goal Orientation 2	-.007	-.004	.968	.057	-.048	-.057	-.001
Learning Goal Orientation 3	-.034	-.070	.969	.036	-.028	.024	-.003
Learning Goal Orientation 4	-.064	-.002	.864	.087	.011	.069	-.013

Table 3. (cont.)

Learning Goal Orientation 5	.031	.027	.646	-.114	.328	-.011	-.036
Usefulness 1	-.077	.105	.009	.822	.134	-.059	-.009
Usefulness 2	.030	-.091	.070	.955	-.055	-.047	-.008
Usefulness 3	-.035	-.037	.038	.962	-.060	.046	-.004
Usefulness 4	.031	.150	.038	.833	-.046	-.058	.053
Prove Performance Goal Orientation 1	-.060	-.197	.091	.050	.717	.103	.117
Prove Performance Goal Orientation 2	.098	-.177	-.067	.046	.931	.079	-.001
Prove Performance Goal Orientation 3	-.081	.262	.022	-.027	.819	-.110	-.020
Prove Performance Goal Orientation 4	.004	.165	.001	-.076	.897	-.060	-.008
Application Specific Self-Efficacy 1	-.052	-.198	.001	.115	.085	.862	-.064
Application Specific Self-Efficacy 2	-.075	.085	-.015	-.013	-.068	.927	.065
Application Specific Self-Efficacy 3	.038	.058	.040	-.166	-.004	.879	-.004
Application Specific Self-Efficacy 4	.069	.210	-.025	.046	.001	.696	-.035
Avoid Performance Goal Orientation 1	.034	-.091	.026	.020	.074	.059	.825
Avoid Performance Goal Orientation 2	.072	-.188	-.149	.053	.042	.034	.805
Avoid Performance Goal Orientation 3	-.060	.093	.073	-.004	-.067	-.061	.911
Avoid Performance Goal Orientation 4	-.023	.169	.010	-.052	.026	-.045	.826
Behavioral Intention 1	.054	.258	-.044	.481	.028	.167	-.006
Behavioral Intention 2	.191	.147	-.066	.472	.083	.133	-.011

Notes: Created using Principal Components Analysis, with a Promax rotation. Coefficient values above .500 have been bolded in this table.

Step 1b: Confirmatory Factor Analysis (CFA)

The results of the exploratory factor analysis were supported and further extended by a confirmatory factor analysis (CFA), using the predicted latent variable-manifest variable groupings for the structure and the predicted effects paths as unanalyzed correlations between the latent variables. The results of this analysis can be found in Table 4. The model for this CFA can also be found in Appendix J. In general, the results of the CFA supported those of the prior exploratory factor analysis. What was new in the results of the CFA was that several of the connections involving the avoid performance goal orientation (APGO) latent factor were non-significant. Although the four APGO items clearly loaded onto only one construct (i.e., APGO), this latent construct was not significantly related to all the other constructs for which significant relationships had been expected. Whereas prove performance goal orientation (PPGO) showed to indeed have significant relationships with learning goal orientation, enjoyment, and self-efficacy, as expected, APGO did not. Indeed, APGO was only related significantly with its PPGO counterpart, but not with any other factors. As such, a new model was created for the Step 2 testing, in which I removed the non-significant paths from APGO to LGO, enjoyment, and self-efficacy. This second model was then retested using the same CFA technique as described above. The factor loadings for this model are represented in Table 5, with a new model found in Appendix K. Finally, fit indices for the two models are compared in Table 6. This comparison shows that there are no significant differences between the two models and as such the less complex (i.e., more parsimonious) model (that is, the one without the links from APGO to LGO, enjoyment, and self-efficacy) was more appropriate for further use in Step 2.

Table 4.

Factor Loadings from Initial Confirmatory Factor Analysis

Construct Factor Connections		Estimate	S.E.	C.R.	P
Sur23PPerf	<--- ProvePerformanceGO	1.000			
Sur24PPerf	<--- ProvePerformanceGO	1.194	.093	12.884	***
Sur25PPerf	<--- ProvePerformanceGO	1.069	.088	12.176	***
Sur26PPerf	<--- ProvePerformanceGO	1.158	.088	13.197	***
Sur28APerf	<--- AvoidPerformanceGO	1.000			
Sur29APerf	<--- AvoidPerformanceGO	.987	.074	13.406	***
Sur30APerf	<--- AvoidPerformanceGO	1.012	.069	14.604	***
Sur31APerf	<--- AvoidPerformanceGO	1.028	.076	13.562	***
Sur15Enjoy	<--- Enjoyment	1.000			
Sur16Enjoy	<--- Enjoyment	1.012	.037	27.136	***
Sur17Enjoy	<--- Enjoyment	1.064	.036	29.179	***
Sur18Enjoy	<--- Enjoyment	1.066	.040	26.670	***
Sur19Learn	<--- LearningGO	1.000			
Sur20Learn	<--- LearningGO	1.066	.051	21.078	***
Sur21Learn	<--- LearningGO	1.042	.050	20.654	***
Sur22Learn	<--- LearningGO	.966	.046	20.798	***
Sur11Effic	<--- Self-Efficacy	1.000			
Sur12Effic	<--- Self-Efficacy	1.124	.082	13.701	***

Construct Factor Connections			Estimate	S.E.	C.R.	P
Sur13Effic	<---	Self-Efficacy	1.044	.080	13.099	***
Sur14Effic	<---	Self-Efficacy	1.153	.077	14.906	***
Sur5Ease	<---	Ease of Use	1.000			
Sur6Ease	<---	Ease of Use	1.013	.062	16.245	***
Sur7Ease	<---	Ease of Use	1.015	.052	19.477	***
Sur8Ease	<---	Ease of Use	1.030	.054	19.223	***
Sur1Useful	<---	Usefulness	1.000			
Sur2Useful	<---	Usefulness	.994	.054	18.500	***
Sur3Useful	<---	Usefulness	1.029	.050	20.636	***
Sur4Useful	<---	Usefulness	1.024	.053	19.384	***
Sur27Learn	<---	LearningGO	.778	.055	14.090	***
Sur10BI	<---	Behavioral Int	.966	.057	16.852	***
Sur9BI	<---	Behavioral Int	1.000			

***= P<.001

Table 5.

Factor Loadings with Insignificant Paths Removed

Construct Factor Connections		Estimate	S.E.	C.R.	P
Sur23PPerf	<--- ProvePerformanceGO	1.000			
Sur24PPerf	<--- ProvePerformanceGO	1.194	.093	12.884	***
Sur25PPerf	<--- ProvePerformanceGO	1.069	.088	12.176	***
Sur26PPerf	<--- ProvePerformanceGO	1.158	.088	13.197	***
Sur28APerf	<--- AvoidPerformanceGO	1.000			
Sur29APerf	<--- AvoidPerformanceGO	.987	.074	13.406	***
Sur30APerf	<--- AvoidPerformanceGO	1.012	.069	14.604	***
Sur31APerf	<--- AvoidPerformanceGO	1.028	.076	13.562	***
Sur15Enjoy	<--- Enjoyment	1.000			
Sur16Enjoy	<--- Enjoyment	1.012	.037	27.136	***
Sur17Enjoy	<--- Enjoyment	1.064	.036	29.179	***
Sur18Enjoy	<--- Enjoyment	1.066	.040	26.670	***
Sur19Learn	<--- LearningGO	1.000			
Sur20Learn	<--- LearningGO	1.066	.051	21.078	***
Sur21Learn	<--- LearningGO	1.042	.050	20.654	***
Sur22Learn	<--- LearningGO	.966	.046	20.798	***
Sur11Effic	<--- Self-Efficacy	1.000			
Sur12Effic	<--- Self-Efficacy	1.124	.082	13.701	***

Construct Factor Connections	Estimate	S.E.	C.R.	P
Sur13Effic <--- Self-Efficacy	1.044	.080	13.099	***
Sur14Effic <--- Self-Efficacy	1.153	.077	14.906	***
Sur5Ease <--- Ease of Use	1.000			
Sur6Ease <--- Ease of Use	1.013	.062	16.245	***
Sur7Ease <--- Ease of Use	1.015	.052	19.477	***
Sur8Ease <--- Ease of Use	1.030	.054	19.223	***
Sur1Useful <--- Usefulness	1.000			
Sur2Useful <--- Usefulness	.994	.054	18.500	***
Sur3Useful <--- Usefulness	1.029	.050	20.636	***
Sur4Useful <--- Usefulness	1.024	.053	19.384	***
Sur27Learn <--- LearningGO	.778	.055	14.090	***
Sur10BI <--- Behavioral Int	.966	.057	16.852	***
Sur9BI <--- Behavioral Int	1.000			

***= P<.001

Table 6.

Goodness-of-Fit Indicators of Models for SLE Use and Learning Performance

Model	χ^2	<i>df</i>	χ^2/df	χ^2_{diff}	GFI	RMSEA
Proposed SLE Use Model	1295.42*	477	2.72	--	.788	.079
SLE Use Model with Non-Significant Paths Removed	1300.91*	480	2.71	5.49	.787	.079

N=275; * = significant result

Step 2: Structural Equation Modeling

The new SLE Use model (i.e., the one without any paths from APGO to LGO, enjoyment, and self-efficacy) was analyzed in Step 2 using AMOS PASW 17.0. The new model consisted of nine latent variables (Avoid Performance Goal Orientation, Prove Performance Goal Orientation, Learning Goal Orientation, Enjoyment, Self-Efficacy, Ease of Use, Usefulness, Behavioral Intention, and System Learning/Use) and their associated indicator variables. Instead of the unanalyzed correlations which had connected the latent variables in the Step 1b CFA analyses, however, a combination of unanalyzed correlations and predicted directional paths were now used. The resulting model was defined as follows:

1. Latent variable Avoid Performance Goal Orientation (APGO), one of three exogenous variables, was indicated by four manifest variables (Sur28APerf, Sur29APerf, Sur30APerf, and Sur31APerf).

