# Influence of Learner Factors on Soldier Attitude Toward Army Serious Gaming

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# INFLUENCE OF LEARNER FACTORS ON SOLDIER ATTITUDE TOWARD ARMY SERIOUS GAMING

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**ABSTRACT**

INFLUENCE OF LEARNER FACTORS ON SOLDIER ATTITUDE TOWARD ARMY SERIOUS GAMING

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This study determined the influence of the learner factors on Soldier attitudes toward the use of serious gaming for U.S. Army training and leader development. It extended Selwyn's work (Selwyn, 1997a, 1997b, 2003, 2004, 2006, 2013; Selwyn, Gorard, Furlong, & Madden, 2003) identifying or measuring attitude toward using a technology and Bonanno and Kommers (2008) work extending Selwyn's work to measure the influence of learner factors on those attitude components toward the use of Army serious gaming for instructional purposes. The population studied was 709 Active duty U.S. Army Soldiers.

This quantitative non-experimental descriptive research design methodology used a 21-item instrument derived from items created and validated by Selwyn and other researchers and modified by Bonanno and Kommers (2008). The revised instrument corrected Bonanno and Kommers items that combined two or more attitudinal objects in a single question that might have resulted in a response bias. It used terms familiar to the population to define more precisely their attitude toward Army Serious Gaming (ASG).

This study found no statistically significant difference between active duty U.S. Army Soldiers in their general attitude toward Army Serious Gaming (ASG) based on their gender, age or military class. This study found statistically significant differences in

their general attitude toward ASG between active duty U.S. Army Soldiers based on their education level and perceived gaming competence. Statistically significant differences between active duty U.S. Army Soldiers within specific affective, perceived control, perceived usefulness, and behavioral attitude constructs toward ASG are discussed.

*Keywords*: serious game, Army Serious Gaming (ASG), Army serious game, learner attitudinal components, learner attitudinal factors.

## DEDICATION

This thesis is dedicated to Sarah, who remained supportive from beginning to end. My parents, who died during this journey, remain in my thoughts; so do my brothers and their families, which put up with my many absences from them while taking this path.

## ACKNOWLEDGMENTS

The effort that is finally concluding started seven years ago. In that time much happened and many helped – I appreciate the assistance everyone gave me.

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For the fellow student that understood and shared the beer (Dr. Rodney Ragsdale), thank you for the encouragement when the task seemed to overwhelm.

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# CHAPTER I

## Introduction

Nations educate their military forces to ensure the survival of their states. Successful nations know that simulating battle through training and leader development during times of peace is necessary to win battles during times of war. The U.S. Department of Defense (DOD) , considered the "greatest training organization of all time" (Aldrich, 2004, p. 7), invests more funding innovating military education and training than any other organization in history, investing first in simulations, and now in serious games, for training its occupational workforce for war. Within the DOD, the U.S. Army takes personal computer based instructional games most seriously and is most heavily invested in serious gaming for the training and leader development of its Soldier human resources, with an initial investment of $50M in its five-year Army Games for Training (AGFT) program that started development in 2010 (Robson, 2008).

Although PC technology is physically capable of transitioning gaming into mainstream military training and leader development, the Army and DOD have little research available to them to prove that Soldiers will readily adapt to using these serious military games. Worse, the Army and DOD have no research indicating the influence of specific learner factors upon Soldiers attitude toward using serious gaming as a behavior. This potential attitude towards use knowledge gap in the Army Gaming training domain may become more severe because Soldiers should expect to train using serious games from locations that are distant from other Soldiers training in the serious game - perhaps even from their own homes using their own computing devices. This "training at the point of need" model, already in use for other Distributed Learning (DL) components of

The Army Distributed Learning Program (TADLP), will extend to "serious gaming when appropriately utilized within the instructional environment" (U. S. Army, 2014, p. 132).

As the larger military budget was at risk when first cut by $350 billion dollars, and may be cut by another $600 billion dollars unless sequestration is repealed (Kim, 2011), difficult funding decisions are upon the DOD. Because there is scant evidence that learners in general and no evidence that Army Soldiers in particular have positive beliefs about the utility of serious gaming as a behavior, the $50M AGFT learning investment is at risk amidst another $18B Army funding loss (Chandler, Odierno, & McHugh, 2013).

**Purpose of the Study**

The purpose of this study was to inform the Army of learner demographic factors that influence Soldier's general attitude toward the use of Army serious gaming for instructional purposes. Understanding the influence of these learner demographic factors upon general attitude towards using gaming should help the Army to tailor serious game pedagogical design where possible or make different training investments where it is not possible, allowing obtaining better return on potentially decreasing investment.

**Research Questions**

The study researched five Army Serious Gaming (ASG) behavior questions:

$RQ_1$: Do Soldiers general attitude towards ASG differ as a function of gender?

$RQ_2$: Do Soldiers general attitude towards ASG differ as a function of age?

$RQ_3$: Do Soldiers general attitude towards ASG differ as a function of education?

$RQ_4$: Do Soldiers general attitude towards ASG differ as a function of perceived gaming competence?

$RQ_5$: Do Soldiers general attitude towards ASG differ as a function of military

class (commissioned officer, non-commissioned officer, or enlisted)?

**Background and Significance**

Whether military or non-military learners, the DOD, considered by Aldrich (2004, p. 7) to be the "greatest training organization of all time," invests more funding innovating military education and training than any organization in history. DOD invested first in simulations, and now in serious games, for training its occupational workforce for war. All DOD services recognize three domains of training simulation called the Live, Virtual, and Constructive (LVC) training domains. The Live domain trains real people in the real world using real or fake equipment. The Virtual domain trains real people in a simulated world using simulated equipment. The Constructive domain trains real people by using simulated people in a simulated world using simulated equipment. Constructive training computer programs can provide accelerated results of decisions that can be integrated into the other domains in blended training exercises (Joy, Rykard, & Green, 2014). The LVC domains usually involve the training target audience working in the same location on military provided equipment - precluding participation issues.

The Army recognizes that serious gaming - the fourth domain – Gaming (LVC-G) - may have participation issues. Despite early claims that "Online gaming is becoming more popular" among 14,048 high school sophomores surveyed in 2002 (Green & McNeese, 2008, p. 258) or later claims that "59 percent of Americans play video games" (Entertainment Software Association, 2014, p. 2), the military population may be different. In 2005 research of United States Military Academy (USMA) cadets, Orvis, et al. found "... a wide range of prior videogame experience across the military participants

in this sample, with 17% of cadets reporting they have no experience playing videogames and 44% reporting they have limited videogame experience"(Karin A. Orvis, Orvis, Belanich, & Mullin, 2005, p. vii). At the conclusion a two-year extension of that research, Orvis, et al. found that "... as many as 60% of the cadets reported that they had no or very limited videogame experience in the past year" (Karin A Orvis, Moore, Belanich, Murphy, & Horn, 2010, p. 145). In 2009, Orvis et al. sought to more accurately determine military videogame use frequency using results from the biennial 2006-2007 Sample Survey of Military Personnel (SSMP) administered to Soldiers worldwide by the U.S. Army Research Institute's (ARI) Personnel Survey Office. Demographic data collected from the 10,044 Soldiers who completed the SSMP included gender, age, education and rank, called class in this proposal (Karin A Orvis et al., 2010, p. 146). Significantly, Orvis, et al. found that less than 43% of responding Soldiers played any type of videogame at least once a week and 38.5% had never played a videogame. When restricted to action/adventure games similar to those in the Army Games for Training (AGFT) serious games suite, the weekly play figures by rank drop to under 50% for E-4s and below, under 30% for E-5 to E-7 and O-1s to O-2s, under 27% for O-3s to O-4s, and under 10% for E8s to E-9s and O-5s to O-6s (Karin A Orvis et al., 2010, p. 150). Gender distinctions were significant with 35% of men and 58.5% of women reporting they had never played a videogame of any type and only 39.1% of men and 10.8% of women playing action/adventure games weekly (Karin A Orvis et al., 2010, p. 149). For age, there was a "...significant negative correlation between age and videogame usage... between 27 and 60% of soldiers, regardless of age group, reported that they never play any type of videogame, with the percentage increasing as age increased" (Karin A Orvis

et al., 2010, p. 149). Orvis et al. did not report education level differences.

The significance of the study was that the Army needed research results on the influence of demographic learner factors upon Soldier's general attitude toward the use of instructional gaming that can inform Army decisions toward the use of instructional gaming for Soldiers. Although there is previous research measuring civilian attitudes toward using specific Information Technology (IT) systems as objects, there was little measuring attitude toward use as a behavior - an important distinction, and less toward gaming as a behavior. Understanding the influence of learner demographic factors upon general attitude toward using gaming should help the Army to tailor serious game pedagogical design or make different training investments where tailoring is not possible based upon those attitudes, obtaining better return on investment.

**Limitations**

Requiring subjects to agree to take the instrument could introduce non-respondent or volunteer selection bias against subjects who were not interested enough in the topic to take the instrument, or did not want to expend the time to take it. This risk was offset by emphasizing the importance of each subject's responses to the research results and by the use of closed form five-point Likert responses to keep the total time needed for a subject to take the instrument under five minutes. Use of an automated internet based instrument that permits all Soldiers in all places to participate at all times of the day should also have reduced this limitation. Bonanno and Kommers stated their instrument required "...further refinement and validation in order to ensure reliability and construct validity" (2008, p. 106). For this research, multiple steps precluded threats to reliability and validity, although hypothesis guessing remained a risk due to instrument wording.

Multiple measures for each of the four key constructs helped preclude internal consistency reliability threats. The short instrument length also precluded internal validity single group mortality, history, and maturation threats. For measurement external validity, use of a large 709 person sample supported generalization of results to the larger population of 498,642 of Army Soldiers on active duty as of 31 December 2014 (DOD, 2014). Collection, analysis, and comparison of results of the differences for the 21 separate dependent variables, their "parent" dependent variable data groups, and the "grand parent" dependent variable data group should help reduce restricted generalizability across constructs and confounding constructs threats. Inter-rater reliability and parallel forms reliability are not at risk in this study.

**Assumptions**

Assumptions were that all participants were English reading active duty Army Soldiers, had access to the Army Knowledge Online (AKO) intranet, and at least 384 of them would consent to take the five-minute instrument during the window, after reading the request to participate found on the AKO homepage. Soldiers log into AKO daily.

**Procedures**

The research procedure for this study was that respondents completed the on-line survey instrument and provided learner factor demographic data. The researcher collected, recoded, and processed Likert-scale responses for the 21 sampling variables within the affective components, perceived control components, perceived usefulness components, and behavioral components dependent variable constructs in figure 1.

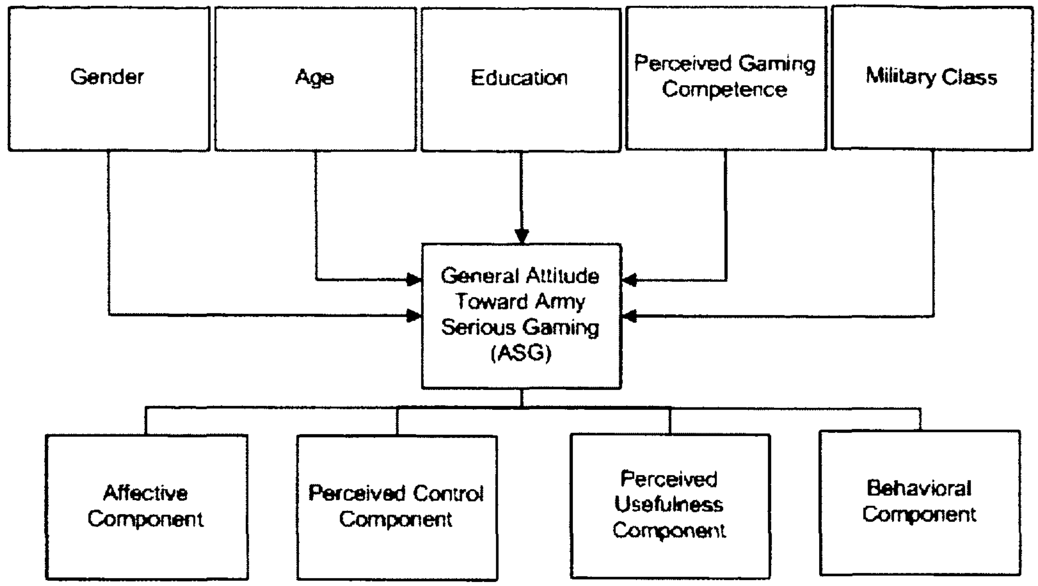


*Figure 1.* Scope of study

The researcher collected, as necessary recoded, and processed learner factor independent variable datum, then performed statistical analysis to answer the research questions.

**Definition of Terms**

**Serious game** - Zyda (2005) stated that 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" (p. 26). Adcock, Watson, Morrison, and Belfore (2010) stated, "Serious games are, at their core, exploratory learning environments designed around the pedagogy and constraints associated with specific knowledge domains. This focus on instructional content is what separates games designed for entertainment from games designed to educate" (2010, p. 152).

**Army Serious Gaming (ASG)** - ASG is the behavior of using games to train and develop Soldiers and leaders. Understanding the distinction between the behavior and the target, or object, of the behavior is important. When appropriately utilized within the

Distributed Learning (DL) instructional environment, ASG is a DL courseware component of The Army Distributed Learning Program (TADLP). TADLP supports the DOD intent to "deliver learner centric training when and where required, increasing and sustaining readiness throughout the force, Active and Reserve" (U. S. Army, 2014, p. 115).

**Army serious game** - The target, or object, of the ASG behavior is U.S. Army serious games. They comprise three sometimes-overlapping categories. The categories are first person tactical training games, leader tactical training games and language and culture training games.

**Learner demographic factors** - The five learner factors investigated to determine their affect upon Soldier attitude toward using ASG as a behavior are gender, age, perceived gaming competence, education level, and military class.

**Components of general attitude toward Army Serious Gaming (ASG)** - The four separate components of general attitude towards using ASG as a behavior arc Selwyn's affective, perceived control, perceived usefulness, and behavioral components.

**General attitude toward ASG** - is the sum of each of the four separate attitude components.

**Summary and Overview**

The study extended (Selwyn, 1997a, 1997b, 2003, 2004, 2006, 2013; Selwyn, Gorard, Furlong, & Madden, 2003) identifying or measuring attitude toward using a technology and Bonanno and Kommers (2008) work to explore the influence of learner factors on general attitude towards using instructional games. As shown at figure 1, it investigated the influence of the demographic learner factors of gender, age, education

level, perceived gaming competence, and military class on general attitude toward the use of Army serious gaming as an instructional tool.

Chapter II reviews the literature selected to answer the research questions. Literature was reviewed describing research on learner factors as independent variables that effect skill and activities as dependent variables first followed by research on learner factors as independent variables that effect attitude as the dependent variable. Literature was reviewed describing attitude toward an object (AO) and attitude toward a behavior (AB) as the dependent variable that the learner factors affected.

As Ajzen and Fishbein stated, "Individuals will intend to perform a behaviour when they evaluate it positively and when they believe that important others think they should perform it" (1980, p. 6) and that "to predict a single behaviour we have to assess the person's attitude toward the behaviour and not his attitude toward the target at which the behaviour is directed" (1980, p. 27). To confer understanding of how to assess a person's attitude toward the behavior and not the target of the behavior, the literature review must have necessarily been chronological and deep, using figures and tables to explain why a particular model, or component of a model, was inappropriate for this research study. Although twelve models and theories and more than a dozen studies between 1975 and 2013 were reviewed, concentrating upon distinctions between two attitude constructs: attitude toward the object ($A_O$) or attitude toward the behavior involving the object ($A_B$), six were most important to understand. They were Ajzen's TPB (1988), Kay's CAM (1993), Davis' TAM (1993), Roger's IDPT (1995), Selwyn's CAS (1997b), and Bonanno and Kommers implementation (2008) of Selwyn's CAS. In 1993, Kay developed the Computer Attitude Measure (CAM) to measure attitude toward the

use of computer systems (Kay, 1993) and Davis developed the Technology Acceptance Model (TAM) to measure the causal relationships between system design features, perceived usefulness, perceived ease of use, attitude toward using, and actual usage behavior (Davis, 1993). In 1995, Rogers maintained in his Innovation Decision Process Theory (IDPT) that people's attitudes towards a new technology are a key element in its diffusion (Rogers, 1995). In 1997, building upon Kay's CAM, Davis' TAM, and Ajzen's theory of Planned Behavior (Ajzen, 1988), Selwyn developed the Computer Attitude Scale (CAS) for measuring attitude toward computers. Selwyn's (1997b) CAS consisted of the Affective Component (six items), the Perceived Usefulness Component (five items), the Perceived Control Component (six items) and the Behavioural Component (four items). In 2008, Bonanno and Kommers extended Ajzen's and Fishbein's 1980 argument, stating it is a fallacy to assign "attitudes towards objects, in this case digital games, as this limits the prediction of the overall pattern of behaviour and understanding of particular actions with respect to the object" (2008, p. 98). Building upon this research base and Kay's CAM, Davis' TAM, and Selwyn CAS instruments, Bonanno and Kommers developed their instrument to "... measure, not attitude to games (as objects), but attitude towards gaming (the behaviour)" (2008, p. 98).