2. APGO was connected via an unanalyzed correlation with the latent variable Prove Performance Goal Orientation (PPGO).

3. PPGO was indicated by four manifest variables (Sur23PPerf, Sur24PPerf, Sur25PPerf, and Sur 26PPerf).

4. PPGO, the second exogenous variable, was connected via direct paths to latent variables Enjoyment and Self-Efficacy, as well as to Learning Goal Orientation via an unanalyzed correlation.

5. LGO, the third and last exogenous variable, was indicated by the five manifest variables Sur19Learn, Sur20Learn, Sur21Learn, Sur22Learn, and Sur27Learn.

6. LGO was connect via directional effects paths to latent variables Enjoyment and Self-efficacy.

7. Enjoyment was indicated by the four manifest variables Sur15Enjoy, Sur16Enjoy, Sur17Enjoy, and Sur18Enjoy.

8. Enjoyment had direct paths to latent variables Usefulness, Ease of Use, and Self-Efficacy.

9. Of these, Self-Efficacy was indicated by the four latent variables Sur11Effic, Sur12Effic, Sur13Effic, and Sur14Effic and, in turn, had direct paths to latent variables Ease of Use and System Use and Learning.

10. Ease of Use (indicated by the four manifest variables Sur5Ease, Sur6Ease, Sur7Ease, and Sur8Ease) had direct paths to latent variables Usefulness and Behavioral Intention.

11. Usefulness was indicated by the four manifest variables Sur1Useful, Sur2Useful, Sur3Useful, and Sur4Useful. It had a direct path to latent variable Behavioral Intention.

12. Finally, Behavioral Intention (indicated by the two manifest variables Sur9BI, and Sur10BI) had a direct path to System Use and Learning.

13. Learning was indicated by the two manifest variables Testeven and Testodd.

14. Error terms were added for all endogenous manifest variables, and disturbance terms for all endogenous latent constructs. These are depicted in the model.

The new SLE Use model was then subjected to a Maximum Likelihood estimation using AMOS 17. As indicated by degrees of freedom ($df = 480$), this model was over-identified. Once fitted, the paths were evaluated by means of standardized residuals, parameter estimates, and the measures of overall fit provided by the AMOS program. The χ^2 statistic, $\chi^2(480) = 932.634$, was significant ($p < 0.05$), which would normally indicate less than good fit, but given the sample size of $N = 275$, this did not negate good fit, as even well-fitting models often have significant χ^2 values. In fact, all other indices show that the new SLE Use model had a good fit for the data (RMR = 0.322, RMSEA = 0.059, GFI = 0.829, AGFI = 0.800). The SEM results for the new SLE Use Model, including fit indices, are summarized in Table 7.

Table 7.

New SLE Use and Learning Model Fit Indices

	SLE Use Model
Absolute fit	
ML chi-square	932.634
Degrees of freedom	480
Standardized Root Mean Square Residual (RMR)	.322
Squared error of approximation (RMSEA)	.059
Joreskog GFI	.829
Joreskog AGFI	.800
Relative fit to independence model	
Normed Fit Index (NFI)	.894
Comparative Fit Index (CFI)	.946
Independence Model chi-square	8833.918
Independence Model df	528
Parsimonious fit	
Parsimonious fit index (PNFI)	.813
Nested model comparison	
Chi-square difference test between the independence model and new SLE Use Model	7901.284 (48), $p < 0.005$

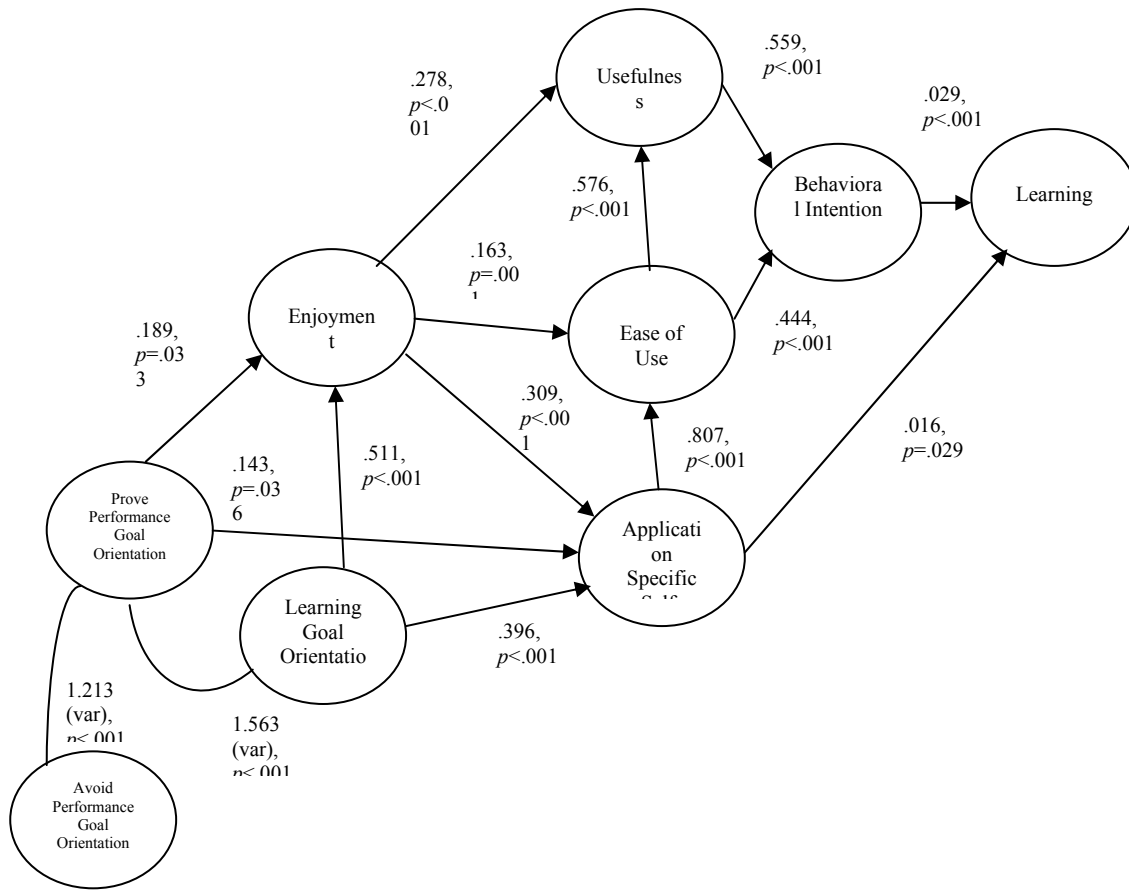


Figure 5. New model for SLE Use and Learning. Also found in Appendix L

CHAPTER SIX: DISCUSSION

Overall, the results from this study were largely in line with the predictions. All but a few of the proposed hypotheses were supported, and performance goal orientation was successfully integrated into a model for predicting successful SLE use and subsequent learning. The following section begins by first outlining the results for each of the hypotheses presented earlier and then continues into a discussion of how these findings can affect the development, implementation, and use of SLEs in the future so that researchers, teachers, instructors, and students can all gain maximum results from those SLEs. Finally, possible future directions for this line of research are discussed.

Hypotheses Results

Learning Goal Orientation

Learning goal orientation showed to have very strong connections with self-efficacy and enjoyment, as well as having a positive correlation with prove performance goal orientation. However, no significant relationship existed between learning goal orientation and avoid performance goal orientation. A deeper look at this missing relationship and the foundations of both concepts suggested that individuals who scored high on learning goal orientation would have very little in common with those who scored high on avoid performance goal orientation. The quest for knowledge sometimes involves failure that cannot be avoided.

Learning goal orientation's high power relationship with enjoyment was more powerful than originally hypothesized. This can be attributed to learning goal-oriented individuals' deep seeded desire for knowledge and skill. This desire can be a driving force that when achieved

brings with it a sense of pride that instills enjoyment within an individual. As such, the hypotheses for learning goal orientation yielded the following results;

H1a: Learning goal orientation will have a positive effect on enjoyment. -- SUPPORTED

H1b: Learning goal orientation's positive effect on enjoyment will be less than that of performance goal orientation. – NOT SUPPORTED. In fact, Learning Goal Orientations effect was much higher.

H2a: Learning goal orientation will have a positive effect on application specific self-efficacy. --SUPPORTED

H2b: Learning goal orientation's effect on application specific self-efficacy will be greater than that of performance goal orientation. -- SUPPORTED

Performance Goal Orientation

Performance goal orientation was broken up into its two parts of prove performance goal orientation and avoid performance goal orientation. However, these two components were believed to be very closely related and thus to share many of the same relationships. This proved to not be the case. While prove performance goal orientation did have a significant relationship with learning goal orientation, enjoyment, and self-efficacy, avoid performance goal orientation only showed a substantive and significant correlation with prove performance goal orientation. It exhibited no other significant relationships. This finding was the most critical to the creation of an accurate model, as the paths from avoid performance goal orientation were removed to provide for a better fitting model of SLE use and learning. The lack of significant relationships from avoid performance goal orientation is possibly the result of a low desire for individuals

high on the trait to engage in unknown activities that might produce failure. As such, the hypotheses for performance goal orientation yielded the following results;

H3.1 & .2: Performance goal orientation will have a positive effect on enjoyment. – SUPPORTED FOR PROVE PERFORMANCE GOAL ORIENTATION; NOT SUPPORTED FOR AVOID PERFORMANCE GOAL ORIENTATION

H4.1 & .2: Performance goal orientation will have a positive effect on application specific self efficacy. – SUPPORTED FOR PROVE PERFORMANCE GOAL ORIENTATION; NOT SUPPORTED FOR AVOID PERFORMANCE GOAL ORIENTATION

H5.1 & .2: Performance goal orientation will have a positive relationship with learning goal orientation. – SUPPORTED FOR PROVE PERFORMANCE GOAL ORIENTATION; NOT SUPPORTED FOR AVOID PERFORMANCE GOAL ORIENTATION

Enjoyment

Enjoyment was believed to have similar relationships for the SLE model as it did in Yi and Hwang's (2003) web-based system model. Indeed this belief was confirmed and all of the same relationships existed on a significant level. Specifically, enjoyment had a positive effect on self-efficacy, ease of use, and usefulness. As such, the hypotheses for enjoyment yielded the following results;

H6: Enjoyment will have a positive effect on application specific self-efficacy. -- SUPPORTED

H7: Enjoyment will have a positive effect on ease of use. -- SUPPORTED

H8: Enjoyment will have a positive effect on usefulness. -- SUPPORTED

Application-Specific Self-Efficacy

As well, application-specific self-efficacy was believed to maintain similar relationships to the Yi and Hwang model. These hypotheses were correct and self-efficacy showed significant positive relationships with both ease of use and actual SLE system use and learning. As such, the hypotheses for application-specific self-efficacy yielded the following results;

H9: Application-specific self-efficacy will have a positive effect on ease of use. -- SUPPORTED

H10: Application-specific self-efficacy will have a positive effect on use of the SLE. -- SUPPORTED

Ease of Use, Usefulness, and Behavioral Intention

The original Davis TAM model (1989) included several factors and relationships that have shown to be resilient in more recent adaptations of that model and the SLE Use and Learning Model is no different. Ease of use shows positive relationships with both usefulness and behavioral intention. Usefulness also showed a significant positive relationship with behavioral intention, and in turn, behavioral intention had a positive effect on actual SLE system use and learning. Thus the following results;

H11: Ease of use will have a positive effect on usefulness. -- SUPPORTED

H12: Ease of use will have a positive effect on behavioral intention. -- SUPPORTED

H13: Usefulness will have a positive effect on behavioral intention. -- SUPPORTED

H14: Behavioral intention will have a positive effect on use of the SLE. -- SUPPORTED

Implications for Future SLE Development and Use

The results of this study have shown that performance is an important aspect of successful implementation of SLEs. The works of both Davis and Yi and Hwang provided solid foundational models from which I was able to expand to a model that was effective for SLEs. The new model which was created by this study gives researchers, developers, and trainers a new base to help aid in the creation of more robust and useful systems. Incorporating the theories drawn from successful video game creation, namely, scoring, achievement, and story elements, can help to create SLE systems which support increased learning through engaging and immersive game play which encourages replay for and even more effective level of knowledge and understanding.

When comparing the new model produced by this dissertation to the previous models it has been derived from, specifically the Yi and Hwang (2003) model, only a few differences emerge. The inclusion of performance goal orientation measures is logical for the new model, with a strong connection to the performance founded world of video games. However, given the strong correlation that prove performance goal orientation had with learning goal orientation, perhaps the inclusion of performance orientation measures would benefit previous models of technology acceptance.

The Yi and Hwang model was designed specifically with web-based systems in mind, while the new model developed here is considering SLEs, but even within these two technologies many similarities are present. For both, the user interface can be critical to the continued use of the system. While a more clear connection with performance goal orientation might be present for

SLEs, web-based systems undoubtedly can benefit from an interface that allows users to perform at a high level and show off their skills with the system.

Comparing the SLE Use and Learning Model to Yi and Hwang's Model and Davis' TAM Model, a trend emerges. As technologies have expanded their scope it has become necessary for the technology acceptance models to expand as well. New techniques for using technology to our benefit are constantly being developed, and this development brings with it many new ideas and directions for research, development and implementation of the new systems. This constant movement necessitates the need for acceptance models that are adaptable and yet sustainable. Beginning with the foundation of TAM Model, the SLE Use and Learning Model shows how this adaptation is possible with limited but pertinent deviation and expansion from the original theories.

The data from this study also serves as a validation of the previous models. Yi and Hwang's study only included 42 participants, generally considered low for Structural Equation Modeling. However, the elements of their model stood up in the new SLE Use and Learning Model. Conversely, due to the similarities between the models the SLE Model can benefit from the previous studies strengths. Namely, participants in Yi and Hwang's study were involved with the technology for several months, a decided longer exposure to the study technology than participants in the current study. The lengthy exposure for Yi and Hwang's participants grants the confidence that results from the current study would hold up even with a more lengthy exposure to the SLE system.

Study Limitations

Even though the data in this study strongly supported the hypotheses and the new model which was created, some limitations still need to be mentioned. Participation in this study was completed entirely online, which allowed for such a large participant pool to be reached, however, means that participants were unsupervised while completing critical elements of the experiment. Specifically, since the data was of a self-reporting nature, there is no certainty as to whether participants successfully completed all or any of the elements of using the Insignia Trainer program.

As well, the exposure of the SLE to participants was limited, and leaves little if any insight into the replayability of the system. Along the same lines, participants in this study are not very likely to need to use the knowledge gained from completing the Insignia Trainer program in their everyday lives (i.e. knowing military rating insignias). This limits any ability to understanding the staying power of the knowledge gained using the system (although learning assessment scores were considerably high and indicate that some substantial learning took place early on).

Future Research and Use

Future research in this field may focus more attention on the different types of performance goal orientation that have been presented in this study. A deeper understanding of these concepts can help create an even more detailed model of system use, to aid developers and steer industry standards for future SLE and other serious games. The SLE Use and Learning Model has taught us that while the performance aspects of SLEs, such as scoring metrics, engaging, immersive stories, and achievement-based encouragement, learning goal orientation

characteristics are still very, if not somewhat more, important. Providing users with an understandable and clear learning objective, as well as, a way for users to evaluate their own learning, is an important characteristic for SLE longevity, that designers and developers need to understand and incorporate. Also, an emphasis should be placed on understanding that successfully gaining a new skill or knowledge is an enjoyable activity, which promotes self pride and belief.

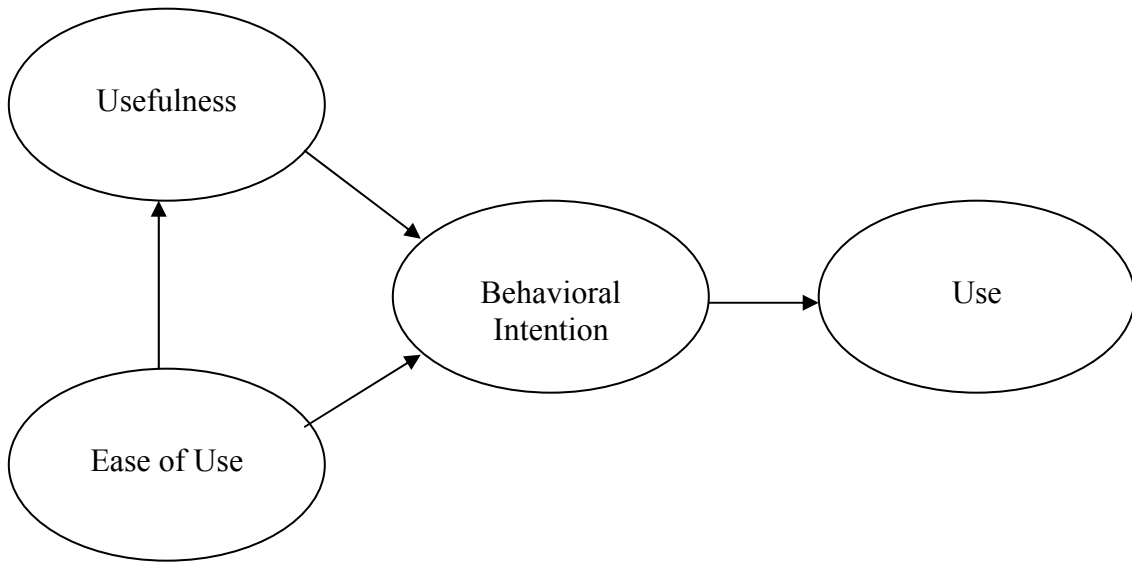
Future research could extend out in several ways. First, a more involved performance aspect (i.e. longer exposure to SLE, repeated uses of SLE, etc.) could be utilized to further validate the robustness of the SLE Use and Learning Model. Beyond this, research should be conducted using different types of technology. From this, a more universal and complete model of technology acceptance can be created.

David Lightman: [*typing*] “Are you still playing the game?”