Chapter III describes the methods for collecting and analyzing data. It describes the population, sample selection criteria, independent and dependent variables, the data collection instrument, and procedures for gathering statistical data for analysis. Chapter IV describes the data analysis organized by research question. It concludes with an examination of the data in relation to each other. The summary, conclusions, and recommendations are drawn in Chapter V.

# CHAPTER II

## Review of Literature

Understanding past serious gaming history, organization, and research is necessary to understand the research about the learner factors that influence the military learner's attitude toward serious gaming as a behavior.

### Serious Gaming Technology Development History

In ancient times through the 19th century, LVC-G simulation for martial arts training fared poorly overall. For Greek Hoplite soldiers, representative of warriors for the Archaic (c. 700-480 BC) and Classical (480-338 BC) Periods, Soldiers who wanted to train via live simulation had to use their own initiative (De Souza, 2008). Wealthy men "...might hire a private fight instructor... but others argued that this was a waste of money because skill in handling weapons came naturally" (De Souza, 2008, p. 210). The more methodical Romans (AD 284-476) individually trained soldiers and collectively trained teams and organizations in maneuvers of entire legionary battle groups. These live simulations were so successful that Josephus famously stated "Roman exercises were bloodless battles and their battles were bloody exercises" (De Souza, 2008, p. 201). By the Middle Ages, live simulation collective training had declined so far that "Western European heavy cavalry, ineffective on the defense, could dismount to fight... but ... without the system and drill of Greek and Roman infantry, had difficulty doing more than standing fast on the battlefield (Jones, 1987, p. 119). Gaming became part of professional military training in the $18^{th}$ century when Helwig, Master of the Pages for the Duke of Brunswick constructively extended chess "providing that his pawns represented units of men instead of individuals" (Berg, 1977, p. 2). By 1824, Kriegsspiel advanced so far,

with sand tables representing actual terrain, scaled units and utilizing complex rule sets, that the Prussian Army Chief of Staff declared, “It is not a game at all, it is training for War! I shall recommend it most emphatically for the whole army” (Berg, 1977, p. 3).

During most of the twentieth century, the U.S. Army, the most powerful military service, continued to advance the use of simulation domains, driven by training requirements in four major wars between 1916 and 1975. In the early part of that century, the devastating effects of artillery during the First World War caused the Army to develop the requirements for the first digital computer, called Electronic Numerical Integrator And Computer (ENIAC), to calculate artillery firing table ballistics data quickly enough for use in constructive simulations. Although not completed until shortly after the Second World War ended, its "first task was to provide calculations used to plan the detonation of the hydrogen bomb" (Mead, 2013, p. 13). The Army also fielded the best known early airplane virtual simulation (Mead, 2013), the Link Trainer, that was used in one form or another throughout the Second World War. However, after the end of that war and the separation of the Air Corps from the Army to create the U.S. Air Force, the separate services of the U.S. military seldom worked together to integrate their separate training simulation efforts with each other, or into the burgeoning science of Instructional Systems Development (ISD), until after the Vietnam War.

Army computerized constructive simulation training dates back to the 1940’s and Army computerized virtual simulation training dates back to the 1950’s. Army computer virtual gaming started in the 1990s, as "the military began exploring the use of PCs and video game consoles as affordable alternatives to their big simulators” (Macedonia, 2007, p. 96). However, adding virtual gaming to the U.S. Army’s LVC suite had to wait until

PC computer graphics cards technology could support moving 3D simulations from expensive workstation computers, like those the military normally uses, to lower cost PCs that could help expand the use of simulations for training and other educational purposes (Goldiez, Rogers, & Woodward, 1999).

At the close of the twentieth century, Army gaming expanded into two broad categories called miltainment and serious gaming, serious gaming categories described later in the review. Miltainment is entertainment that utilizes gaming to celebrate the military. The best-known example is the America's Army (AA) series of recruiting games that was the first PC based virtual game the Army released in 2002.

Born from a 1999 concept study by Col. Casey Wardynski, director of the Office of Economic and Manpower Analysis at the U.S. Military Academy at West Point, N.Y., the then titled Army Game Project that began at the Naval Post Graduate School in Monterey, California in January 2000, became America's Army: Recon. Granted "unprecedented access to units, training and equipment" and gaining "information and insights that were eventually modeled in the game to contribute to its authentic Army feel," the development team integrated "values and consequences in a first-person action environment" (McLeroy, 2008b, p. 8). Players explored "entry-level and advanced training, as well as soldiering in small units" virtually going "through boot camp and airborne training, and even ...special forces," with players learning "about rules of engagement, lifesaving, laws of war and Army values" (p. 8). Setting "it apart from its commercial counterparts" (p. 8), AA used actual Army Rules of Engagement, punishing players that committed fratricide by placing them in a virtual stockade, keeping them there, in real time, until completing their sentence. AA combined the "knowledge of all

things Army with industry professionals' understanding of how technology can be leveraged to relate the Army experience" (McLeroy, 2008, p. 7). It used computer game technology to provide the public "a virtual Soldier experience that was engaging, informative and entertaining" (McLeroy, p. 7). Although Soldiers can use AA for limited training and educational purposes, it is miltainment because AA primarily was, and remains, a tool to recruit civilians to join the Army.

Beginning in 2000, the Army continued to explore leader tactical training games gaming solutions, including the military (leader tactical training) and civilian (miltainment) versions of Full Spectrum Warrior (FSW), a game that taught squad leadership development, Full Spectrum Leader, a mid-grade leadership level game, and Full Spectrum Command (FSC), orientated at higher leadership levels.

However, after the Army Training and Doctrine Command (TRADOC) appointed a TRADOC Capability Manager (TCM) for gaming, the Army contracted Bohemia Interactive to create the approved U.S. Army gaming solution to fulfill as many training requirements with one suite as possible. VBS2 is a suite, "a fully interactive, three-dimensional training system providing a premium synthetic environment suitable for a wide range of military (or similar) training ... purposes ... (that) offers both virtual and constructive interfaces onto high-fidelity worlds of unparalleled realism" (Bohemia Interactive, 2010, p. 1). VBS2, that was recently upgraded to VBS3, is also used by the U.S. Marine Corps, the Australian and New Zealand Defense Forces, and the United Kingdom Ministry of Defense for "...mission rehearsal, tactical training and simulated combined arms exercises" (Bohemia Interactive, 2010, p. 1). The VBS2 Fusion component can programmatically open and interact with other serious games.

Because of operational requirements in Iraq and Afghanistan, the Army needed to develop language and culture training games to train effective language use and cultural behavior during the exercise of Soldier and leader individual or collective tasks in the context of simulated conditions or situations. Titles include Tactical Iraqi, Pashto, Dari, French, and Indonesian. Each use learner, language, and culture models, automated speech recognition, socially intelligent virtual humans, and intelligent tutoring and assessment tools that automatically track each trainee's progress and performance within its three main learning modules. The Skill Builder taught Soldiers new language and culture skills; the Arcade Game exercised the Soldier's new skills; and the Mission Game practiced the Soldiers in their new skills in mission-orientated diagnostic simulations.

**Organizational Issues That Affected Army Serious Gaming Development**

In 1974, a year after the United States ended its direct involvement in the Vietnam War, the heads of the training commands for the U.S Army, Air Force, Navy and Marine Corps began an initiative to "develop a common doctrine and procedures for systematic development of training and education curricula" (C. L. Anderson, 1986, p. 1). TRADOC funded the effort; the U.S. Navy provided the first chair for the enduring Inter-service Training Review Organization (ITRO), and Florida State University conducted the research (C. L. Anderson, 1986). Out of that effort came the inter-service agreement that the uniformed services would systemically develop training methods, training media, and instructional materials using the Instructional Systems Development (ISD) approach, that utilized the Analysis, Design, Development, and Implementation (ADDI) model, in a process to be called the Systems Approach to Training (SAT) (C. L. Anderson, 1986). The ITRO then published five inter-service ISD procedures handbooks for implementing

the science of ISD, that the ITRO Chairperson called "probably the most basic and authoritative document on that subject in the world" (C. L. Anderson, 1986, p. 1). However, the ITRO handbooks could not forecast the need to develop and integrate the live simulation-training domain with the virtual and constructive simulation training domains, so they could provide little assistance to training developers that wanted to integrate those simulations or games.

Unfortunately, even with the guidance the handbooks provided, the Army learned that having a reference did not mean that Army personnel would use it. Ten years after ITRO handbooks were distributed and ISD adapted, the Army conducted a ten-month study to determine if training had recovered since the war ended, and if not why not. A team assessed the 25 most critical Military Occupational Specialties (MOS), interviewing thirty thousand Soldiers and their leaders in those jobs in operational (warfighting) units. The team then backtracked their findings back to the institutional (training development and training delivery) proponent schools that were responsible for the training. The team found that the Army's previous adaptation of the SAT process had failed. It failed not because of any weakness in the SAT process, that was found to be sound, but because SAT was "...regrettably ... used by exception" (Army Training Board, 1985, p. 1). The 1985 report discovered many problems and proposed many solutions, but remained within TRADOC and was not intended for public release.

In early 1986, a public paper based on the report went viral, embarrassing the Army. Afterwards, a TRADOC official admitted that the report found that Army training developers performing ISD functions "never did any of those things, or did them in such a poor fashion that they didn't work... the people we hired were not very good. They

simply didn't know their jobs. So we had the blind leading the blind" (C. L. Anderson, 1986, p. 3). The primary report recommendations that were then implemented that required hiring or training "... a fully trained professional corps of civilian training developers ... deeply grounded in ISD" (C. L. Anderson, 1986, p. 1). The Army established Army Career Program 32 for military and civilian training developers, and later adapted U.S. government policy that only Instructional Systems Specialists (ISS) who met OPM criteria for GS 1750 position, most often met with a college degree in the field, perform ISD training development. Importantly, within the OPM and DOD, the GS 1750 ISS should perform job and task analysis that determines an LVC-G task's requisite sub-task skills, knowledge, and attitudes (KSA), especially the attitude component of "interest, motivation necessary to perform" the task (DOD, 2001b, p. 68). Although steps in the right direction, the job and task analysis completion gap between the many GS 1750s that developed for live simulation, that was the majority of Army training, and the few that developed such analysis for virtual and constructive simulation training grew.

Following the Army lead, the DOD increased its numbers of degreed civilian ISD GS 1750 ISS professionals, trained its non-degreed uniformed personnel in the SAT process, and published the five most detailed handbooks created for implementing ISD. Those handbooks, which focus on acquiring training data products and services, utilizing the ISD and SAT, and developing Interactive Multimedia Instruction (IMI), used the 1975 ITRO handbooks as source material. Regrettably, the terms live, virtual, and constructive that later were synonymous with DOD simulation training categorization do not appear in them. They describe simulation as either first person simulation wherein the program "...creates as closely as possible an actual situation (e.g., operating a piece of

equipment or trouble-shooting)" or third person simulation wherein the student "vicariously experiences some situation by directing a person in the program to do whatever the student wants to do" (DOD, 2001a, p. 72). Although these definitions bear some resemblance to virtual and constructive simulation, they are too imprecise for use by a training developer that needs to develop a serious game. As Figure 2 illustrates, the handbooks weight toward IMI product training development near the top of the chart - not supported in simulation - that work underpinned by the 1750's job and task analysis.

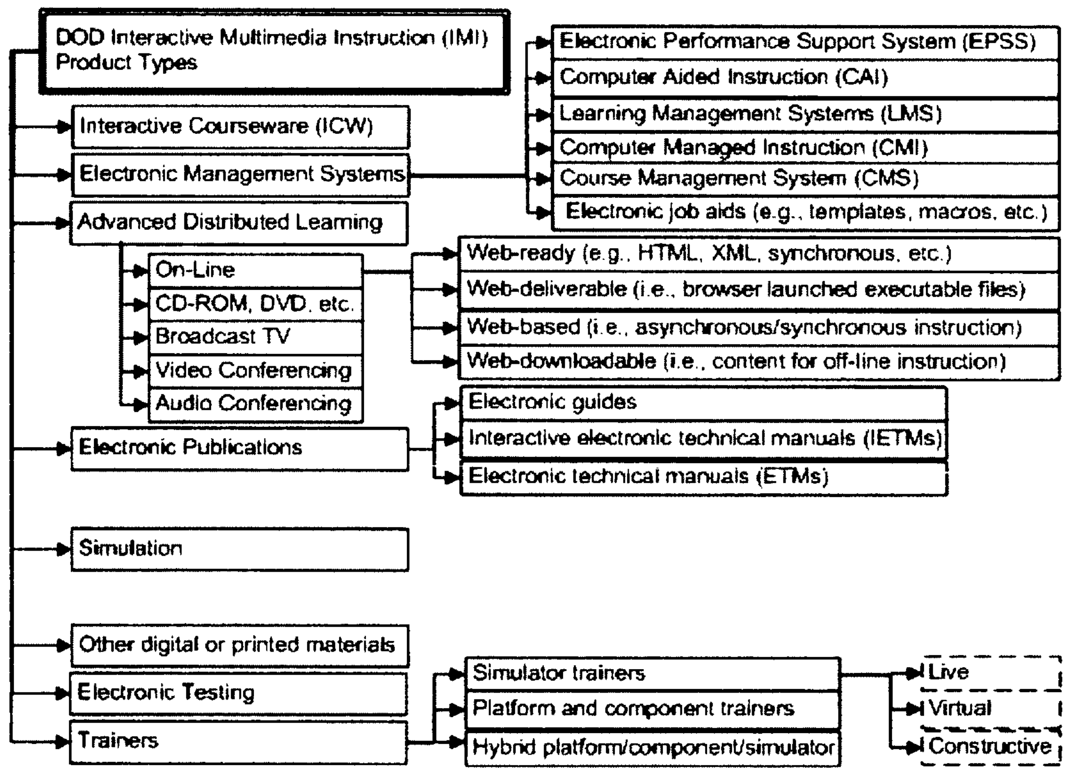


*Figure 2.* DOD IMI Products. Adapted from "Department of Defense Handbook, Development of Interactive Multimedia Instruction (IMI) (Part 3 of 5 Parts)," by Department of Defense, 2001, p. 3. Copyright 2001 by the Government Printing Office.

The simulation definitions in the handbooks point to simulation term on the left side of the figure. This researcher added the dashed box live, virtual, and constructive terms to indicate where the DOD envisioned simulation training might occur - absent LVC distinctions. Serious gaming is not on the DOD chart.

The Army, like the DOD, separates those developers that introduce a technology and the training requirements for it, called capability developers, from those developers that create the systems that enable the use of the technology, called material developers, from those that develop the actual training that uses the training products in the system, that are called training developers. Both training developers and capability developers suffered from issues that impeded the collection of serious gaming attitude data.

Within the Army, training developers and training delivery personnel (trainers) work for proponent schools, the proponent area defined by a particular knowledge area that defines their scope of work. The GS 1750 Instructional Systems Specialists (ISS) form the core of each proponent school's training development workforce. The large GS 1750 ISS workforce that the Army hired after the 1985 report performed the job and task analysis necessary to determine the interest and motivation necessary to perform distributed learning and live simulation tasks near the top of Figure 2, giving those tasks development an advantage over virtual and constructive simulation task development. That advantage, however, dissipated as that work force retired and was not replaced, returning the Army to the dismal training development state it occupied in 1985. Most notably, the job and task analysis that should have been done to determine if the interest and motivation necessary to perform serious gaming tasks was present could not be done because the highest priority training gap in the Army in February 2011 was that for LVC-G training environments, "The Army lacks ... sufficient training developers with the requisite skills" (U.S. Army, 2011a, p. 10). The proposed solution found the gap should be mitigated by again hiring "a professionally educated corps of GS 1750 civilian training developers capable of conducting competent ISD analysis, design, development,

implementation, and evaluation work... creating or modifying TD Job Series KSAs to require knowledge of application of ... serious gaming... strategies" (U.S. Army, 2011b, pp. 6-7). Regrettably, this recovery has not occurred to the degree hoped for because late in 2011 the GAO issued a report that re-orientated where the Army placed its training development resources. That report stated although TRADOC requirements for training developers remained stable between FY 2005-2011, TRADOC "...has a backlog of 436 man-years in doctrine development," "a backlog of 204 man-years for developing, updating, and reviewing curricula" and "has not established a plan to address this backlog" (U.S. Government Accountability Office, 2011, p. 16). Notably, a chart (2011, p. 6) in that report indicates that between FY 2005-2011 that the stable population referred to was actually decreasing in degreed ISD personnel while increasing in non-degreed instructor and trainer personnel - that can't perform job and task analysis.

Capability developers also had an issue that hindered the collection of serious gaming attitude data - that being confusion as to whose area serious gaming fell within. Typically, capability developers that work within only one scope of knowledge also work for that proponent that has that scope. However, when a technology needs to be introduced crosses two or proponent scope boundaries then the Army appoints a TRADOC Capability Manager (TCM) for that area. As can be seen in Figure 3, the TCM for the Army Distributed Learning Program (TADLP) is responsible for most IMI DL product training requirements, including "serious gaming when appropriately utilized within the instructional environment" (U. S. Army, 2014, p. 132). Typically, training developers in proponent schools work with their own capability developers within their school for non-distributed learning products - unless there is a TCM for that technology

area. For IMI DL products, called courseware, on the top of Figure 3, proponent-training developers work with the TCM TADLP, who is the distributed learning capability developer. For the same reason, the Army appointed a TCM Live, a TCM Virtual, and a TCM Constructive to work with training developers introducing live, virtual, and constructive simulation technologies into the LVC trainers at the bottom of Figure 3.

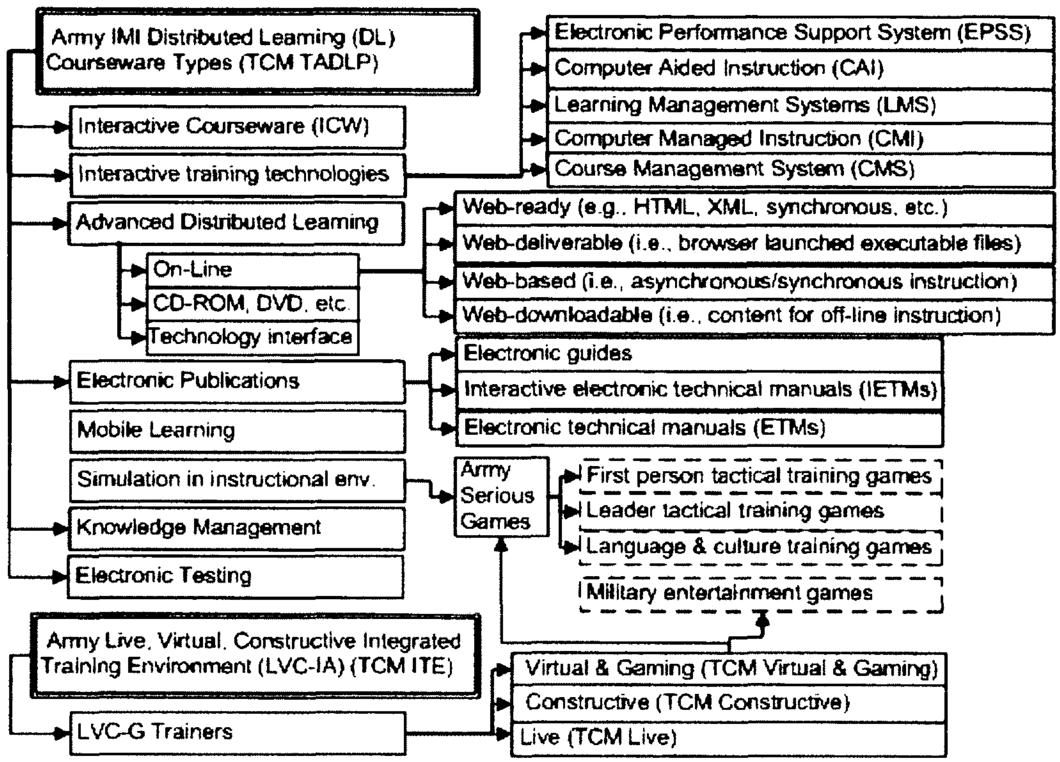


*Figure 3.* Army Distributed Learning Courseware Types. Adapted from "Army Training and Leader Development," by U.S. Army, 2014, p. 132. Copyright 2014 by the Government Printing Office.

There was little initial overlap for two reasons. The first was because the TCMs intentionally implemented the TADLP and LVC technologies in large training facilities Soldiers traveled to in order to use to get the most proven capability for the lowest cost. The second was that initially serious gaming needed to overcome the tendency of its larger TADLP and simulation TCM cousins to treat it as a distraction from focusing on the main tasks in their charters, TADLP and LVC simulations. From their rational point

of view, every dollar spent on gaming was a dollar diverted from a desperately needed DL course or a larger LVC simulation with more capability than a desktop computer could provide. These conditions changed as the TCM TADLP sought to move DL training out of the large digital training facilities (DTFs) that Soldiers were taking their DL from and into desktop computers in their workplace and in their homes. Because serious gaming within the instructional environment belonged by regulation to TCM TADLP, it seemed logical to move serious games to desktop computers also. Because the desktop computer was now reaching the point of being able to support serious games, TRADOC appointed a separate TCM Gaming in 2009. However, even though TCM TADLP and TCM Gaming signed an agreement to define their roles, some confusion still arises because TCM TADLP still has serious games responsibilities and because in 2014 the Army folded the separate TCM Gaming into a combined TCM Virtual and Gaming.

**Serious Gaming Categorization**

As seen in Figure 3, excluding miltainment, Army serious gaming has three sub-categories. The first Army serious games sub-category is first person tactical training games that help individual Soldiers acquire or exercise individual or collective task skills in simulated conditions or situations. The second serious games sub-category is leader tactical training games that help Soldiers, that are also leaders, acquire or exercise leader individual or collective task skills in simulated conditions or situations, often by control of other actual or simulated Soldiers. The third serious games sub-category is language and culture training games. These games train effective language use and cultural behavior during the exercise of Soldier and leader individual or collective tasks in the context of simulated conditions or situations.

The best-known example of an Army serious game flexible enough to serve both the first and second sub-categories' training audiences is VBS2, and now VBS3 that is in the process of being fielded. As indicated earlier, the VBS2 Fusion component can programmatically open and interact with the Army's Tactical Language & Culture Training Systems that are the best-known examples of the third serious games sub-category. Language and culture training games titles include Tactical Iraqi, Pashto, Dari, French, and Indonesian.

**Serious Gaming Research**

Understanding adult human physiology, specifically the parts of the adult brain that control motivation, attitude, and learning, is necessary to understand attitude change. The adult human brain uses about 100 billion neurons (Bloom, Nelson, & Lazerson, 2001) to control learning. By encoding, storing, and retrieving information in neural networks, they control all aspects of human behavior (Squire & Kandel, 2000). When adults learn, they alter neural networks created through previous experience and knowledge. Demographic factors including gender, age, education, perceived gaming confidence, or class influenced those experiences and knowledge. Because this neural network knowledge is physical, it cannot be removed by wishing it away (Zull, 2002), "especially if it is a deeply held attitude or belief. Literally, another neuronal network must take the place of the current attitude or belief… (taking) repetition, practice, and time" (Wlodkowski, 2008, p. 12). Jung defined attitude as a "readiness of the psyche to act or react in a certain way" (Jung, 1922; Jung, Hull, Baynes, & Read, 1971, p. 687). Jung believed that attitudes, unlike personality, should change based on experience. Anderson (1983) advocated that attitude change might be possible by activating an

affective or emotion neural network node since the composition of an associative neural network can be changed by activating a single node. Because a change in attitude, including attitude towards using serious games for instruction, requires a biological change in the adult learners' neural network, ascertaining that attitude is critical to allow DOD to tailor serious game pedagogical design where possible, or to make different training investments where it is not possible.

Much of the focus in this area of inquiry is increasingly on attitudes, skills, or activity type as separate dependent variables. Because some of the necessary literature reviewed focused on the independent variable learner factors effect on the learner's dependent variable of skill or activity type rather than the learners dependent variable of attitude toward use, this literature review attempts to separate that research from that focused on the attitude dependent variables where necessary. Accordingly, research that focused on the independent variable learner factors effect on the learner's dependent variable of skill or activity type is introduced first to avoid confusion with the later part of the literature review that focuses on the independent variable learner factors effect on attitude. Then, research that explores attitude toward the object ($A_O$) as the dependent variable is reviewed before research that explores attitude toward the behavior involving the object ($A_B$) as the dependent variable.

**Independent Variable Learner Factors Effect on Skill or Activity Type**

For the independent variables of learner factors effect on the learner's dependent variable of skill or activity type, there were six studies reviewed. In 1997, Selwyn reported the results of his research into the independent variables of gender, age, education level and desired major field of study on the dependent variable of the activity,

including for the playing of computer games, of using home computers by senior high school and college students in the United Kingdom (Selwyn, 1997a). Using his Computer Attitude Scale (CAS) instrument described later in the dependent variable section of this literature review (Selwyn, 1997b), Selwyn surveyed 983 students and conducted 19 follow-up focus group interviews with 96 of the students. Selwyn found significant and widening gender differences between male and female students in utilization and attitude toward using computers at home. No age, education level or desired major field of study results were reported beyond the statements "more longitudinal and comparative research is ... needed" (Selwyn, 1997a, p. 225). The use of age as an independent variable in research increased following Prensky's (2001a) publication of "Digital Natives, Digital Immigrants." In 2003, Selwyn, Gorard, Furlong, and Madden reported results of their research into the independent variables learner factors of gender, age, education level and marital status on the dependent variable of the activity of using information and communication technologies (ICT) that includes home computers by senior citizens in the west of England and South Wales. Using a 36 page structured interview instrument administered by a university-based research organization, Selwyn et al.surveyed 1001 adults between 61 and 96 years of age (Selwyn et al., 2003). Gender was defined as male or female, age as 61-70 or 70 and over, education as less than 16 years or 16 or more, and marital status as married/partner or single/separated/widowed. Selwyn et al. found that while non-users of ICT outnumbered users in all categories, significant learner factor differences existed among those that did use ICT. Selwyn et al. found separately on all four variables that those respondents that were male, younger, better-educated, or married or has a partner were more than twice as likely to use ICT (Selwyn et al., 2003). Later in

2003 and based on his research just concluded, Selwyn, concerned that the digital divide debate discussion concentrated too much "on the characteristics of the individuals who *are* using" computers" (Selwyn, 2003, p. 99), proposed trying to develop a deeper conceptual understanding of the independent variable(s) of why people may be excluded from the dependent variable activity of computer use. Selwyn posited that once the reason for non-use was identified, an alternative framework to perform the activity could be developed. In 2006, Selwyn reported results of further research into the non-use of ICT by senior citizens in the west of England and South Wales. For this non-use activity research, Selwyn interviewed 100 of the original survey population and increased the number of independent variable learner factors to add socio-economic status and geographic mobility to gender, age, education level and marital status (Selwyn, 2006). Gender, age, and marital status were defines as before, age was split into three groups of 21-40, 41-60, and 61 or more. Selwyn defined socio-economic status as service, skilled non-manual, skilled manual, partly skilled and mobility referred to thc ability to leave the neighborhood. Selwyn found better than 70% ICT use predictive accuracy for gender, education, marital status, mobility, and socio-economic status with 62% predictive accuracy for age (Selwyn, 2006). Selwyn also collected ethnic background, health status, and household composition independent variable learner factor data but found too little predictive accuracy for ICT use to report. In 2014, regarding educational technology and issues of inequality Selwyn states "...some individuals ... are clearly able to be more proactive, productive, and successful when learning with digital technologies, while others are left more vulnerable" (Selwyn, 2013, p. 165). Selwyn continued, "... the likelihood of gaining advantage ... is clearly related to the resources the social groups

command ....missing in these discourses is any consideration of the differential and inequitable positions of subjects in terms of ... age, gender, class..." (Selwyn, 2013, p. 165). In 2015, van Deursen, van Dijk, and ten Klooster will report their results of a four year longitudinal cross sectional analysis among 4881 Dutch citizens that studied the influence of the independent variables of gender, age, education, and income on seven dependent variable Internet activities, one of the activities being recreational internet gaming (van Deursen, van Dijk, & ten Klooster, 2015). Because the scope of the study was activities performed instead of skills or attitudes, the researchers did not consider using Perceived Gaming Competence or confidence as an independent variable for the Gaming activity since that is a variable associated with the study of attitude (van Deursen et al., p. 271). Although they had considered using Davis' (1989) Technology Acceptance Model (TAM), that is discussed later in this literature review, to base their research upon they selected a different approach. An 18-item inventory recorded the respondents' answers as to how frequently they performed the seven activities using an ordinal-level measure with a five-point scale. For the independent variables, gender was either male or female, age groups were 16 to 35, 36 to 50, 51 to 65, and 66 and over, education groups were low, middle, or high with each representing ascending unspecified levels of college, and an unspecified number of income groups ranged between 10,000 Euros to 80,000 Euros and above (van Deursen et al., 2015). As of 13 November 2914, 10,000 Euros equated to 12,464 United States dollars and 80,000 Euros equated to 99,712 United States dollars, those figure being well below and well above the median basic pay rates for U.S. military personnel classes. Their gender interaction findings were that Dutch women played significantly more online games than Dutch men at the beginning of the study in

2010 but that by 2013 the difference "had almost disappeared" (van Deursen et al., 2015, p. 266). They found a negative effect for age with gaming being more popular among the young but opined "contemporary youth will grow old. Therefore, to a certain degree, age differences can be considered a temporary phenomenon" (van Deursen et al., 2015, p. 270). For the other two independent variables, they found that "people with lower education levels or those with lower incomes generally use the Internet more for gaming than their counterparts with higher education levels and higher incomes" (van Deursen et al., 2015, p. 267).

**Independent Variable Learner Factors Effect on Attitude**

For the independent variables of learner factors effect on the learner's dependent variable of attitude or learning style, four studies were reviewed. One non-experimental descriptive study explored the influence of learner factors “on attitudes towards using instructional games" (Bonanno & Kommers, 2008, p. 97). A second non-experimental descriptive study measured “attitudes toward digital game-based learning based upon … learning styles” (Ching-Chiu, 2006, p. 29). Attitude toward gaming was the dependent variable for the former while learning style was the dependent variable for the latter. Independent variables for both were the learner factors of gender, age, and perceived gaming competence. Bonanno and Kommers found significant gender differences in attitude toward gaming, with men more positive, while Ching-Chiu found significant differences only in age, a factor unexamined by the first study. A potential population limitation of both of the studies, in extending results to the DOD, is that they used either college students or adults too old to serve in the military. They both recommended further research. In 2005, Orvis, Orvis, Belanich, and Mullin conducted an experiment that in

part gathered descriptive survey data investigating the influence of prior videogame experience and perceived ease of use on learner attitude toward engaging in or continuing training within "such environments for training purposes" (Karin A. Orvis et al., 2005, p. 5). Orvis et al. used 413 first-year U. S. Military Academy cadets taking part in a serious game-based tactics training exercise as test subjects (Karin A. Orvis et al., 2005, p. 8) - the exercise test game being America's Army before the Army relegated it to miltainment status when VBS1 fielded. Measures of interest included general and specific game experience and ease in using user interface, understanding that prior videogame experience and perceived ease of use together help construct the independent variable learner factor of perceived gaming confidence for this proposal. Both general and specific (America's Army) game experience were measured on a five point scale that ranged from 1 (none) to 5 (much more than average) (Karin A. Orvis et al., 2005, p. 9). Computer self-efficacy, that was "What is you level of confidence using computers?" was measured on a five point scale from 1 (low) to 5 (high) (Karin A. Orvis et al., 2005, p. 10). Orvis et al. found that while learners with either higher levels of computer self-efficacy or prior videogame experience reported greater motivation to continue training, that learners with both, "possessed the highest levels of training motivation" (Karin A. Orvis et al., 2005, p. 20), that is attitude toward performing the behavior. Introducing a volunteer bias, the subjects volunteered from the larger population of 1100 cadets that participated in the larger training exercise. Interestingly, Orvis et al. also found that "... a videogame genre-specific effect was demonstrated in that only specific prior game experiences that share similar characteristics with the current training game were significantly predictive of the learner outcomes" (Karin A. Orvis et al., 2005, p. vii). Orvis, et al. found that serious

games that most closely resembled virtual simulations were "positively related to training motivation for the America's Army game," perhaps because they were "more closely associated to training well-defined skills (versus solely providing entertainment) as compared to other types of videogames" (Karin A. Orvis et al., 2005, p. 19). In 2008, Orvis, Horn, and Belanich extended their previous work to examine the role of task difficulty and prior videogame experience on performance and motivation in instructional videogames, using 21 volunteers, and using VBS1 as the test serious game (Karin A. Orvis, Horn, & Belanich, 2008). Orvis, et al. wanted to determine in part if a learners level of training motivation "...may be particularly relevant to examine in game-based instructional environments, as proponents of instructional videogames argue that a fundamental advantage of using videogames (over other more traditional instructions tools) is the ability to capture and maintain trainee motivation over the course of the instruction" (Karin A. Orvis et al., 2008, p. 2417). Modifying a critical measure, this time Orvis, et al. measured prior videogame experience by use of an open-ended item that aksed "In a typical week, how many hours do you play videogames?" (Karin A. Orvis et al., 2008, p. 2421). Despite the study suffering from both a volunteer bias and a small sample size, Orvis, et al. found "...prior videogame experience has an important influence on performance and motivation" (Karin A. Orvis et al., 2008, p. 2427) and that "experienced gamers initially reported higher task self-efficacy ...than inexperienced gamers" (Karin A. Orvis et al., 2008, p. 2428).