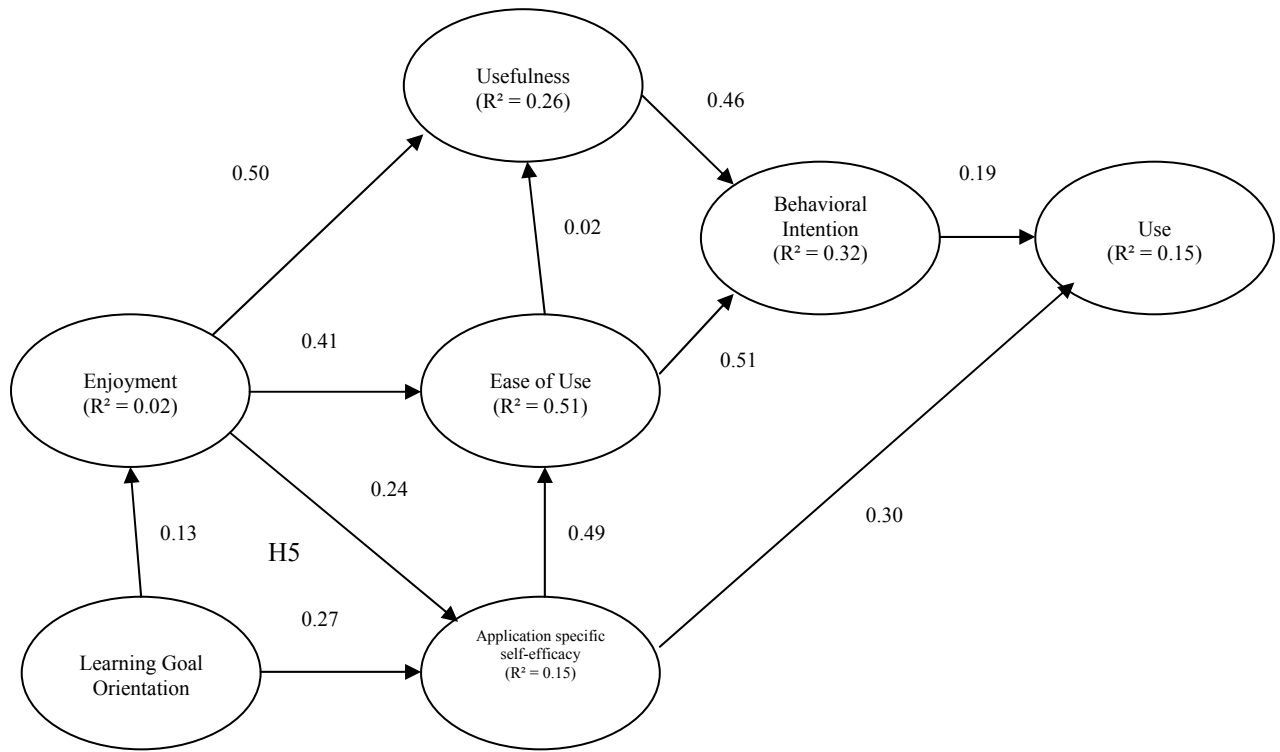
Joshua: “Of course.”

- *War Games* (MGM, 1983)

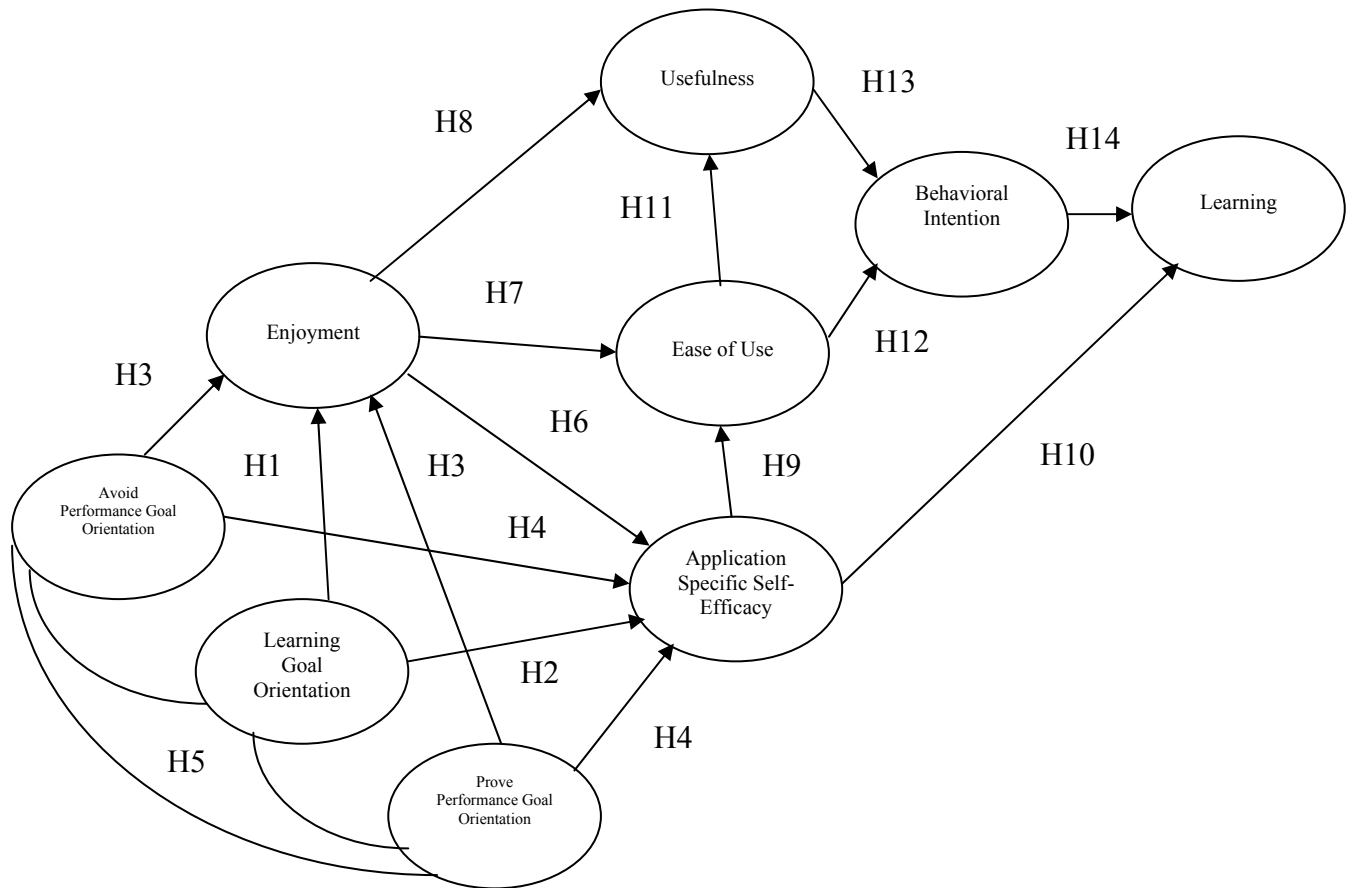
APPENDIX A. DAVIS' (1989) TECHNOLOGY ACCEPTANCE MODEL
(TAM)



APPENDIX B. YI AND HWANG'S (2003) WEB-BASED USE PREDICTION
MODEL



APPENDIX C. PROPOSED SLE USE PREDICTION MODEL



APPENDIX D: BIO-DATA FORM

Age: _____

Gender: _____

Class: _____ Freshman _____ Sophomore _____ Junior _____ Senior

GPA: _____

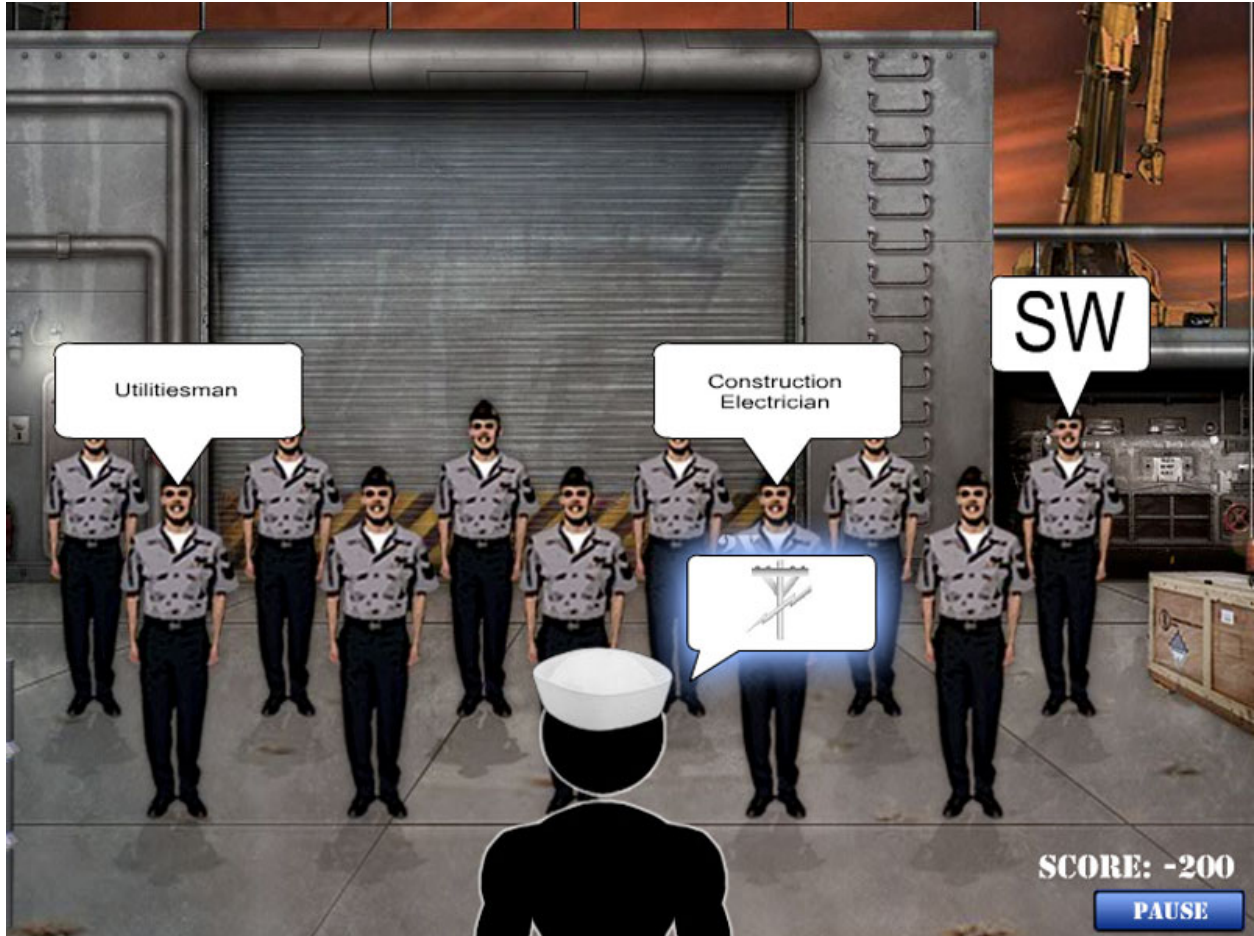
Military Experience: _____ Civilian
_____ Active Military Branch: _____ Length of Service: _____
_____ Veteran Branch: _____ Length of Service: _____