**Dependent Variable Attitude toward Object ($A_O$) or toward Behavior ($A_B$) Research**

For the independent variables of learner factors, the literature reviewed revealed twelve models and theories and more than a dozen studies between 1975 and 2013 that

described research to measure user acceptance of Information Technology (IT) systems, concentrating upon their distinctions between two attitude constructs: attitude toward the object ($A_O$) or attitude toward the behavior involving the object ($A_B$). The review revealed only one non-experimental descriptive study, by Bonanno and Kommers (2008), that measured attitudes toward the use of gaming for instruction as a behavior. Reviewed here are the Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), Model of Personnel Computer Utilization (MPCU), and Motivational Model (MM). Also reviewed are the Computer Attitude Measure (CAM), Combined TAM and TPB (C-TAM-TPB), Innovation Design Process Theory (IDPT), Social Cognitive Theory (SCT), Computer Attitude Scale (CAS), TAM Two (TAM2), Adapted TAM Two (A-TAM), and Unified Theory of Acceptance and Use of Technology (UTAUT). This chronological review of those models and studies found that in many cases, as Taiwo and Downe found in their study of UTAUT, that there may have been "inadequacy and inconsistency in the use and output of a theory" (2013, p. 56) during the studies that underlie the research literature reviewed. These inconsistencies in user acceptance causal relationship findings are more conspicuous because many of the studies use the same validated variables. These inconsistencies are why the research of Bonanno and Kommers' (2008) is the basis for this research study.

In short, Bonanno and Kommers' (2008) attitude gaming as a behavior ($A_B$) based research is the basis for this study because there are too many inconsistent findings in the attitude toward object ($A_O$) based models literature and theirs was the first study that concentrated on instructional gaming as a behavior. Bonanno and Kommers' (2008) research, measuring the influence of learner factors by gender and perceived gaming

competence on instructional gaming as a behavior, was based predominantly on the research of Fishbein and Ajzen (1975), Kay (1993), Davis (1993), and Selwyn (1997b) that measured attitudes toward the use of computer systems as a behavior ($A_B$). Both the pertinent object and behavior based research is described to permit the reader to understand and differentiate between them.

**Theory of Reasoned Action (TRA)**

In 1975, Fishbein and Ajzen developed the attitude toward behavior (AB) orientated Theory of Reasoned Action (TRA) model shown at Figure 4. The Theory of Reasoned Action predicts the behavioral intention (BI) construct that measures the strength of intention to perform a behavior. BI is the sum of the person's attitude (A) and subjective norms (SN) constructs. Within TRA, attitude toward behavior is "an individual's positive or negative feelings (evaluative affect) about performing the target behavior" (Fishbein & Ajzen, 1975, p. 216) and subjective norm is "... the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 302).

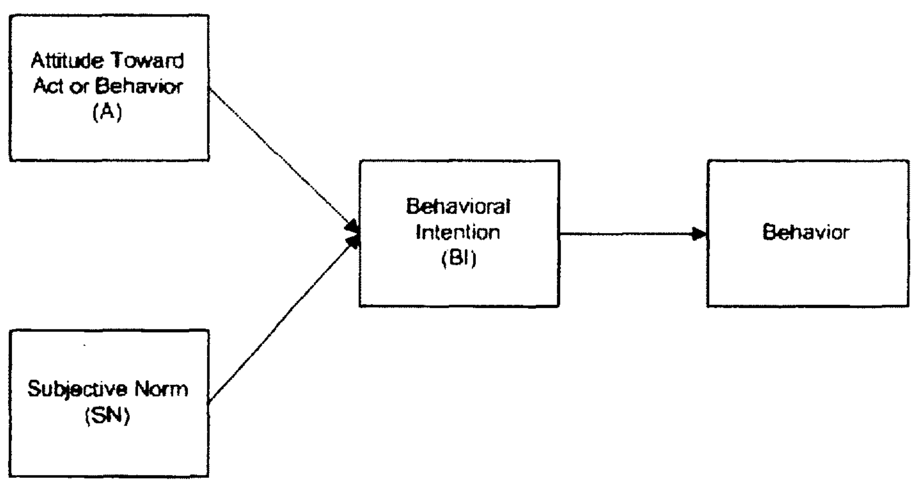


*Figure 4.* Theory of Reasoned Action. Adapted from "Belief, Attitude, Intention, And Behavior : An Introduction to Theory And Research," by M. Fishbein and I. Ajzen, 1975, p. 216. Copyright 1975 by the Addison-Wesley Longman, Incorporated.

Within the TRA model BI is the dependent or response variable, A and SN are the independent or explanatory variables, and TRA is expressed as BI = A + SN. In 1988, Sheppard, Hartwick, and Warshaw conducted a meta-analysis of 87 separate studies of the relationship between an individual's intention to perform a behavior (I) and actual performance of the behavior (B) expressed as I-B and the relationship between an individual's attitudes and subjective norms and intention to perform a behavior expressed as A+SN-I. Because over half of the research to that date investigated activities that the TRA model was not originally intended, the researchers expected "the Fishbein and Ajzen model would fare poorly in such situations" (Sheppard, Hartwick, & Warshaw, 1988, p. 338). Surprisingly, the researchers found "...strong support for the overall predictive utility of the Fishbein and Ajzen model" (Sheppard et al., 1988, p. 336) with I-B accounting for 47.3 percent and A+SN-I accounting for 64.6 percent of the variance. In 2003, Hale, Householder, and Greene reported that because attitude toward performing a behavior (AB) and subjective norms (SN) are not weighted (W) equally in predicting behavior (BI), the TRA formula should be adjusted to $BI = (AB)W_1 + (SN)W_2$ (Hale, Householder, & Greene, 2003). In summary, TRA's strength in predictive utility in the 87 studies analyzed by Sheppard, Hartwick, and Warshaw (1988) provides support for using both the subjective norm and attitude toward behavior variables within this behaviorally orientated model to underpin the research that is the subject of this proposal, although the strength of the subjective norm variable wanes in later reviewed behavioral studies.

**Technology Acceptance Model (TAM)**

In 1986, concerned those current performance objective approaches to assess whether people will use new systems did not consider system use was often at the

discretion of the user, Davis (1986), building on the work of Fishbein and Ajzen (1975), developed the attitude toward using (a behavior - $A_B$) orientated Technology Acceptance Model (TAM) shown at Figure 5. The Technology Acceptance Model posits that attitude toward using is the sum of the person's perceptions of usefulness and ease of use constructs, with ease of use also directly affecting perceived usefulness.

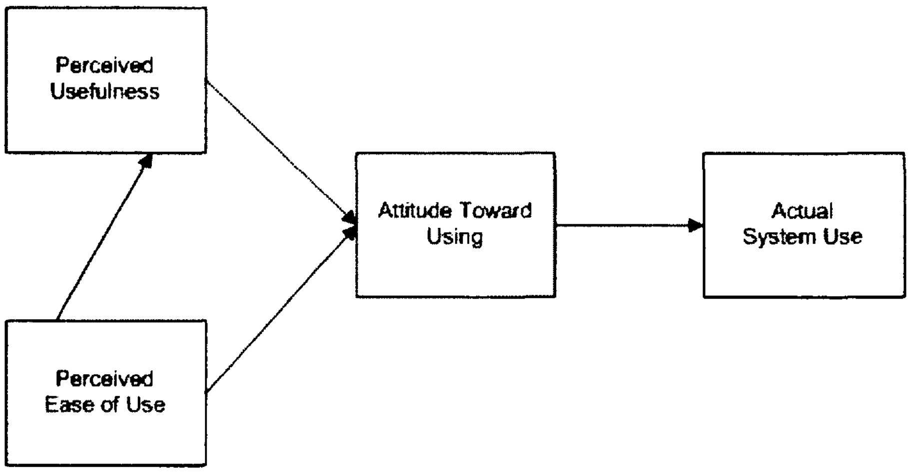


*Figure 5.* Technology Acceptance Model. Adapted from "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results," by F. D, Davis, 1986, p. 24. Copyright 1986 by the Massachusetts Institute of Technology.

In this early TAM model, attitude toward using a target system "was hypothesized to be a major determinant of whether or not he actually uses it. Attitude toward using ... is a function of ... perceived usefulness and perceived ease of use" (1986, p. 24). Davis defined perceived usefulness (PU) as "the degree to which a person believes that using a particular system would enhance his or her job performance" (1986, p. 26) and perceived ease of use (PEOU) as "the degree to which a person believes that using a particular system would be free of physical and mental effort" (1986, p. 26). Davis considered attitude toward using ($A_B$) as the affective response to the usefulness and ease of use perceptions that he considered cognitive responses to the target system object. Davis

excluded the TRA subjective norm (SN) component of the Fishbein model from the TAM because in the TAM's user acceptance testing context "no information will be available to the subjects pertaining to the expectations of their salient referents regarding the use of the target system" (1986, p. 36). Davis also excluded the TRA behavioral intention (BI) to perform the behavior variable from the TAM, because in the user acceptance-testing context "measurements of subject's motivation to use a new system would take place directly after demonstrating the system to the user. Thus, the time required to form an intention would not be expected to elapse prior to measurement" (1986, p. 38). Citing the lack of sufficiently reliable and valid scales for perceived usefulness (PU) and perceived ease of use (PEOU), Davis developed new scales with ten items in each pool with deliberate overlap (1986, p. 83), using five existing items for attitude toward using the system or object and two for actual system use. Davis pilot tested with a convenience sample of 112 system developers, document analysts, and managers. He found Cronbach's coefficient alpha to exceed .90 for all constructs but actual system use. After refinement, Davis used a within-subjects experimental design with a counter-balancing sequence for treatments on 40 MBA students to evaluate the TAM (1986). In these data Davis found perceived usefulness had "a powerful effect on attitude toward using and a powerful direct effect on self-predicted usage behavior above and beyond its indirect effect through attitude toward using...usefulness 2.65 times as important as ease of use in determining self-predicted system usage" (1986, p. 173).

In 1989, Davis reiterated that valid measurement scales for predicting user acceptance of computers were in short supply and those measures in use were unvalidated and had unknown relationships to actual usage, However, Davis still defined

perceived usefulness (PU) as before (Davis, 1989, p. 320). Davis re-defined perceived ease of use (PEOU) slightly to become "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320), omitting his previous declaration that effort be mental or physical. Davis stated he intended the perceived ease of use construct to be similar to Bandura's self-efficacy construct in that they should both function as proximal determinants of behavior. Davis intended the perceived usefulness construct be similar to Bandura's outcome judgment construct in that it should both measure the "...extent to which a behavior, once successfully executed, is believed to be linked to valued outcomes" (Davis, 1989, p. 321). Davis, Bagozzi, and Warshaw (1989) compared Fishbein and Ajzen's TRA model that posits user attitude and subjective norm have a significant effect on behavioral intention to use a technology with Davis' TAM that posits usefulness and perceived ease of use are the significant predictors of acceptance. In a study of 107 computer system users, Davis, Bagozzi, and Warshaw (1989) reported "Perceived usefulness strongly influenced peoples' intentions... Perceived ease of use had a small but significant effect ... Attitudes only partially mediated the effects of these beliefs on intentions. Subjective norms had no effect on intentions" (1989, p. 982).

In 1993, Davis again reported development of the TAM detailing the causal relationships between system design features, perceived usefulness (PU), perceived ease of use (PEOU), attitude toward using ($A_O$), and actual usage behavior (B), that Davis called the behavioral response. Reporting research into why the selection of system functional and interface characteristics by people other than the target audience that will use the system affect acceptance or rejection of information systems by the target

audience, Davis used Fishbein and Ajzen's (1975) psychological attitude theory to support their rationale for the TAM relationships hypothesized. Fishbein and Ajzen's psychological attitude theory distinguishes between attitude toward an object ($A_O$) that "... refers to a person's affective evaluation of a specified attitude object" (Davis, 1993, p. 476), and attitude toward the behavior ($A_B$), that refers to "... a person's evaluation of a specified behavior involving the object" (Davis, 1993, p. 476). Unless considered carefully, Davis's seeming description of the TAM utilizing "attitude toward using *the system*" (Davis, 1993, p. 476) (italics added) might be mistaken for evaluation of a specified attitude object, and be described as an attitude toward an object ($A_O$) - the system, rather than the correct interpretation of an attitude toward the behavior ($A_B$), the behavior being *using* the system" (Davis, 1993, p. 476) (italics added) . Davis hypothesized that a prospective user's overall attitude toward using a given system, again representing a behavior ($A_B$), is "... the major determinant of whether he or she actually uses it. Attitude toward using, in turn, is a function of ... perceived usefulness and perceived ease of use" (Davis, 1993, p. 476). Davis's regression analysis of the results found attitude toward using ($A_B$) had a significant effect on usage and the attitude sub-component of perceived usefulness had a strong direct effect beyond that of other components of attitude, it being "... 50% more influential than ease of use in determining usage" (Davis, 1993, p. 475). This 1993 finding that the attitude sub-component of perceived usefulness was 50% more influential than ease of use was significant in its later use in other research. In 2004, Ma and Liu, stating that findings on the TAM "model are mixed in terms of statistical significance, direction, and magnitude" (p. 59), performed a review of 91 studies related to TAM and performed a meta-analysis of empirical findings

in 26 TAM studies conducted between 1993 and 2000. Ma and Liu developed meta-analysis inclusion criteria that required each study meet four conditions. The study must directly or indirectly empirically test TAM, report sample size, report correlation co-efficients between the constructs of TAM or values that could be converted to correlations, and be published after 1989 when TAM was first published (Ma & Liu, 2004). Ma and Liu examined the variables of perceived ease of use, perceived usefulness, and technology acceptance that Davis validated (Davis, 1993; Ma & Liu, 2004). Ma and Liu found for TAM "both the relationships between perceived ease of use and perceived usefulness, and between perceived usefulness and technology acceptance, are strong while the relationship between perceived ease of use and technology acceptance is weak" (Ma & Liu, 2004, p. 66). Because Ma and Liu found in many TAM studies small sample sizes, an absence of moderators, and insufficient statistics, they recommend future studies, whether of experimental or survey approaches, include use of larger samples and additional variables "such as gender, culture, self-efficacy, complexity of a technology, or the state of knowledge of a technology" (Ma & Liu, 2004, p. 67). In summary, TAM's strengths in predictive utility provide support for using the attitude toward using ($A_B$), perceived usefulness (PU) and perceived ease of use (PEOU) variables to underpin the research that is the subject of this proposal, and may mitigate some of the weaknesses found in the 26 studies analyzed by Ma and Liu (2004).

**Theory of Planned Behavior (TPB)**

In 1991, Ajzen extended the attitude toward behavior orientated TRA model to become the Theory of Planned Behavior (TPB) shown at Figure 6. In the Theory of Planned Behavior, Ajzen, accepting that behavioral intention cannot always determine

actual behavior when a person's control over the behavior is limited, added a new variable construct called perceived behavioral control (PBC). TPB is based upon Bandura's (1986) Social Cognitive Theory (SCT) self-efficacy construct that measures a person's belief in his or her capability to perform the behavior required to produce an outcome. Like self-efficacy, TPB measured the attitude toward performing the behavior ($A_B$) rather than the personal or performance-related consequences of the behavior that Bandura (1986) defined as outcome expectancy.

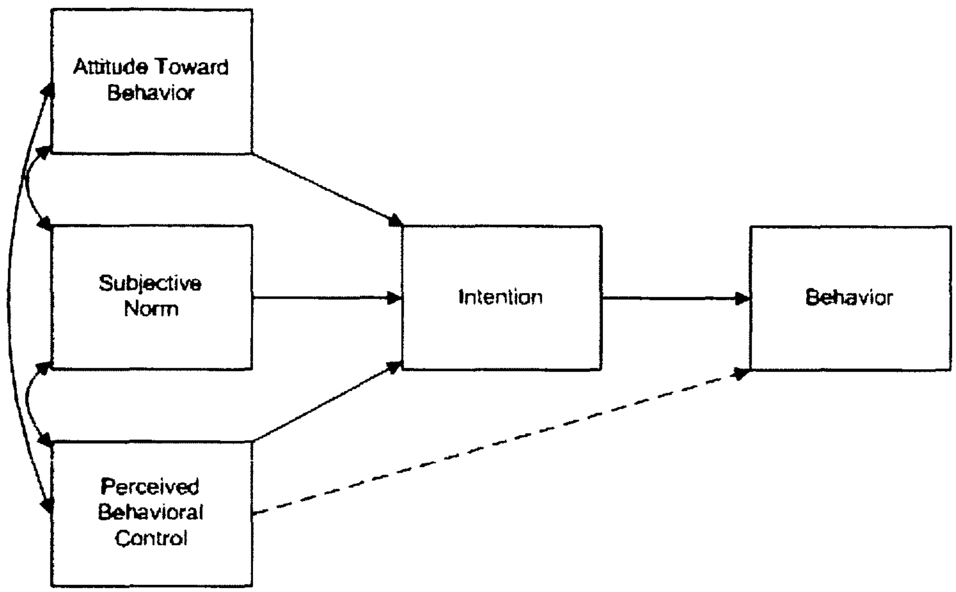


*Figure 6.* Theory of Planned Behavior. Adapted from "The Theory of Planned Behavior," by F. D. Davis, 1986, *Organizational Behavior and Human Decision Processes, 50*(2), p. 24. Copyright 1991 by Elsevier.

TPB posited that attitude toward a behavior, subjective norm, and perceived behavioral control were the three conceptually independent antecedents of intention to perform the behavior. Ajzen defined perceived behavioral control (PBC) as "... the perceived ease or difficulty of performing the behavior" and slightly redefined attitude toward the behavior ($A_B$) from the Fishbein and Ajzen (1975) definition to become "... the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question"

(Ajzen, 1991, p. 188). Social norm (SN) was defined much as it was by Fishbein and Ajzen (1975). Analyzing 16 studies reporting predication of behavioral intention (BI) results between 1985 and 1991 Ajzen found the three TPB determinant variables accounted for an average of .71 variance of intention (1991). He found PBC led to "... considerable improvements in the prediction of intentions," that "with only one exception, attitudes ... made significant contributions," but that "... the results for subjective norms were mixed, with no discernible pattern" (Ajzen, 1991, p. 189). In summary, TPB's strengths and weaknesses in predictive utility for its different variables in the 16 studies analyzed by Ajzen (1991) provides more support for using the perceived behavioral control (PBC) and attitude toward the behavior ($A_B$) variables than the subjective norm (SN) variable within this behavior orientated model to underpin the research that is the subject of this proposal.

**Model of Personnel Computer Utilization (MPCU)**

In 1991, Thompson, Higgins, and Howell (1991) adapted and refined Triandis' (1977) theory of human behavior model, that competed with Fishbein and Ajzen's TRA model, to produce their mixed attitude toward behavior ($A_B$) and attitude toward object ($A_O$) orientated Model of Personnel Computer Utilization (Thompson et al., 1991) shown at Figure 7. They chose to modify Triandis' theory instead of TRA because "while Fishbein and Ajzen's theory considers all beliefs that a person has about an act or behavior, Triandis makes a distinction between beliefs that link emotions to the act (occurring at the moment of action) and beliefs that link the act to future consequences" (Thompson et al., 1991, p. 125). Triandis (1980) argued that feelings toward a behavior, called affect - here abbreviated as "AF" for affective feelings, thoughts about what a

person should do, called social factors - here abbreviated as "SI" for social influence, and the perceived long-term consequences of the behavior (PLTC) determine a person's behavioral intention (BI). In the Model of Personnel Computer Utilization, Thompson, Higgins, and Howell, posit that social norms, complexity of use, fit between the job and PC capabilities, and long-term consequences exert a strong influence on utilization. In turn, actual behavior (B) is determined by what people have usually done, called habits (H), facilitating conditions (FC), and their behavioral intention (BI).

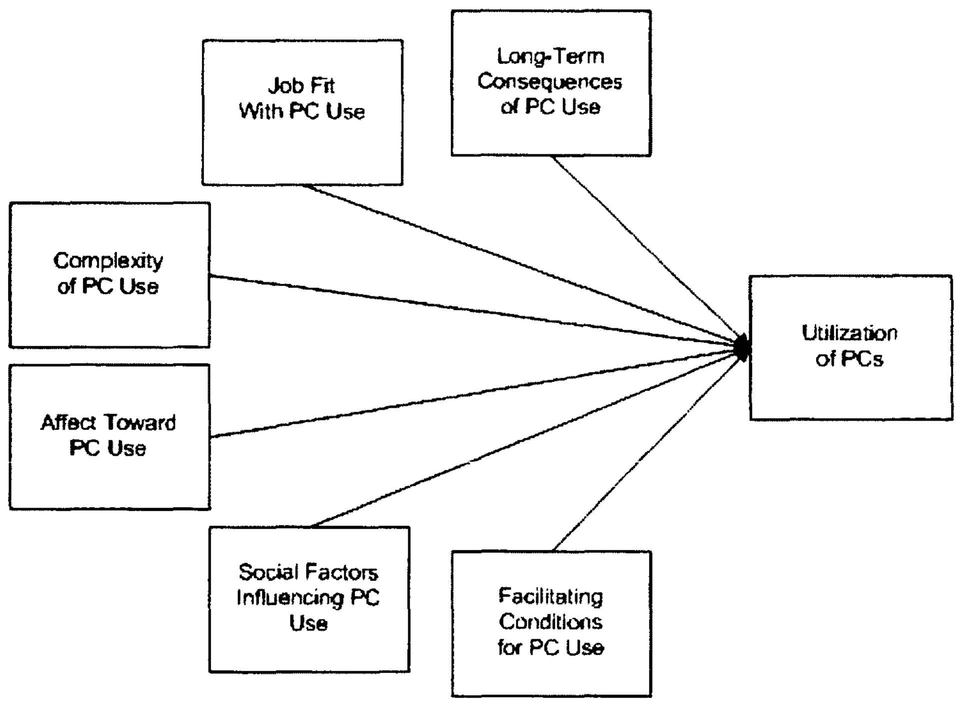


*Figure 7.* Model of Personnel Computer Utilization. Adapted from "Personal Computing: Toward a Conceptual Model of Utilization," by R. L. Thompson, C. A. Higgins, and J. M. Howell, 1991, *MIS Quarterly*, 15(1), p. 131. Copyright 1991 by the Society for Management Information Systems and Management Information Systems Research Center of the University of Minnesota.

Testing a sub-set of Triandis' 1980 theory, Thompson, Higgins, and Howell (1991) excluded behavioral intention (BI) from their MPCU as a construct composed of variables to focus on the direct variable effects of social factors (SI), the affect component of attitude (AF), perceived consequences (PLTC), and facilitating conditions

(FC) as determinants of actual behavior toward the personnel computer object (Ao). They further modified the theory by deleting habit as a variable and adding the three variables of job-fit (JF), complexity (C), and long-term consequences (PLTC) to the perceived consequences variable construct. The instrument developed by Thompson, Higgins, and Howell (1991) was affected by scale length such that Cronbach's alpha reliability of was determined to be .60 for complexity, .61 for affect, .64 for utilization, .65 for social factors, .76 for long-term consequences, and .82 for facilitating conditions, causing the authors to acknowledge that "...future studies should develop stronger measures" (Thompson et al., 1991, p. 135). Despite the low Cronbach's alpha figures and the net response rate from the 455 people that used a computer within the selected organization that were sent the survey being only 47%, the authors stated they found "social factors, complexity, job fit, and long-term consequences had significant effects on PC use" (Thompson et al., 1991, p. 137). They also reported there "... was no evidence that affect and facilitating conditions (as defined) influenced PC use" (Thompson et al., 1991, pp. 137-138) despite stating in the limitations section that "Finally, the affect construct needs to be re-visited ... the items chosen in the study ... do not measure all possible facets of affect toward PC use. This scale needs to be bolstered by including other items" (Thompson et al., 1991, p. 139). In summary, MPCU's use in the single study for a single company conducted by Thompson, Higgins, and Howell (1991), and its exclusion of behavioral intention, supports using only the affect (AF) variable within this mixed behavior and object orientated model to underpin the research that is the subject of this proposal.

**Motivational Model (MM)**

In 1992, Davis, Bagozzi, and Warshaw, reporting research from two studies into whether "...people use computers at work more because they are useful or because they are enjoyable to use" (p. 1111), developed their attitude toward object ($A_O$) orientated Motivational Model (MM). The researchers hypothesized that two dependent or response variables of intrinsic motivation and extrinsic motivation, control individual behavior that is the independent variable of intent to use computers in the workplace. The extrinsic dependent or response variable was perceived usefulness (PU), defined as "a person's expectation that using the computer will result in improved job performance" (Davis et al., 1992, p. 1112), the computer being the object in the attitude toward using the object ($A_O$) variable discussed in this proposal. The intrinsic dependent or response variable was enjoyment (E), defined as "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" (Davis et al., 1992, p. 1113) . They also hypothesized that ease of use (PEOU) and output quality (OQ) would act as antecedent extrinsic dependent or response variables. In the first study, of 120 male and 80 female MBA students, Davis, Bagozzi, and Warshaw reported MM Cronbach alpha reliability coefficients of ".91 for usefulness, .81 for enjoyment, .88 for ease of use, and .78 for output quality" (Davis et al., 1992, p. 1117). They found usefulness (PU) had a strong effect and enjoyment (E) had a significant effect of usage intention (BI), together explaining 62% of the variance in usage intention. In the second study of 40 MBA students paid for their participation Davis, Bagozzi, and Warshaw (1992) reported MM Cronbach alpha reliability coefficients of ".97 for usefulness, .92 for enjoyment, .95 for ease of use, and .69 for output quality" (p. 1124). They again found usefulness (PU) had a strong effect, that was

four to five times greater than enjoyment, and that still had a significant effect on usage intention (BI), together explaining 75% of the variance in usage intention. In summary, MM's variation in strength in predictive utility for its different variables in the two studies analyzed by Davis, Bagozzi, and Warshaw (1992) provides more support for using the perceived usefulness (PU) variable than the enjoyment (E) variable within this object orientated model to underpin the research that is the subject of this proposal.

**Computer Attitude Model (CAM)**

In 1993, Kay reported that during the preceding decade researchers assessed more than 15 different constructs measuring computer attitudes and that the number of them, and the absence of theoretical justification for many of them, made it difficult to other researchers to interpret and compare the studies that used them (Kay, 1993). Kay's solution was to develop an attitude toward object ($A_O$) based standard Computer Attitude Measure (CAM) with just four constructs for researchers to compare (cognitive, affective, behavioral, and perceived control), all with solid theoretical justification. Three of the constructs (affect, cognition, and conation - also known as behavioral intention) date back to Plato and were formally articulated as the tripartite model by Smith (1948). Rosenberg and Hovland (1960), Ostrom (1969), and Hilgard (1980) used the model comprehensively, with Breckler (1984) proving the validity of the model empirically. Kay summarized these three CAM constructs thus, "Affect reflects feelings toward the attitude object; cognition reflects perceptions of and information about the attitude object; conation reflects behavioral intentions and action with respect to the attitude object" (1993, p. 372). The fourth construct Kay used in this newer CAM (perceived behavioral control) was derived from Rotter's (1966) more generalized concept of locus of control

and Bandura's (1982) perceived self-efficacy measures. Ajzen's research (1988), finding that the perception of behavioral control by a person had a significant impact on that person's motivation and behavior toward performing the behavior, led Kay to adapt Ajzen's definition that perceived behavioral control is "...the perceived ease or difficulty of performing a particular behavior" (Kay, 1993, p. 372). Kay reported CAM instrument internal reliability coefficient for the full measure to be .95, and alpha coefficients for each attitude subscale ranged from .70 to .97 (1993). Compared to previously reviewed models, CAM's PBC is PBC, affect resembles affective feelings (AF), cognition resembles attitude toward object ($A_O$) or behavior ($A_B$), and conation resembles behavioral intent (BI). Kay administered the CAM to 647 pre-service teachers at four universities to assess the constructs. Of the sample's 647 predominantly rural teachers, 27% were of the male gender and 73% were of the female gender, ranging in age from 21 to 52 years with a mean age of 28.2 years. Kay found the attitude dimensions and subscales structurally independent. Significant positive correlations ($p < .001$) among all attitude subscales supported CAM construct validity. In summary, CAM's strength in predictive utility in the study performed by Kay (1993) provides support for using the affect (AF), perceived behavioral control (PBC), and cognition ($A_O$ or $A_B$) variables in this object orientated model to underpin the research that is the subject of this proposal.

**Combined Technology Acceptance Model and Theory of Planned Behavior (C-TAM-TPB)**

In 1995, Taylor and Todd (1995) developed their attitude toward behavior ($A_B$) orientated C-TAM-TPB model shown at Figure 8 to determine if "models such as the TAM were predictive of behavior for inexperienced users and ... whether the

determinants of IT usage were the same for experienced and inexperienced users of a system" (Taylor & Todd, 1995, p. 561). The Combined TAM and TPB combined selected attitudinal, social and control factors from the TAM and the TPB. C-TAM-TPB combined the TAM's perceived usefulness (PU) and perceived ease of use (PEOU) constructs into the TRA/TPB's attitude toward using behavior ($A_B$) that with the TPB's subjective norm (SN) and perceived behavioral control (PBC) constructs together forms the behavioral intention (BI) to perform the behavior (B), noting that perceived behavioral control can result in the behavior independently of intention (Taylor & Todd, 1995, p. 562). Taylor and Todd (1995) collected data from 786 of 1000 business school students that visited a computer resource center (CRC) to use its IT system that completed the survey instrument that by design did not ask them whether they had prior experience with the CRC IT system.

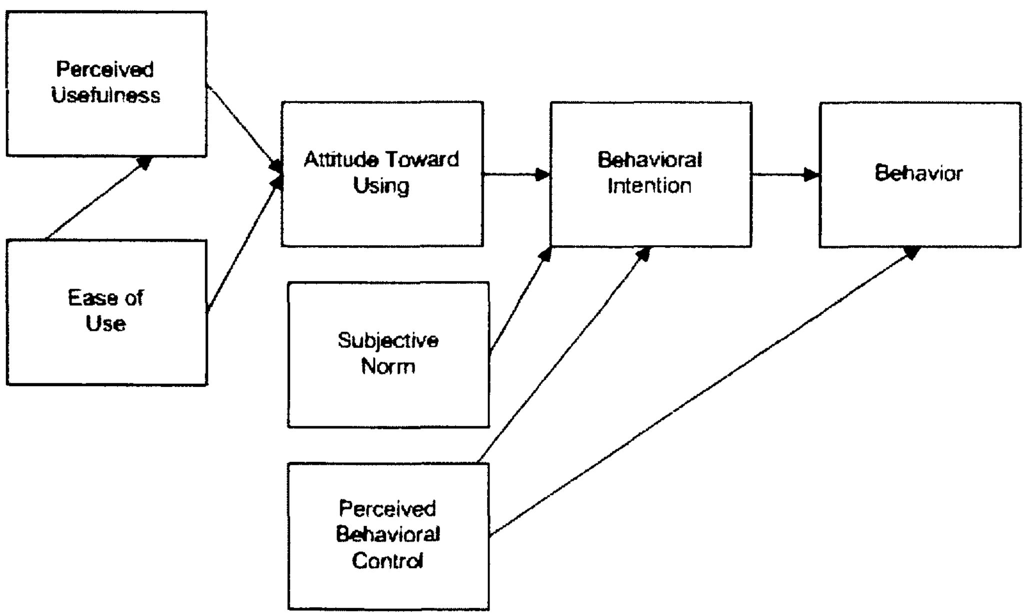


*Figure 8.* Combined TAM and TPB. Adapted from "The Role of Prior Experience," by S. Taylor and P. Todd, 1995, *MIS Quarterly*, 19(4), p. 562. Copyright 1995 by the Society for Management Information Systems and Management Information Systems Research Center of the University of Minnesota.