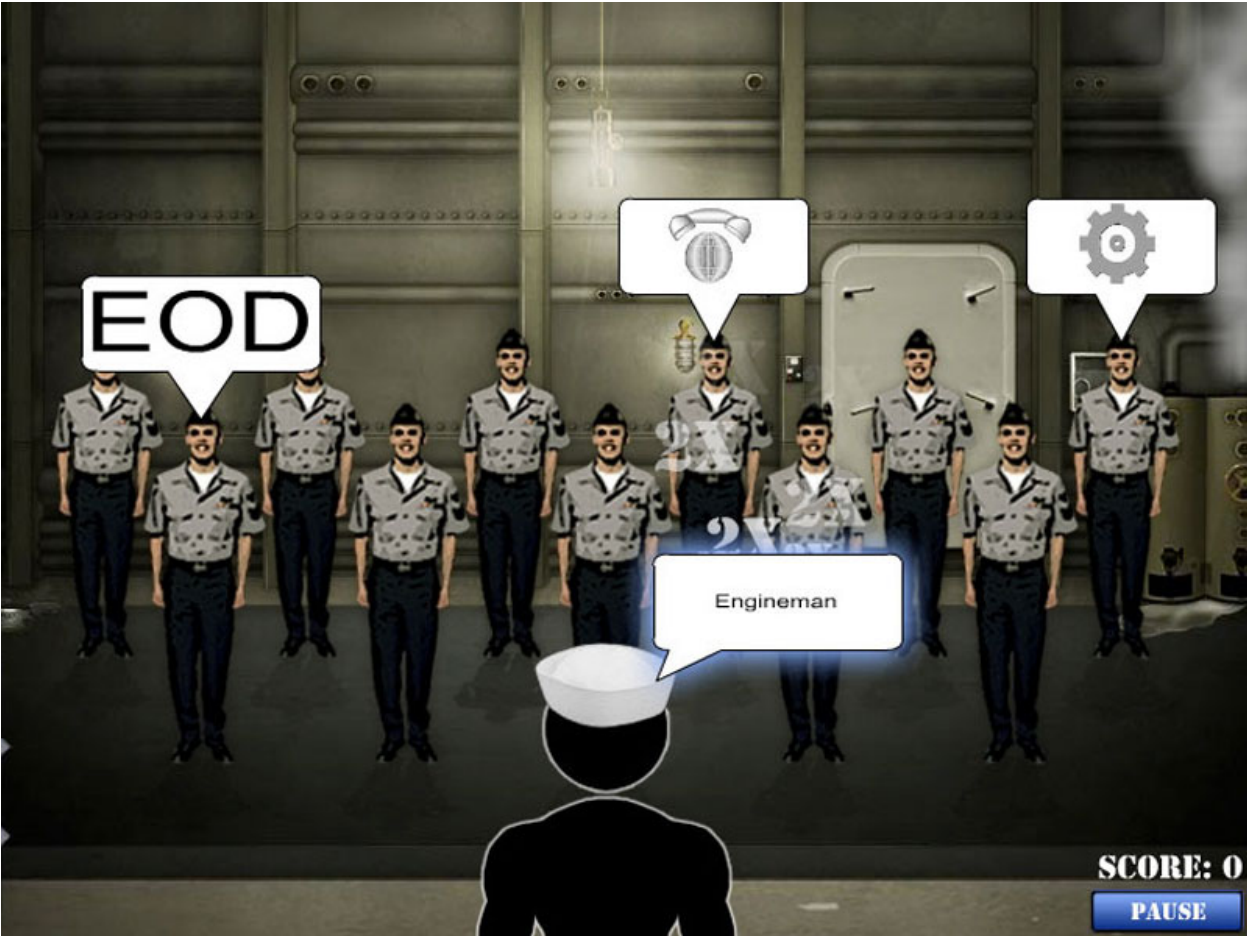
Average Hours of Computer Use per Week: _____

Average Hours of Video Game Play per Week: _____

Type of Video Games Played: _____ RPG
_____ FPS
_____ Fighter
_____ Racing
_____ Other

APPENDIX E: SCREENSHOTS OF THE U.S. NAVY INSIGNIA TRAINER
PROGRAM





APPENDIX F: POST-TEST TO ASSESS LEARNING OF RANK INSIGNIAS

US Navy Insignia Learning Measure

Participant ID: _____

Date: _____

Please circle the letter correlating to the correct answer to each question.

1.) **AZ** is the abbreviation for:

- A – Aviation Machinist's Mate
- B – Aerographer's Mate
- C - Engineering Aide
- D - Aviation Maintenance Administrationman

2.) **SW** is the abbreviation for:

- A – Steel Worker
- B – Special Warfare Boat Operator
- C - Storekeeper
- D - Sonar Technician

3.) **CT** is the abbreviation for:

- A – Construction Electrician
- B – Culinary Specialist
- C - Cryptologic Technician
- D - Navy Counselor

4.) **EQ** is the abbreviation for:

- A – Engineman
- B – Electronics Technician
- C - Engineering Aide
- D - Equipment Operator

5.) **IS** is the abbreviation for:

- A – Information Systems Technician
- B – Intelligence Specialist
- C - Hull Maintenance Technician
- D - Interior Communications Technician

6.) Which of the following is the insignia for **Interior Communications Electrician**?



7.) What is the abbreviation for **Interior Communications Electrician**?

- A – IC
- B – EO
- C – IS
- D – IT

8.) Which of the following is the insignia for **Mineman**?



9.) What is the abbreviation for **Mineman**?

- A – MC

- B – MT
- C – MU
- D – MN

10.) Which of the following is the insignia for Personnel Specialist?

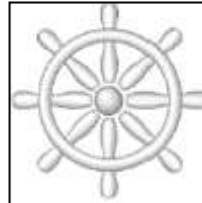


11.) What is the abbreviation for Personnel Specialist?

- A – RP
- B – PS
- C – PC
- D – PR

12.) The following insignia is for which naval rating?

- A – Air-Traffic Controller
- B – Quartermaster
- C – Gunner's Mate
- D – Master at Arm's



13.) The following insignia is for which naval rating?

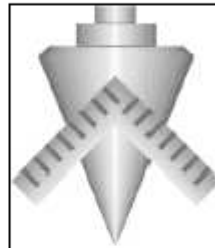
- A – Religious Programs Specialist
- B – Hospital Corpsman
- C – Utilitiesman
- D – Aircrew Survival Equipmentman



- 14.) The following insignia is for which naval rating?
 A – Postal Clerk
 B – Mass Communications Specialist
 C – Yeoman
 D – Boatswain's Mate



- 15.) The following insignia is for which naval rating?
 A – Builder
 B – Equipment Operator
 C – Aviation Structural Mechanic
 D – Fire Control Technician

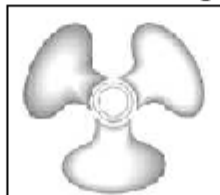


- 16.) The following insignia is for which naval rating?
 A – Aviation Support Equipment Technician
 B – Torpedoman's Mate
 C – Sonar Technician
 D – Master at Arms

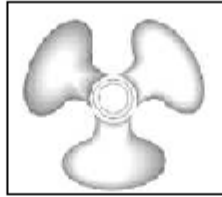


- 17.) Match the abbreviation of **OS** to the correct rating and insignia:

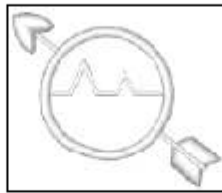
A – Operation Specialist;



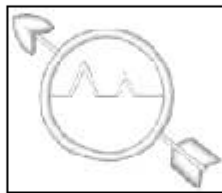
B – Machinist's Mate;