Taylor and Todd determined prior experience (usage) of the system separately by examining sign-in registers: 451 students used the system during that examination period and 332 of those had prior experience per the register. Reporting results, the "model accounted for only 21 percent of the variance in behavior and 43 percent of the variance in behavioral intention" for experienced users and "17 percent of the variance in behavior and 60 percent of the variance" for inexperienced users (Taylor & Todd, 1995, p. 564). Taylor and Todd found that "Contrary to our expectations, perceived usefulness was the strongest predicator of intention for the inexperienced group" while "...perceived behavioral control had less of an impact...." (Taylor & Todd, 1995, p. 566), making those potential variables for selection for this study to measure experience differentials. In summary, C-TAM-TPB's relative strengths in predictive utility provide support for using the attitude toward using ($A_B$), perceived usefulness (PU) and perceived ease of use (PEOU) variables to underpin the research that is the subject of this proposal, and may mitigate some weaknesses found in the study performed by Taylor and Todd (1995).

**Innovation Design Process Theory (IDPT)**

In 1991 Moore and Benbasat developed an attitude toward object ($A_O$) orientated instrument to measure "the various perceptions that an individual may have of adopting an information technology (IT) innovation" (1991, p. 192) that was based upon Roger's 1962 Innovation Design Process Theory (IDPT) that positited that certain factors influenced an individual's decision to adopt or reject an innovation (Rogers, 1962). Because other researchers however were "...unconvinced that measures of these variables... are independent of 'innovativeness' as the dependent variable" and that "A more precise definition of the variables as well as the use of factor analysis and other

techniques to arrive at independent measures are needed" (Wilkening, 1963, p. 416), Rodgers modified the theory over time. By 1982 Rogers identified five dependent or response variables those being relative advantage, compatibility, complexity, observability, and trialability (Rogers, 1982). Relative advantage, closely related to Davis' perceived usefulness scale (Moore & Benbasat, 1991, p. 197), was defined as "the degree to which an innovation is perceived as being better than its precursor" (Moore & Benbasat, 1991, p. 195). Compatibility was defined as "the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adapters" (Moore & Benbasat, 1991, p. 195). Complexity, closely related to Davis' perceived ease of use scale (Moore & Benbasat, 1991, p. 197), was defined as "the degree to which an innovation is perceived as being difficult to use" (Moore & Benbasat, 1991, p. 195). Observability was defined as "the degree to which the results of an innovation are observable to others" (Moore & Benbasat, 1991, p. 195), Trialability was defined as "the degree to which an innovation may be experimented with before its adaption" (Moore & Benbasat, 1991, p. 195). In 1991, Moore and Benbasat adapted Roger's variables converting complexity into ease of use while retaining its definition, splitting observability into results demonstrability and visibility, and adding the dependent or response variables of voluntariness and image (Moore & Benbasat, 1991). Image was defined as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore & Benbasat, 1991, p. 195). Voluntariness of use was defined as "the degree to which use of an innovation is perceived as being voluntary, or of free will" (Moore & Benbasat, 1991, p. 195). Visibility was defined as "the degree to which one can see others using the system"

(Moore & Benbasat, 1991, p. 195). Results demonstrability was defined as "the tangibility of the results of using the innovation, including their observability and communicability" (Moore & Benbasat, 1991, p. 203). Moore and Benbasat subjected the resulting eight scales to four rounds of category sorting by expert judges to verify convergent and discriminant validity and three field trials to ensure acceptable levels of reliability, performing factor analysis to ensure validity, and discriminant analysis between adaptor and non-adaptor responses (Moore & Benbasat, 1991). Moore and Benbasat reported inter-judge average agreement for the fours sorts as .83, .86, .75, and .85 and average Cohen's Kappa of .80, .83, .71, and .82 respectively (1991, p. 202), and calculated Cronbach's alpha coefficients for each scale for the field test with a sample size of 270 for each of the two samples. Results were .82 and .87 for voluntariness, .79 and .80 for image, .95 and .92 for relative advantage, .88 and .83 for compatibility, .81 and .80 for ease of use, .73 and .71 for trialability, .81 and .77 for results demonstrability, and .72 and .73 for visibility (Moore & Benbasat, 1991, p. 206). In summary, the unavailability of IDPT study results that used the instrument does not support using its variables to underpin the research that is the subject of this proposal.

**Social Cognitive Theory (SCT)**

In 1995, Compeau and Higgins extended Bandura's (1986) Social Cognitive Theory (SCT) to develop and validate a self-efficacy instrument to measure individuals beliefs about their ability to competently use computers (Compeau & Higgins, 1995). They defined computer self-efficacy as "a judgment of one's capability to use a computer" to apply skills to broader tasks that are defined by the "level of capability expected," called magnitude; the" level of conviction about the judgment," called

strength; and the "degree to which the judgment is limited to a single domain," called generalizability (Compeau & Higgins, 1995, p. 192). Revised dependent or response variables studied in the 14 hypothesis studied were encouragement by others, others use, support, computer self-efficacy, performance outcome expectations, personal outcome expectations, affect, anxiety, and use, with all measures exceeding .80 for internal consistency reliability (Compeau & Higgins, 1995, p. 201). Discussing affect and anxiety, SCT hypothesized that the higher the individuals liking for computer use, "the higher his/her use of computers" and that the higher the individuals computer anxiety, "the lower his/her use of computers" (1995, p. 197). 1020 respondents returned the instrument (1995) with data analysis providing "evidence of the construct validity of the computer self-efficacy measure. The scale demonstrated high internal consistency (reliability), empirical directness (discriminant validity), and was related as predicted to the other constructs (nomological) validity" (Compeau & Higgins, 1995, p. 204). In summary, Compeau and Higgins finding that "Affect and anxiety had a significant impact on computer use" (1995, p. 203), supports their inclusion as affective feelings (AF) variables to underpin the research that is the subject of this proposal.

**Computer Attitude Scale (CAS)**

In 1997, Selwyn reported development and administration of a Computer Attitude Scale (CAS) for measuring attitude toward using ($A_B$) computers that was theoretically "formulated within both the framework for assessing attitudes towards computers set out by Kay (1993) and Davis' (1993) Technology Acceptance Model" (Selwyn, 1997b, p. 36), and predicated upon "... Kay's (1993) structure of computer attitude <that> draws on the tripartite model of attitude (Breckler, 1984) and Ajzen's (1988) Theory of Planned

Behavior" (TPB) (Selwyn, 1997b, p. 36) as seen in Figure 9, CAS. In CAS, four constructs are used to base assessments of attitude. Selwyn initially grounded his scale within a framework measuring "... affect (feelings towards computers); cognition (perceptions and information regarding computers); conation or behavioural (behavioural intentions and actions with respect to computers); ... perceived behavioural control (perceived ease, or difficulty, of using computer's); <and> ... perceived usefulness (the degree to which an individual believes using computers will enhance their job performance)" (Selwyn, 1997b, p. 36).

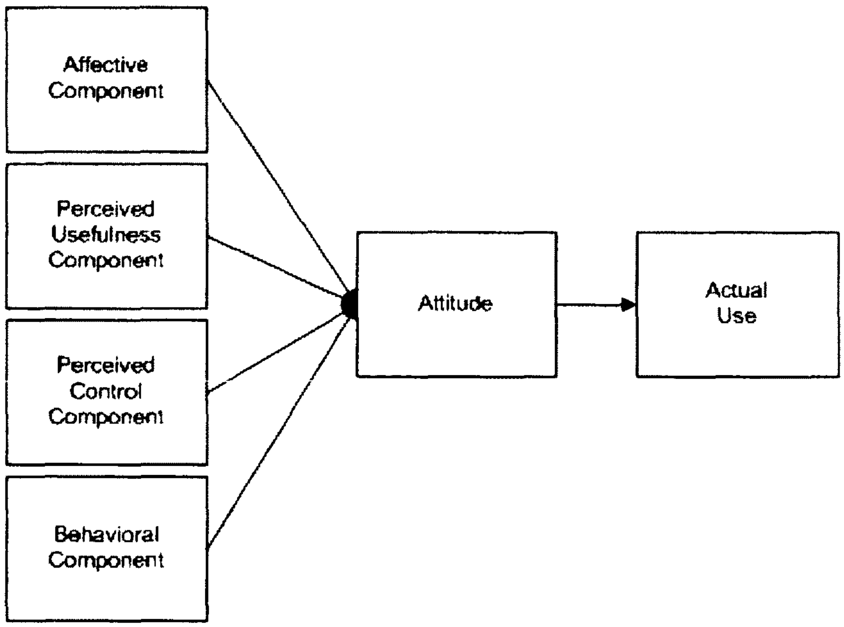


Figure 9. Computer Attitude Scale. Adapted from "Students' Attitudes Toward Computers: Validation Of A Computer Attitude Scale For 16-19 Education," by N. Selwyn, 1997, *Computers and Education*, (1), p. 36. Copyright 1997 by Pergamon.

Selwyn then created a pool of 49 items for the instrument by writing new items and adapting items from eight other scales. Those items underwent an (266 student sample) item number analysis, followed by a factor analysis that reduced the original 49 item in the inventory down to 21 items that had four independent underlying constructs (Selwyn, 1997b). The four surviving constructs shown in order at Table 1 were the

Affective Component (six items), the Perceived Usefulness Component (five items), the Perceived Control Component (six items) and the Behavioural Component (four items).

Table 1

*Retained Items on Selwyn's 1997 Scale Measuring Attitude Toward Computing*

| |
|---|
| AFF1 If given the opportunity to use a computer I am afraid that I might damage it in some way* |
| AFF2 I hesitate to use a computer for fear of making mistakes I can't correct* |
| AFF3 I don't feel apprehensive about using a computer |
| AFF4 Computers make me feel uncomfortable* |
| AFF5 Using a computer does not scare me at all |
| AFF6 I hesitate to use a computer in case I look stupid* |
| USE1 Computers help me organize my work better |
| USE2 Computers make it possible to work more productively |
| USE3 Computers can allow me to do more interesting and imaginative work |
| USE4 Most things that a computer can be used for I can do just as well myself* |
| USE5 Computers can enhance the presentation of my work to a degree that justifies the extra effort |
| CON1 I could probably teach myself most of the things I need to know about computers |
| CON2 I can make the computer do what I want it to |
| CON3 If I get problems using the computer, I can usually solve them one way or another |
| CON4 I am not in complete control when using a computer* |
| CON5 I need an experienced person nearby when using a computer* |
| CON6 I do not need someone to tell me the best way to use a computer |
| BEH1 I would avoid taking a job if I knew it involved working with computers* |
| BEH2 I avoid coming into contact with computers in college/school*+ |
| BEH3 I will only use computers at college/school when told to*+ |
| BEH4 I will use computers regularly throughout college/school*+ |

Selwyn marked reversal items, items that required inverting scale values for evaluation, with an asterisk and marked items that required use of one or the other term, depending upon the educational level of the participant, with a cross, presenting all items on a five-point interval response (Likert) scale labeled from "strongly agree" to "strongly disagree." Selwyn negatively worded ten items to preclude positive or negative response sets and placed construct items alternately to prevent a clustering effect. Selwyn administered the instrument to 87 students between 16 to 19 years of age, of whom 46%

were of the male gender and 54% were of the female gender, ranging in age from 16 to 19 years with no mean age indicated. Selwyn calculated Cronbach's coefficient alpha reliability "for each of the four sub-scales and the overall scale as a whole ... the alpha coefficients for all sub-scales ... significantly high; suggesting the internal consistency of the constructs and overall scale is satisfactory" (Selwyn, 1997b, p. 36). Re-administering the scale to the original sample two weeks after the pilot to calculate the co-efficient of stability for test-retest reliability, found "coefficients for all scales were high, with an overall Pearson's test-retest coefficient of $r=0.93$ ($P<0.001$)" (Selwyn, 1997b, p. 37). Review of CAS indicates that its Affective Component accounts for the affective feelings variables of affect and anxiety found in the SCT, MPCU, CAM, and SCT models and its Perceived Control Component accounts for the perceived control, perceived behavioral control, and perceived ease of use variables found in the TPB, CAM, C-TAM-TPB, MM, and IDPT models. The CAS Perceived Usefulness Component accounts for the perceived usefulness and relative advantage variables found in the TAM, MM, C-TAM-TPB, and IDPT models and its Behavioral Component accounts for the behavioral attitude toward a behavior, behavioral attitude toward an object and behavioral intention to perform a behavior variables found in the TRA, TPB, CAM, TAM, and C-TAM-TPB models.

In summary, CAS provides a reliable and valid attitude toward (computing) behavior ($A_B$) scale with good internal consistency, test-retest reliability and criterion validity (Selwyn, 1997b) that support the use of its four variable components constructs to underpin the research that is the subject of this proposal, limited only by its focus on computing behavior instead of gaming behavior.

**Technology Acceptance Model Two (TAM2)**

In early 2000, Venkatesh and Davis extended Davis' Technology Acceptance Model (TAM) to explain "... perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes" (2000, p. 186), naming the new theoretical model, seen in Figure 10, TAM 2. In TAM2 voluntariness, subject norm, and image are the social influence processes variables and job relevance, output quality, result demonstrability, and perceived ease are the cognitive instrumental processes. Subjective norm (SN), that had been deliberately omitted from the original TAM because it "...had no significant effect on intentions over and above perceived usefulness and ease of use" (Venkatesh & Davis, 2000, p. 187), is still defined as "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 302). Voluntariness (V) is defined slightly differently from earlier research that found it to be "the degree to which use of an innovation is perceived as being voluntary, or of free will" (Moore & Benbasat, 1991, p. 195) to the definition of "the extent to which potential adopters perceive the adoption decision to be non-mandatory" (Venkatesh & Davis, 2000, p. 188). Image (I) is still defined as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore & Benbasat, 1991, p. 195). Job relevance (JR) is defined as "an individual's perception regarding the degree to which the target system is applicable to his or her job" (Venkatesh & Davis, 2000, p. 191). Output quality (OQ) is defined as "how well the system performs those tasks" that "it is capable of performing" "over and ... the degree to which those tasks match their job goals (job relevance)" (Venkatesh & Davis, 2000, p. 191). Result demonstrability (RD) is still defined as "the tangibility of the results of using the innovation, including their observability and

communicability"(Moore & Benbasat, 1991, p. 203). Perceived ease of use (PEOU) is defined in TAM2 as it was for the TAM, that it is "the degree to which a person believes that using a particular system would be free of effort"(Davis, 1989, p. 320).

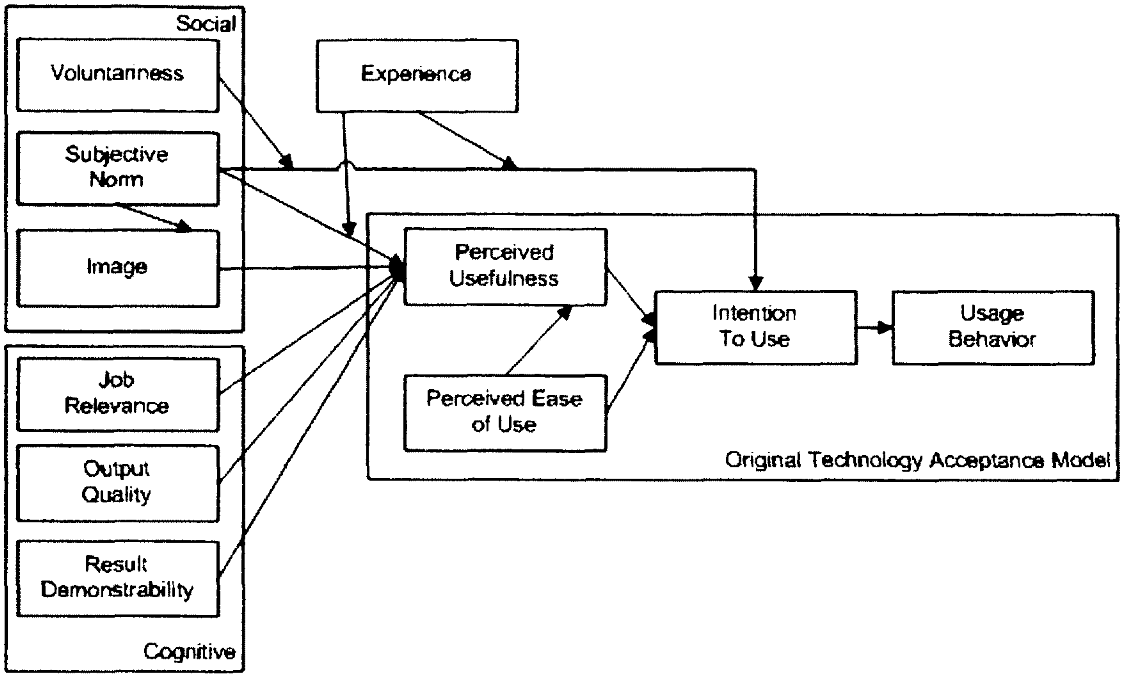


*Figure 10.* TAM2. Adapted from "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," by V. Venkatesh and F. D. Davis, 2000, *Management Science*, (2), p. 188. Copyright 2000 by the Institute for Operations Research and the Management Sciences.

Prior research by Taylor and Todd (1995), Moore and Benbasat (1991), and Davis et al., (1992) operationalized the TAM2 constructs for the 26 item instrument that they tested on 156 employees using longitudinal data on four different systems in four different organizations. Despite sample sizes of under 50 for all four studies and the use of only two items for four of the nine constructs, Venkatesh and Davis reported that TAM2 "... was strongly supported for all four organizations ... accounting for 40%- 60% of the variance in usefulness perceptions and 34%-52% of the variance in usage intention" (Venkatesh & Davis, 2000, p. 186). In summary, TAM2 extends TAM to try to explain

social influence (SN, V, and I) and cognitive instrumental processes (JR, OQ, RD, and PEOU) effects on perceived usefulness (PU) and behavioral intention (BI). It is however this degree of focus toward those social and cognitive variables, with the exception of PEOU, PU, and BI, that provides little support for their use to underpin the research that is the subject of this proposal.

**Adapted Technology Acceptance Model Two (A-TAM)**

In late 2000, Venkatesh separately adapted Davis' TAM, the adapted version here called A-TAM and as shown in Figure 11, to return to it the ability to measure attitude toward using a system specific or object orientated technology ($A_O$) that Davis, Bagozzi, and Warshaw (1989) deliberately omitted in their then final TAM model (Davis et al., 1989, pp. 995-996; Venkatesh, 2000, p. 343), that favored attitude toward a behavior ($A_B$). Differing with Davis, Bagozzi, and Warshaw (1989) belief that "workers' intentions were influenced by perceived usefulness; workers' intentions were slightly influenced by perceived ease of use; and the effects of beliefs on intentions were only partially mediated by attitudes" (Davis et al., 1989, p. 995), Venkatesh modified TAM to become "an anchoring and adjustment-based theoretical model of the determinants of system-specific perceived ease of use" (Venkatesh, 2000, p. 342). A-TAM added the anchor constructs of internal and external control, emotion and intrinsic motivation, and emotion to measure early perceptions of new system ease of use. The dependent or response variable for the emotion anchor construct is conceptualized as computer anxiety, that in this proposal is categorized as an affective feeling (AF), and as seen in Table 2, uses nine dependent variable responses. This computer anxiety construct that mixes $A_O$ and $A_B$ items resembles Selwyn's CAS Affective Component construct.

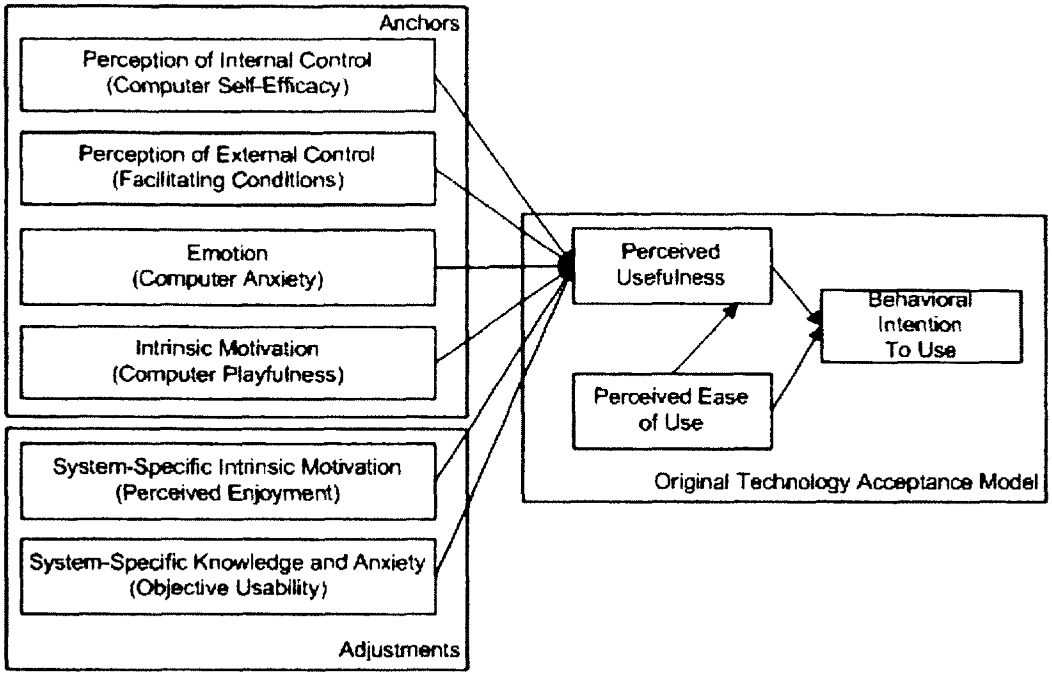


*Figure 11.* A-TAM. Adapted from "Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model," by V. Venkatesh, 2000, *Information Systems Research, 11*(4), p. 346. Copyright 2000 by the Institute for Operations Research and the Management Sciences.

Table 2

*A-TAM Survey Instrument Computer Anxiety Anchor Construct Items*

| |
|---|
| Computers do not scare me at all. |
| Working with a computer makes me nervous. |
| I do not feel threatened when others talk about computers. |
| It wouldn't bother me to take computer courses. |
| Computers make me feel uncomfortable. |
| I feel at ease in a computer class. |
| I get a sinking feeling when I think of trying to use a computer. |
| I feel comfortable working with a computer. |
| Computers make me feel uneasy. |

The dependent or response variables for the control anchor are internal control, conceptualized as computer self-efficacy (CSE), and external control, conceptualized as facilitating conditions (FC), and as seen in Table 3 uses five and ten dependent variable responses respectively. This perceived control construct that seems to focus on system

specific Ao items resembles Selwyn's CAS Perceived Control Component construct.

Table 3

*A-TAM Survey Instrument Perceived Control Anchor Construct Items*

| |
|---|
| **Perceptions of External Control (Facilitating Conditions)** |
| I have control over using the system. |
| I have the resources necessary to use the system. |
| I have the knowledge necessary to use the system. |
| Given the resources, opportunities, and knowledge it takes to use the system, it would be easy for me to use the system. |
| The system is not compatible with other systems I use. |
| **Perceptions of Internal Control (Computer Self-Efficacy)** |
| I could complete the job using a software package... |
| ... if there was no one around to tell me what to do as I go. |
| ... if I had never used a package like it before. |
| ... if I had only the software manuals for reference. |
| ... if I had seen someone else using it before trying it myself. |
| ... if I could call someone for help if I got stuck. |
| ... if someone else had helped me get started. |
| ... if I had a lot of time to complete the job for which the software was provided. |
| ... if I had just the built-in help facility for assistance. |
| ... if someone showed me how to do it first. |
| ... if I had used similar packages before this one to do the same job. |

The dependent or response variable for the intrinsic motivation anchor is conceptualized as computer playfulness (CP) and as seen in Table 4, uses seven dependent variable responses.

Table 4

*A-TAM Survey Instrument Computer Playfulness Anchor Construct Items*

| |
|---|
| The following questions ask you how you would characterize yourself when you use computers: |
| ... spontaneous |
| ... unimaginative |
| ... flexible |
| ... creative |
| ... playful |
| ... unoriginal |
| ... uninventive |

Venkatesh expected that over time "system-specific perceived ease of use, while still anchored to the general beliefs regarding computers and computer use, will adjust to reflect objective usability, perceptions of external control specific to the new system environment, and system-specific perceived enjoyment" (Venkatesh, 2000, p. 342). Venkatesh added two adjustments constructs of perceived enjoyment (E) and objective usability (OU) to measure later perceptions of new system ease of use. The objective usability adjustment dependent or response variable "was measured as a ratio of time spent by the subject to the time spent by an expert on the same set of tasks" (Venkatesh, 2000, p. 361) while the dependent or response variable for the perceived enjoyment adjustment, as seen in Table 5, uses three dependent variable responses.

Table 5

*A-TAM Survey Instrument Perceived Enjoyment Adjustment Construct Items*

| |
|---|
| I find using the system to be enjoyable. |
| The actual process of using the system is pleasant. |
| I have fun using the system. |

Although Venkatesh positited anchors and adjustments helped determine perceived ease of use (PEOU), the A-TAM instrument directly measured perceived ease of use and perceived usefulness (PU) that supported behavioral intention to use, that A-TAM also directly measured, as seen in Table 6. This PEOU, PU, and BI construct that seems to mix $A_O$ and $A_B$ items resembles Selwyn's CAS Perceived Control, Perceived Usefulness and Behavioral Component constructs respectively. With all constructs satisfying reliability and discriminant validity criterion, three longitudinal field studies measured user reaction to voluntary use, perceived voluntariness measured to 6.0 on a 7.0 scale (Venkatesh, 2000), for three different new systems.

Table 6

*A-TAM Survey Instrument Perceived Ease of Use, Usefulness and Behavioral Intention Items*

| |
|---|
| **Perceived Ease of Use** |
| My interaction with the system is clear and understandable. |
| Interacting with the system does not require a lot of my mental effort. |
| I find the system to be easy to use. |
| I find it easy to get the system to do what I want it to do. |
| **Perceived Usefulness** |
| Using the system improves my performance in my job. |
| Using the system in my job increases my productivity. |
| Using the system enhances my effectiveness in my job. |
| I find the system to be useful in my job. |
| **Behavioral Intention to Use** |
| Assuming I had access to the system, I intend to use it. |
| Given that I had access to the system, I predict that I would use it. |

Venkatesh found significant support that the attitude toward a system specific computer object (Ao) modified TAM determinants "of perceived ease of use with the hypothesized determinants playing a role as expected over time with increasing experience with the target system" (2000, p. 355), explaining up to 60% of the variance in perceived ease of use (2000, p. 357). The utility of the A-TAM is that the anchor knowledge gained should allow fostering adjustment of an individual's perceived ease of use perceptions that had formed prior to direct experience with the system, with increasing experience of a system allows individuals to further adjust. Tellingly, Venkatesh "found an individual's general beliefs regarding computers were the strongest determinants of system-specific ease of use, even after significant direct experience with the target system" (Venkatesh, 2000, p. 360). In summary, despite the mix of items, A-TAM extended TAM back into measuring attitude toward using a system specific computer object (Ao) instead of attitude toward a

behavior ($A_B$), providing little support for its newer variables use to underpin the research that is the subject of this proposal.

**Unified Theory of Acceptance and Use of Technology (UTAUT)**

In 2003, Venkatesh, Morris, Davis, and Davis (2003) reported development and testing of their Unified Theory of Acceptance and Use of Technology (UTAUT) model shown at Figure 12 intended to provide "... a useful tool for managers needing to assess the likelihood of success for new technology introductions... (Venkatesh et al., 2003, p. 425)" and to help those managers understand what drives individual acceptance of new technology. Venkatesh, Morris, Davis, and Davis reviewed Fishbein and Ajzen's (1975) Theory of Reasoned Action, Ajzen's (1991) Theory of Planned Behavior, Davis' (1989) Technology Acceptance Model, Thompson, Higgins, and Howell's (1991) Model of PC Utilization, Davis, Bagozzi and Warshaw's (1992) Motivational Model, Taylor and Todd's (1995) Combined TAM and TPB Model, Rogers (1995) Innovation Diffusion Theory, and Compeau and Higgen's (1995) model that extended Bandura's (1986) Social Cognitive Theory. In UTAUT the four core determinants of intention and usage are performance expectancy, effort expectancy, social influence, and facilitating conditions; the four key moderators are gender, age, voluntariness, and experience; and attitude toward using technology, self- efficacy, and anxiety are not direct determinants of behavior. Venkatesh, Morris, Davis, and Davis compared the eight models and their extensions using data from four organizations, determining that the eight models "...explained between 17 percent and 53 percent of the variance in user intentions to use information technology" (Venkatesh et al., 2003, p. 425). From their analysis of these results, the authors developed the model (Venkatesh et al., 2003). Performance

expectancy (PE) is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al., 2003, p. 447) and is composed of five constructs from the different models that are "...perceived usefulness (TAM/TAM2 and C-TAM-TPB), extrinsic motivation (MM), job-fit (MPCU), relative advantage (IDT), and outcome expectations (SCT)" (Venkatesh et al., 2003, p. 447).

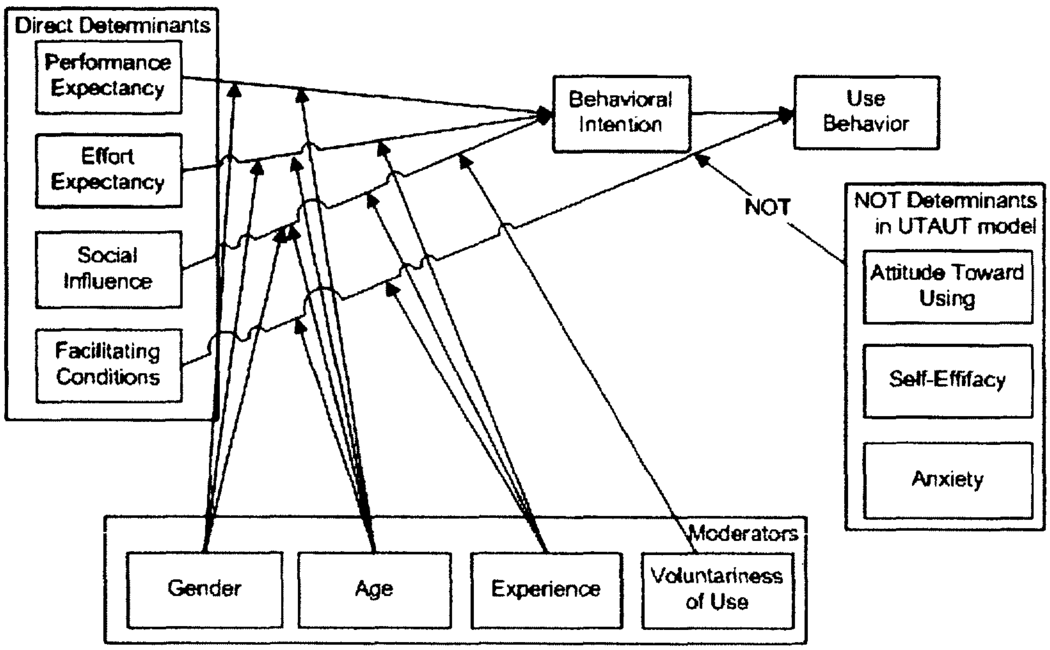


*Figure 12.* UTAUT. Adapted from " User Acceptance of Information Technology: Toward a Unified View," by V. Venkatesh, 2003, *MIS Quarterly*(3), p. 425. Copyright 2003 by the Society for Management Information Systems and Management Information Systems Research Center of the University of Minnesota.