C – Operation Specialist;

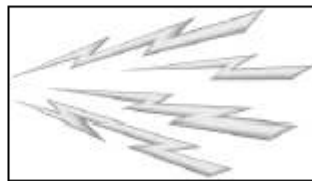


D – Equipment Operator;



18.) Match the abbreviation of IT to the correct rating and insignia:

A – Fire Control Technician;



B – Information Systems Technician;



C – Fire Control Technician;



D - Information Systems Technician;



19.) Match the abbreviation of **AG** to the correct rating and insignia:

A – Aviation Ordnanceman;



B – Aerographer's Mate;



C – Aviation Ordnanceman;



D – Aerographer's Mate;



20.) Match the abbreviation of **AD** to the correct rating and insignia:

A – Aviation Machinist's Mate;



B - Aviation Structural Mechanic;



C – Aviation Machinist's Mate;



D - Aviation Structural Mechanic;



ANSWER KEY

1. D
2. A
3. C
4. D
5. B
6. B
7. A
8. C
9. D
10. B
11. B
12. B
13. D
14. C
15. A
16. D
17. C
18. B
19. D
20. A

APPENDIX G: SURVEY QUESTIONS

1. Using the Insignia Trainer program would improve my performance in this task.
2. Using the Insignia Trainer program would increase my productivity while engaging in this task.
3. Using the Insignia Trainer program would enhance my effectiveness while engaging in this task.
4. I find the Insignia Trained program to be useful for learning this task.
5. Learning to use the Insignia Trainer program is easy for me.
6. I find it easy to get the Insignia Trainer program to do what I want it to do.
7. My interaction with the Insignia Trainer Program is clear and understandable.
8. I find the Insignia Trainer program easy to use.
9. If tasked with learning rank insignias, I would intend on using the Insignia Trainer program frequently.
10. If tasked with learning rank insignias, I would intend on using the Insignia Trainer program as a competitive tool/game with other classmates.
11. I believe I have the ability to access the Insignia Trainer program myself.
12. I believe I have the ability to operate the functions of the Insignia Trainer program myself.
13. I believe I have the ability to understand the scoring output of the Insignia Trainer program myself.
14. I believe I have the ability to complete the Insignia Trainer program's game myself.
15. I have fun using the Insignia Trainer program.

16. Using the Insignia Trainer program is pleasant.
17. I find using the Insignia Trainer program to be enjoyable.
18. The Insignia Trainer program is entertaining.
19. I often look for opportunities to develop new skills and knowledge.
20. I enjoy challenging and difficult tasks where I'll learn new skills.
21. I am willing to select a challenging work assignment that I can learn from.
22. I prefer to work in situations that require a high level of ability and talent.
23. I'm concerned with showing that I can perform better than my peers.
24. I try to figure out what it takes to prove my abilities to others.
25. I enjoy it when others are aware of how well I am doing.
26. I prefer to work on project where I can prove my abilities to others.
27. For me, development of my ability is important enough to take risks.
28. I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others.
29. Avoiding a show of low ability is more important to me than learning a new skill.
30. I'm concerned about taking on at ask if my performance would reveal that I had low ability.
31. I prefer to avoid situations where I might perform poorly.

APPENDIX H: CORRELATION TABLE MEANS AND STANDARD
DEVIATIONS

Descriptive Statistics

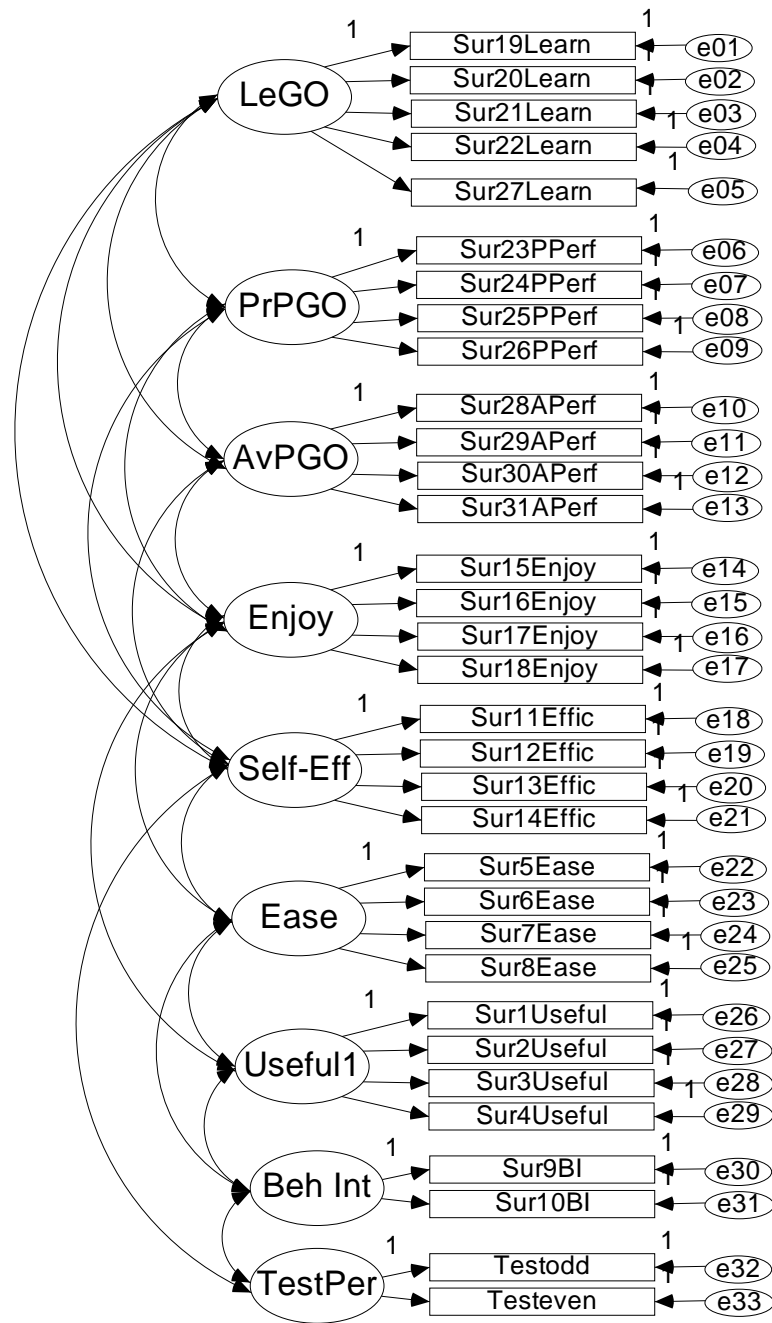
	Mean	Std. Deviation	N
Survey Question 1 Usefulness Question 1	6.8727	2.42444	275
Survey Question 2 Usefulness Question 2	6.8618	2.24482	275
Survey Question 3 Usefulness Question 3	7.0364	2.17621	275
Survey Question 4 Usefulness Question 4	7.2509	2.24883	275
Survey Question 5 Ease of Use Question 1	7.1345	2.38151	275
Survey Question 6 Ease of Use Question 2	6.9855	2.44497	275
Survey Question 7 Ease of Use Question 3	7.3855	2.19916	275
Survey Question 8 Ease of Use Question 4	7.6400	2.24857	275
Survey Question 9 Behavioral Intention Question 1	7.1782	2.38324	275
Survey Question 10 Behavioral Intention Question 2	6.8291	2.36224	275
Survey Question 11 Self Efficacy Question 1	6.4582	2.41216	275
Survey Question 12 Self Efficacy Question 2	6.9782	2.42543	275
Survey Question 13 Self Efficacy Question 3	6.6582	2.34588	275
Survey Question 14 Self efficacy Question 4	7.2764	2.28051	275
Survey Question 15 Enjoyment Question 1	6.1818	2.25469	275
Survey Question 16 EnjoymentQuestion 2	6.3309	2.19396	275
Survey Question 17 Enjoyment Question 3	6.0836	2.25482	275
Survey Question 18 Enjoyment Question 4	6.0727	2.32453	275
Survey Question 19 Learning Goal Orientation Question 1	7.2473	2.04081	275
Survey Question 20 Learning Goal Orientation Question 2	7.2109	1.98145	275
Survey Question 21 Learning Goal Orientation Question 3	7.0691	1.95915	275
Survey Question 22 Learning Goal Orientation Question 4	7.0145	1.80828	275
Survey Question 23 Prove Performance Goal Orientation Question 1	5.9091	2.33876	275
Survey Question 24 Prove Performance Goal Orientation Question 2	6.1491	2.21218	275
Survey Question 25 Prove Performance Goal Orientation Question 3	6.9091	2.11592	275
Survey Question 26 Prove Performance Goal Orientation Question 4	6.4655	2.07736	275
Survey Question 26 Learning Goal Orientation Question 5	6.7491	1.84597	275
Survey Question 28 Avoid Performance Goal Orientation Question 1	5.0436	2.21926	275
Survey Question 29 Avoid Performance Goal Orientation Question 2	4.2400	2.31794	275
Survey Question 30 Avoid Performance Goal Orientation Question 3	4.8182	2.20228	275
Survey Question 31 Avoid Performance Goal Orientation Question 4	5.2909	2.39123	275
Test Percentage Odd Items	.7265	.18985	275
Test Percentage Even Items	.7218	.18785	275

APPENDIX I: CORRELATION TABLE

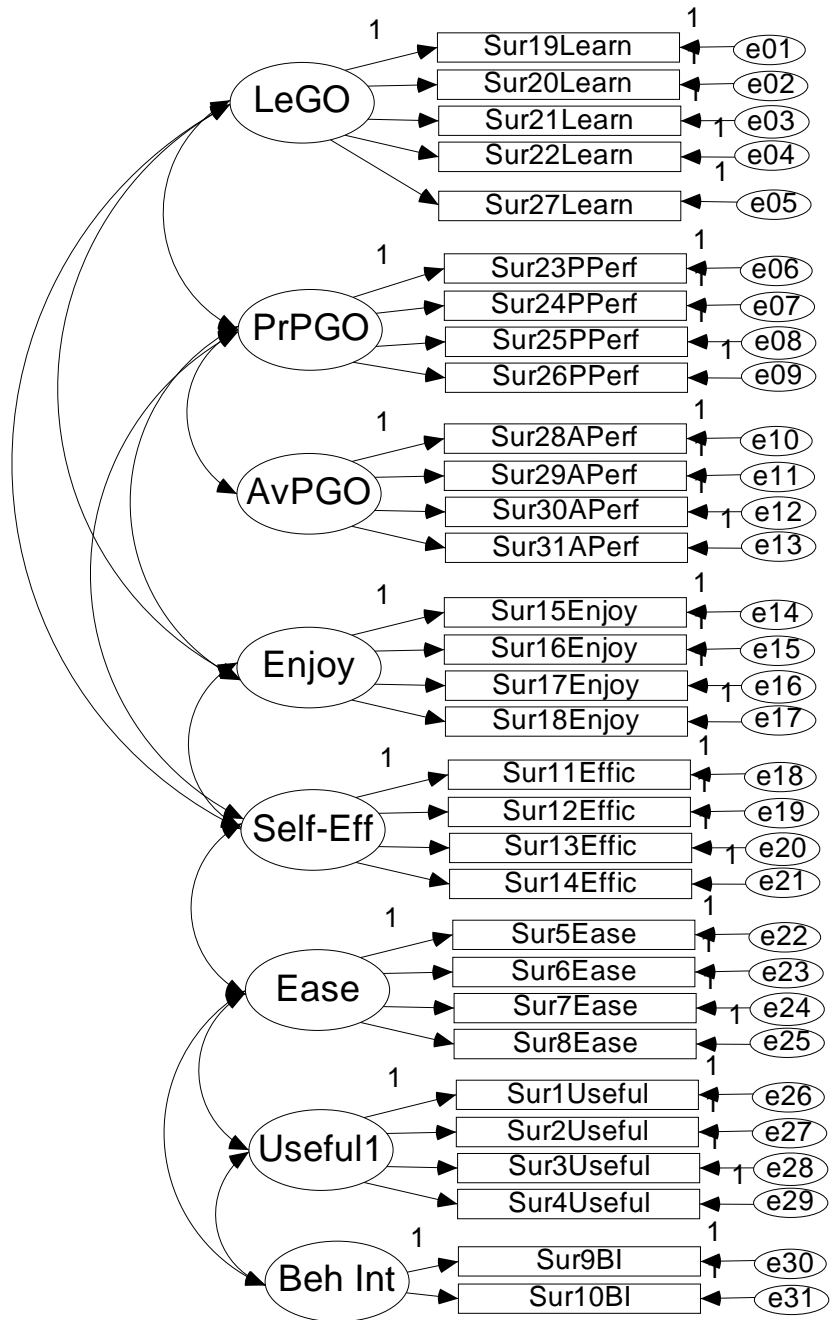
Correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
1 Usefulness Question 1	Pearson Correlation Sig. (2-tailed)	1	.716	.766	.746	.552	.522	.587	.618	.689	.654	.504	.507	.473	.606	.477	.491	.484	.466	.510	.529	.530	.579	.340	.408	.454	.457	.461	.103	-.024	.094	.130	.328	.379	
2 Usefulness Question 2	Pearson Correlation Sig. (2-tailed)	.716	1	.866	.788	.507	.486	.543	.569	.573	.587	.495	.505	.466	.564	.518	.535	.539	.493	.522	.520	.492	.533	.292	.336	.302	.314	.427	.090	-.043	.007	.043	.291	.365	
3 Usefulness Question 3	Pearson Correlation Sig. (2-tailed)	.766	.866	1	.853	.546	.504	.620	.616	.681	.652	.580	.557	.501	.657	.521	.546	.535	.489	.548	.538	.525	.573	.270	.359	.343	.335	.420	.095	-.055	.024	.076	.324	.400	
4 Usefulness Question 4	Pearson Correlation Sig. (2-tailed)	.746	.788	.853	1	.591	.581	.653	.660	.707	.714	.524	.549	.505	.653	.539	.583	.566	.541	.577	.547	.529	.607	.274	.393	.377	.394	.431	.129	-.009	.078	.112	.360	.449	
5 Ease of Use Question 1	Pearson Correlation Sig. (2-tailed)	.552	.507	.546	.591	1	.777	.761	.744	.603	.547	.451	.558	.470	.600	.438	.499	.492	.443	.479	.486	.448	.512	.235	.313	.352	.388	.418	.067	-.069	.030	.082	.376	.416	
6 Ease of Use Question 2	Pearson Correlation Sig. (2-tailed)	.522	.486	.504	.581	.777	1	.744	.743	.573	.530	.411	.564	.477	.580	.402	.456	.411	.366	.453	.458	.446	.506	.267	.279	.398	.375	.404	.111	-.037	.103	.139	.346	.366	
7 Ease of Use Question 3	Pearson Correlation Sig. (2-tailed)	.587	.543	.620	.653	.761	.744	1	.858	.644	.611	.513	.578	.565	.721	.517	.542	.523	.467	.552	.549	.533	.567	.262	.330	.408	.416	.501	.028	.118	.050	.011	.055	.410	.472
8 Ease of Use Question 4	Pearson Correlation Sig. (2-tailed)	.618	.569	.616	.660	.744	.743	.858	1	.633	.625	.505	.601	.575	.710	.515	.567	.536	.503	.612	.597	.553	.610	.298	.367	.464	.443	.500	.072	-.114	.049	.125	.433	.496	
9 Behavioral Intention Question 1	Pearson Correlation Sig. (2-tailed)	.689	.573	.681	.707	.603	.573	.644	.633	1	.733	.572	.573	.524	.666	.551	.531	.527	.502	.532	.507	.498	.545	.284	.350	.403	.375	.400	.107	-.032	.058	.100	.386	.421	
10 Behavioral Intention Question 2	Pearson Correlation Sig. (2-tailed)	.654	.587	.652	.714	.547	.530	.611	.625	.733	1	.534	.574	.493	.629	.577	.592	.567	.571	.518	.485	.468	.531	.279	.399	.423	.375	.432	.077	.000	.082	.084	.307	.399	
11 Self Efficacy Question 1	Pearson Correlation Sig. (2-tailed)	.504	.495	.580	.524	.451	.411	.513	.505	.572	.534	1	.699	.539	.675	.399	.427	.400	.399	.434	.427	.416	.473	.269	.339	.304	.353	.395	.107	-.017	.004	.103	.296	.267	
12 Self Efficacy Question 2	Pearson Correlation Sig. (2-tailed)	.507	.505	.557	.549	.558	.564	.578	.601	.573	.574	.699	1	.690	.743	.382	.460	.441	.395	.426	.408	.430	.499	.286	.325	.306	.283	.326	.171	.006	.104	.108	.334	.316	
13 Self Efficacy Question 3	Pearson Correlation Sig. (2-tailed)	.473	.466	.501	.505	.470	.477	.565	.575	.524	.493	.539	.690	1	.746	.433	.428	.452	.410	.452	.390	.421	.477	.222	.316	.307	.342	.386	.095	-.023	.055	.110	.260	.343	
14 Self efficacy Question 4	Pearson Correlation Sig. (2-tailed)	.606	.564	.657	.653	.600	.580	.721	.710	.666	.629	.675	.743	.746	1	.528	.560	.556	.508	.536	.492	.488	.536	.282	.346	.380	.373	.431	.088	-.061	.048	.095	.355	.451	
15 Enjoyment Question 1	Pearson Correlation Sig. (2-tailed)	.477	.518	.521	.539	.438	.402	.517	.515	.551	.577	.399	.382	.433	.528	1	.858	.856	.860	.470	.417	.398	.410	.238	.333	.253	.315	.360	.124	.022	.032	.094	.218	.340	
16 Enjoyment Question 2	Pearson Correlation Sig. (2-tailed)	.491	.535	.546	.583	.499	.456	.542	.567	.531	.592	.427	.460	.428	.560	.858	1	.909	.864	.512	.434	.418	.425	.195	.321	.297	.312	.371	.118	-.012	.040	.107	.255	.359	
17 Enjoyment Question 3	Pearson Correlation Sig. (2-tailed)	.484	.539	.535	.566	.492	.411	.523	.536	.527	.567	.400	.441	.452	.556	.856	.909	1	.904	.535	.431	.404	.434	.231	.360	.274	.305	.381	.126	.021	.031	.078	.209	.352	
18 Enjoyment Question 4	Pearson Correlation Sig. (2-tailed)	.466	.493	.489	.541	.443	.366	.467	.503	.502	.571	.399	.395	.410	.508	.860	.864	.904	1	.506	.423	.406	.449	.225	.370	.282	.341	.388	.111	.012	.036	.089	.240	.329	
19 Learning GO Question 1	Pearson Correlation Sig. (2-tailed)	.510	.522	.548	.577	.479	.453	.552	.612	.532	.518	.434	.426	.452	.536	.470	.512	.535	.506	1	.795	.757	.759	.324	.400	.453	.429	.617	.052	.124	.008	.065	.326	.330	
20 Learning GO Question 2	Pearson Correlation Sig. (2-tailed)	.529	.520	.538	.547	.486	.458	.549	.597	.507	.485	.427	.408	.390	.492	.417	.434	.431	.423	.795	1	.859	.845	.360	.386	.422	.431	.657	.015	.177	-.012	.022	.302	.294	
21 Learning GO Question 3	Pearson Correlation Sig. (2-tailed)	.530	.492	.525	.529	.448	.446	.533	.553	.498	.468	.416	.430	.421	.488	.398	.418	.404	.406	.757	.859	1	.850	.363	.383	.437	.439	.638	.042	.166	.006	.839	.903	.000	
22 Learning	Pearson	.579	.533	.573	.607	.512	.506	.567	.610	.545	.531	.473	.499	.477	.536	.410	.425	.434	.449	.759	.845	.850	1	.394	.405	.476	.463	.678	.059	-.002	.016	.340	.324		

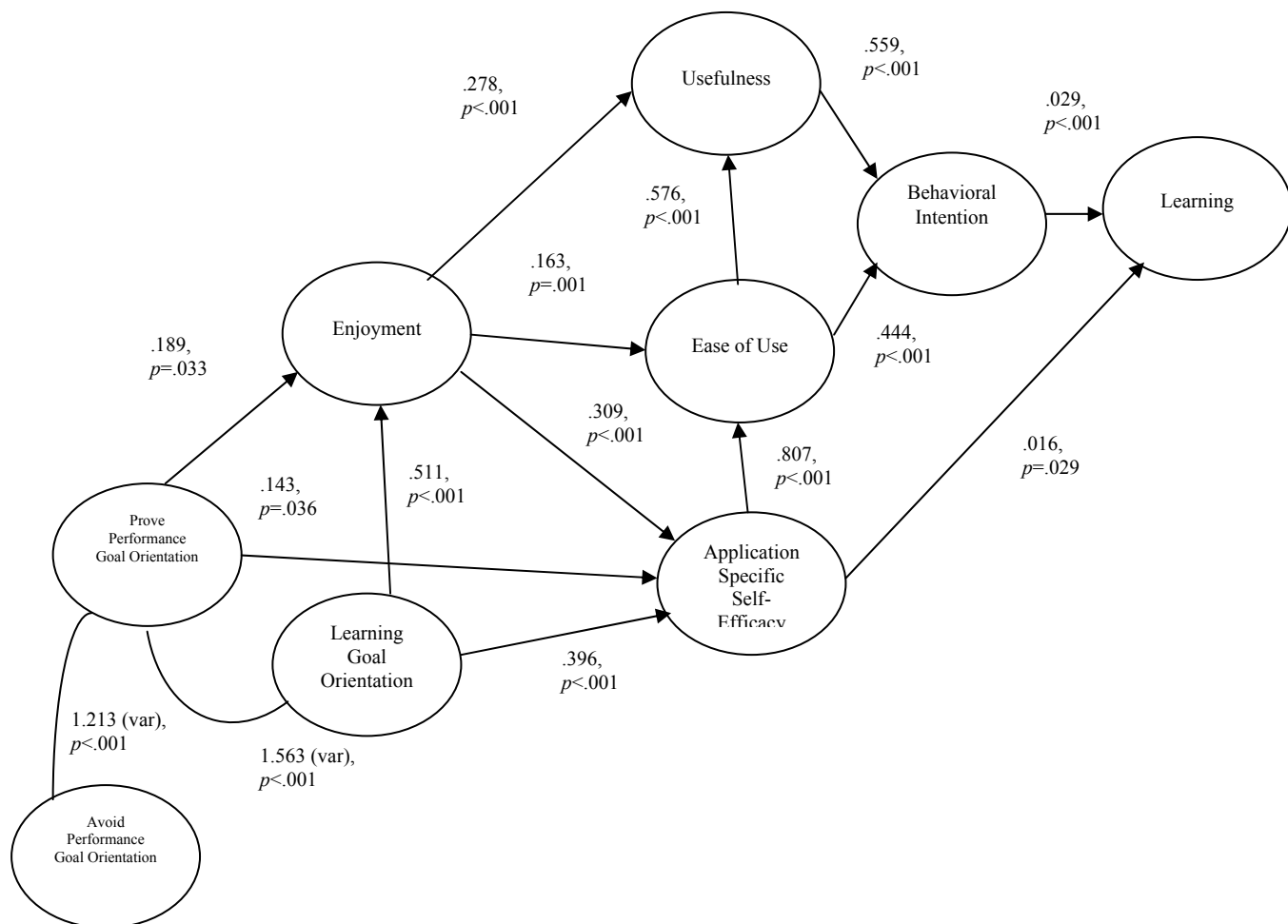
APPENDIX J: CONFIRMATORY FACTOR ANALYSIS MODEL



APPENDIX K: CONFIRMATORY FACTOR ANALYSIS WITH AVOID
PERFORMANCE GOAL ORIENTATION LINKS REMOVED



APPENDIX L: NEW SLE USE AND LEARNING MODEL



LIST OF REFERENCES

- Abt, C. C. (1970). *Serious games*. New York,: Viking Press.
- Agarwal, R., Sambamurthy, V., & Stair, R. M. (2000). Research Report: The evolving relationship between general and specific computer self-efficacy—an empirical assessment. *Information Systems Research, 11*, 418-430.
- Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology, 80*, 260-267.
- Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1977). *Social Learning Theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Brett, J. F. & VandeWalle, D. (1999). Goal orientation and goal content as predictors of performance in a training program. *Journal of Applied Psychology, 84*, 863-873.
- Brophy, J. (2005). Goal theorists should move on from performance goals. *Educational psychologist, 40*, 167-176.
- Button, S., Mathieu, J., & Zajac, D. (1996). Goal orientation in organizational behavior research: A conceptual and empirical foundation. *Organizational Behavior and Human Decision Processes, 67*, 26–48.
- Cannon-Bowers, J. & Bowers, C. (2009). Synthetic Learning Environments: On Developing a Science of Simulation, Games, and Virtual Worlds for Training. In S. Kozlowski & E. Salas (Eds.) *Learning, Training and Development in Organizations*. Routledge Academic.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*, 319-339.

- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, *35*, 982-1002.
- Deshon, R. P., & Gillespie, J. Z. (2005). A motivated action theory account of goal orientation. *Journal of Applied Psychology*, *90*, 1096-1127.
- Dweck, C. S. & Leggett, E. L. (1988). A social cognitive approach to motivation and personality. *Psychological Review*, *95*, 256-273.
- Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist*, *41*, 1040-1048.
- Edwards, H. (2002, October 30). Post-game press conference following New York Jets loss to the Cleveland Browns. ESPN cable television network, Bristol, CT.
- Elliot, A. J., & Harackiewicz, J. M. (1996) Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology*, *70*, 461-475.
- Epstein, J. A., & Harackiewicz, J. M. (1992). Winning is not enough: The effects of competition and achievement motivation on intrinsic interest. *Personality and Social Psychology Bulletin*, *18*, 128-138.
- Ford, K. J., Smith, E. M., Weissbein, D. A., Gully, S. M., & Salas, E. (1998). Relationships of goal orientation, metacognitive activity, and practice strategies with learning outcomes and transfer. *Journal of Applied Psychology*, *83*, 218-233.
- Gelbach, H. (2006). How changes in students' goal orientations relate to outcomes in social studies. *Journal of Educational Research*, *99*, 358-370.

- Lasker, L. (Writer) & Parkes, W. (Writer). (1983). *War Games* [Motion Picture]. United States: MGM Studios.
- Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review*, *91*, 328-346.
- Printrich (2000).
- Payne, S. C., Youngcourt, S. S., & Beaubien, J. M. (2007). A meta-analytic examination of the goal orientation nomological net. *Journal of Applied Psychology*, *92*, 128-150.
- Reeve, J., & Deci, E. L. (1996). Elements of the competitive situation that affect intrinsic motivation. *Personality and Social Psychology Bulletin*, *22*, 24-33.
- Sarason, I. G. (1975). *Anxiety and Preoccupation, Vol. 2*. Washington, D.C.: Hemisphere.
- Seriousgames.org. (n.d.) *Serious Games Initiative Goals and Interests*. Retrieved from <http://www.seriousgames.org/about2.html>
- VandeWalle, D. (1997). Development and validation of a work domain goal orientation instrument. *Educational and Psychological Measurement*, *8*, 995-1015.
- Venkatesh, V. & Speier, C. (2000). Creating an effective training environment for enhancing telework. *International Journal of Human-Computer Studies*, *52*, 991-1005.
- Yarbrough, C. S. (2007). The influence of goal orientation on trainee learning strategies and outcomes in a work readiness program. (Unpublished Doctoral Dissertation). University of Central Florida.
- Yi, M.Y. & Hwang, Y. (2003). Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and technology acceptance model. *International Journal of Human-Computer Studies*, *59*, 431-449.

Zyda, M. (2005). From Visual Simulation to Virtual Reality to Games. *IEEE Computer*, 38(9), 25-32.