Effort expectancy is defined as "the degree of ease associated with the use of the system" (2003, p. 450) and is composed of three constructs from the different models that are "...perceived ease of use (TAM/TAM2), complexity (MPCU), and ease of use (IDT)" (2003, p. 450). Social influence is defined as "the degree to which an individual perceives that important others believe he or she should use the new system" (2003, p. 452) and is composed of the three constructs from the different models that are "... subjective norm in

TRA, TAM2, TPB/DTPB and C-TAM-TPB, social factors in MPCU, and image in IDT" (2003, p. 452). Facilitating conditions is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (2003, p. 453) and is composed of the three constructs from the different models that are "... perceived behavioral control (TPB/ DTPB, C-TAM-TPB), facilitating conditions (MPCU), and compatibility (IDT)" (2003, p. 453). The UTAUT authors excluded the self-efficacy construct that measures a person's belief in his or her capability to perform the behavior required to produce an outcome and anxiety as determinants of intention and usage based on previous research of Venkatesh (2000). In that previous research Venkatesh predicted those self-efficacy beliefs are "empirically distinct from effort expectancy (perceived ease of use)... modeled as indirect determinants of intention fully mediated by perceived ease of use ... distinct from effort expectancy and have no direct effect on intention above and beyond effort expectancy" (2003, p. 455). Attitude toward technology, defined as "an individual's overall affective reaction to using a system"(2003, p. 455) is composed of the four constructs from the different models that are "... attitude toward behavior (TRA, TPB/DTPB, C-TAM-TPB), intrinsic motivation (MM), affect toward use (MPCU), and affect (SCT)" (Venkatesh et al., 2003, p. 455). Because the authors found the attitude construct during UTAUT analysis was the strongest predictor of behavioral intention is some cases such as TRA, TPB/DTPB, and MM, but not significant in others, such as TAM-TPB, MPCU, and SCT, they attributed the difference in predictive ability to the absence of performance and effort expectancies (Venkatesh et al., 2003). Thus, they, perhaps prematurely because it is contrary to TRA and TPB/DTPB theory, declared "any observed relationship between attitude and

intention to be spurious and resulting from the omission of the other key predictors (specifically, performance and effort expectancies)" (Venkatesh et al., 2003, p. 455) . The final UTAUT instrument used the dependent variable constructs shown at Table 7 was stated to outperform the original eight models "providing strong empirical support for UTAUT ... accounting for 70% of the variance ... in user intention - a substantial improvement over any of the eight models or their extensions" (Venkatesh et al., 2003, p. 467). For the four direct determinants, performance expectancy "varied with gender and age ... more significant for men and younger"; effort expectancy "also moderated by gender and age ... more significant for women and older" ; social influence "nonsignificant ... without inclusion of moderators" and facilitating conditions "only matter for older workers in later stages of experience" (Venkatesh et al., 2003, p. 467). A review of the variable items in the UTAUT Performance Expectancy construct that uses Ao items finds that it resembles Selwyn's CAS Perceived Usefulness Component construct. Similarly, the variable items in the UTAUT Effort Expectancy construct that uses Ao items finds that it resembles Selwyn's CAS Perceived Control Component construct. The variable items in UTAUT's Anxiety construct differ most from Selwyn's CAS Affective Component construct in that they are Ao items and UTAUT subordinates them within the Behavioral Intention to Use the System construct, that when UTAUT's Attitude Toward Using Technology construct is added, resembles Selwyn's CAS Behavioral Component construct. UTAUTs Social Influence, Facilitating Condition, and Self-Efficacy constructs are dissimilar from CAS.

Table 7

*Venkatesh et al. 2003 Scale Measuring User Acceptance of Information Technology*

**Performance Expectancy**

01 U6 I would find the system useful in my job.

02 RA1 Using the system enables me to accomplish tasks more quickly.

03 RA5 Using the system increases my productivity.

04 OE7 If I use the system, I will increase my chances of getting a raise.

**Effort Expectancy**

05 EOU3 My interaction with the system would be clear and understandable.

06 EOU5 It would be easy for me to become skillful at using the system.

07 EOU6 I would find the system easy to use.

08 EU4 Learning to operate the system is easy for me.

**Attitude Toward Using Technology**

09 A1 Using the system is a bad/good idea.

10 AF1 The system makes work more interesting.

11 AF2 Working with the system is fun.

12 Affect1 I like working with the system.

**Social Influence**

13 SN1 People who influence my behavior think that I should use the system.

14 SN2 People who are important to me think that I should use the system.

15 SF2 The senior management of this business has been helpful in the use of the system.

16 SF4 In general, the organization has supported the use of the system.

**Facilitating Conditions**

17 PBC2 I have the resources necessary to use the system.

18 PBC3 I have the knowledge necessary to use the system.

19 PBC5 The system is not compatible with other systems I use.

20 FC3 A specific person (or group) is available for assistance with system difficulties.

**Self-Efficacy**

I could complete a job or task using the system if

21 SE1... there was no one around to tell me what to do as I go.

22 SE4 ... I could call someone for help if I got stuck.

23 SE6 ... I had a lot of time to complete the job for which the software was provided.

24 SE7 ... I had just the built-in help facility for assistance.

**Anxiety**

25 ANX1 I feel apprehensive about using the system.

26 ANX2 It scares me to think that I could lose a lot of information using the system by hitting the wrong key.

27 ANX3 I hesitate to use the system for fear of making mistakes I cannot correct.

28 ANX4 The system is somewhat intimidating to me.

**Behavioral Intention To Use The System**

29 BI1 I intend to use the system in the next <n> months.

30 BI2 I predict I would use the system in the next <n> months.

31 BI3 I plan to use the system in the next <n> months

In 2013, Taiwo and Downe, stating that "in terms of statistical significant magnitude and direction, reports on the model are diverse" (Taiwo & Downe, 2013, p. 48), performed a review of 37 studies related to UTAUT and performed a meta-analysis of empirical findings in 15 UTAUT studies conducted between 2001 and 2011. Taiwo and Downe used meta-analysis inclusion criteria adapted from Ma and Liu (Ma & Liu, 2004) that required the paper be a behavioral study, involve technology investigation, directly or indirectly empirically test UTAUT, report correlation co-efficient or values that could be so correlated, report sample size, and be published after 2003 (Taiwo & Downe, 2013). Taiwo and Downe examined in the studies only the six variables of performance expectancy, effort expectancy, social influence, facilitating conditions, behavioral intention, and use behavior that Venkatesh found to have significant effect (Taiwo & Downe, 2013; Venkatesh et al., 2003). Taiwo and Downe found that for UTAUT "that only the relationship between performance expectancy and behavioral intention is strong ... the relationships between effort expectation, social influence, and behavioral intention are weak. Similarly, the relationship between effort facilitating condition, behavioral intention, and use behavior is also weak" (Taiwo & Downe, 2013, p. 48). Because Taiwo and Downe found in many UTAUT studies small sample sizes, insufficient measurement statistics and that "UTAUT theory is merely cited in many article but not actually used" (2013, p. 55), they recommend future studies include use of the T-test and other statistical methods. In summary, studies do not support the theory that UTAUT is the only, or even the leading, "... tool for managers needing to assess the likelihood of success for new technology introductions... (Venkatesh et al., 2003, p. 425)," especially when trying to measure attitude toward a behavior ($A_B$) such as gaming

or computing instead of a system specific object (Ao) such as a particular game or computer.

**Bonanno and Kommers Scale Measuring Attitude toward Instructional Gaming**

In 2008, Bonanno and Kommers, finding no previous research investigation into learners' attitude to gaming, developed their instrument based upon the constructs identified by Kay's (1993) CAM research, Davis' (1993) TAM research, and Selwyn's (1997b) CAS research that resulted in the research model seen at Figure 13.

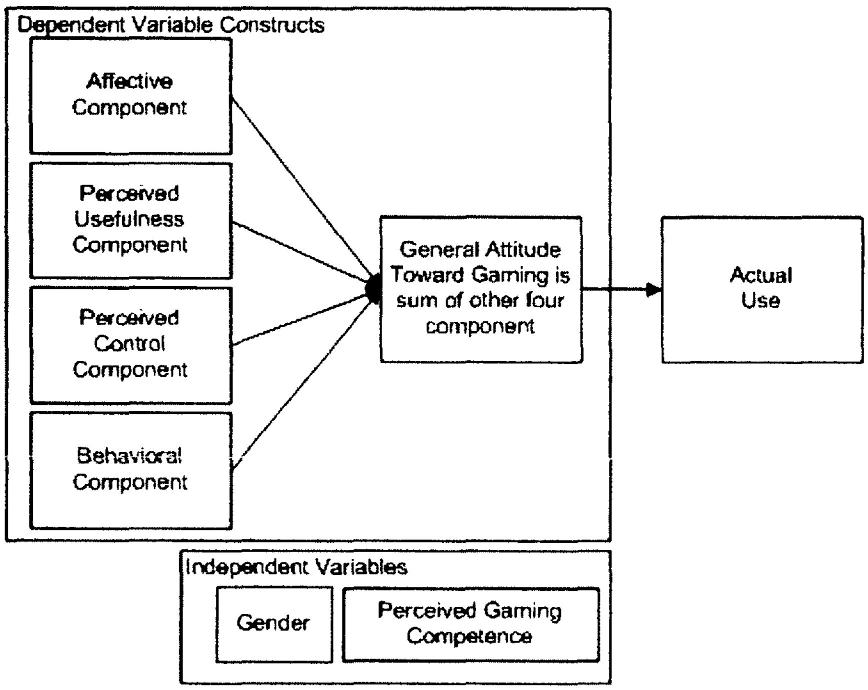


*Figure 13.* Bonanno and Kommers study. Adapted from "Exploring the Influence of Gender and Gaming Competence on Attitudes Towards Using Instructional Games," by P. Bonanno and P. Kommers, 2008, *British Journal of Educational Technology*, (1), p. 106. Copyright 2008 by Blackwell Publishing Ltd.

In Bonanno and Kommers study, Selwyn's four CAS dependent variable constructs are collected and summed to determine General Attitude Toward Gaming with gender and age being the independent variables. Bonanno and Kommers (2008) instrument incorporated from Kay (1993) and Davis (1993) their components of affect (feelings

towards computers), cognition (perceptions and information regarding computers), conation or behavioural (behavioural intentions and actions with respect to computers), perceived behavioural control (perceived ease, or difficulty, of using computers), and perceived usefulness (the degree to which an individual believes using computers will enhance their job performance). Like Selwyn (1997b), Bonanno and Kommers' (2008) instrument shown at Table 8 marked reversal items that required inverting scale values for evaluation with an asterisk.

Table 8

*Bonanno and Kommers 2008 Scale Measuring Attitude toward Instructional Gaming*

| |
|---|
| 01 A1 Given the opportunity to use a game such as Empire Earth or SIMS, I am afraid that I might have trouble in navigating through it.* |
| 02 U1 Games help me relax and thus do my work better.* |
| 03 C1 I could probably teach myself most of the things I need to know about games.* |
| 04 B1 I would avoid learning a topic if it involves Games. |
| 05 A2 I hesitate to use a game in case I look stupid. |
| 06 U2 Games can enhance the learning experience to a degree which justifies the extra effort. |
| 07 C2 I am not in complete control when I use a computer for games. |
| 08 A3 I don't feel uneasy about using a game. |
| 09 C3 I can make the computer do what I want it to do while playing a Game.* |
| 10 B2 I only use games when told to.* |
| 11 C4 I need an experienced person nearby when I'm using a game.* |
| 12 A4 Playing games does not scare me at all.* |
| 13 U3 Most things that one can get from a game can be obtained or arrived at through other means. |
| 14 B3 I avoid playing games. 0.001* |
| 15 C5 If I get problems using a game, I can usually solve then one way or the other.* |
| 16 A5 I hesitate to use a computer for playing games as I'm afraid of making mistakes I can't correct.* |
| 17 U4 Games provide more interesting and imaginative ways for learning. |
| 18 B4 I will use games regularly throughout school/college.* |
| 19 C6 I do not need somebody to tell me the best way to use a game. |
| 20 A6 Games make me feel uncomfortable.* |
| 21 U5 Games make it possible to learn more productively. |

It drew from the validated work of Selwyn (1997b), using the same four dependent variable constructs, that is the Affective Component ("A" - six items), the Perceived Usefulness Component ("U" - five items), the Perceived Control Component ("C" - six items) and the Behavioural Component ("B" - four items), shown in order of presentation on their instrument. Bonanno and Kommers administered their instrument to 170 Maltese college biology students to assess their five dependent variables consisting of the four components of attitude towards gaming – affective components, perceived control, perceived usefulness, behavioral components, and the computed variable of the sum of the four components, against the independent variables of gender and perceived gaming competence. Their research questions asked is there any gender-related difference regarding (1) the four attitudinal components or (2) general attitude toward gaming and (3) is there any relation between gaming competence and attitude towards gaming. Of the 170 students in the sample, selected from a larger 367-person sample of college Biology students, 66.5% were of the male gender and 33.5% were of the female gender, ranging in age from 16 to 18 years with mean age not determined. Bonanno and Kommers (2008) found significant gender differences in the four components of attitude towards gaming and in the general attitude toward gaming, with men more positive. They also found enthusiastic gamers more favorable than moderate or non-gamers, in declining order. Bonanno and Kommers stated that "...promoting a pedagogy that integrates gaming with learning is a gradual process that takes time and that passes through various stages involving a process of attitudinal change" (2008, p. 98). Bonanno and Kommers continued that because "...attitudes are a function of beliefs, learners and teachers will only use games for learning if they come to believe that gaming leads to positive task and

person-oriented outcomes. Those who believe that gaming leads to negative outcomes, such as decreased...performance... will definitely develop critical attitudes" (2008, p. 98). Because the data does not indicate if the 170 students were randomly selected from the larger 367-person sample volunteer and small sample size biases may exist. Bonanno and Kommers state the instrument requires "...further refinement and validation in order to ensure reliability and construct validity" (2008, p. 106). A potential population limitation of extending their results to the U.S. Army was that Bonanno and Kommers used college students instead of adults. Neither did they examine attitude towards games as serious as those used by the U.S. Army, the purpose of which is to train Soldiers to wage war.

In summary Ajzen and Fishbein stated "Individuals will intend to perform a behaviour when they evaluate it positively and when they believe that important others think they should perform it" (1980, p. 6) and that "...to predict a single behaviour we have to assess the person's attitude toward the behaviour and not his attitude toward the target at which the behaviour is directed" (1980, p. 27). In 1993, Kay developed the Computer Attitude Measure (CAM) to measure attitude toward the use of computer systems (Kay, 1993) and Davis developed the Technology Acceptance Model (TAM) to measure the causal relationships between system design features, perceived usefulness, perceived ease of use, attitude toward using, and actual usage behavior (Davis, 1993). In 1995, Rogers maintained in his Innovation Decision Process Theory that people's attitudes towards a new technology are a key element in its diffusion (1995). In 1997, building upon Kay's CAM, Davis' TAM, and Ajzen's theory of Planned Behavior (Ajzen, 1988), Selwyn developed the Computer Attitude Scale (CAS) for measuring attitude toward computers. In 2008, Bonanno and Kommers extend Ajzen's and Fishbein's 1980

argument, stating it is a fallacy to assign "attitudes towards objects, in this case digital games, as this limits the prediction of the overall pattern of behaviour and understanding of particular actions with respect to the object" (2008, p. 98). Building upon this research base and Kay's CAM, Davis' TAM, and Selwyn CAS instruments, Bonanno and Kommers developed their instrument to "... measure, not attitude to games (as objects), but attitude towards gaming (the behaviour)" (2008, p. 98). Thus, if attitudes are "states that are based on aggregates of beliefs and that develop into patterns of stable individual differences" (Snow, Corno, & Jackson, 1996, p. 290), and changing individuals' behaviour is possible once their attitudes have been identified, (Zimbardo, Ebbesen, & Maslach, 1977), and social behaviour can be predicted if attitudes are understood (Ajzen & Fishbein, 1980), then understanding the influence of learner factors on Soldier's general attitude towards Army Serious Gaming is important.

# CHAPTER III

## Method

### Population and Sample

Participants were 709 active duty male and female U.S. Army Soldiers. Because the total Army population size was over a million, it was impractical to query them all. This study drew its sample from the over 300,000 Soldiers who log into Army Knowledge Online (AKO), the Army's intranet, at least once a week. Based upon previous work (Krejcie & Morgan, 1970), this study required a sample population size of at least 384 to obtain a confidence level of 95% for the actual 31 December 2014 population of 498,642 active duty Soldiers - for a .05 confidence interval. The selection strategy was that at the start of the study window period, upon logging into the AKO home page, it presented a question to active duty commissioned, non-commissioned, and enlisted Soldiers that asked them to participate in a short survey to obtain their attitudes on Army serious gaming use. Answering yes routed the Soldier to the on-line instrument.

### Research Variables

The researcher, as part of a qualitative research graduate class in preparation for this research, conducted unpublished research that included a very small pilot in 2010. Primarily a qualitative study that investigated what independent variable learner factors might influence general attitude to using serious games, the study also investigated Bonanno and Kommers (2008) dependent variable constructs underlying utility and validity using primarily qualitative techniques with some quantitative aspects. The Selwyn (1997b) research, the Bonanno and Kommers (2008) research, and this researcher's 2010 unpublished research techniques and findings, are discussed in the

appropriate sections that follow.

***Dependent variables***

The dependent variable general attitude toward Army serious gaming is comprised of the sum of Selwyn's four dependent variable components of attitude that are the affective component, the perceived control component, the perceived usefulness component, and the behavioral component constructs. The affective component measures feelings of fear, hesitation, and uneasiness towards the use of ASG. The perceived control component measures feelings and reactive behaviors while manipulating ASG. The perceived usefulness component measures behaviours arising from beliefs about the advantages of using ASG for training. The behavioral component measures the positive behavior of willingness to use ASG for learning and the negative behavior of tending to avoid the use of ASG for learning. Selwyn's (1997b) development of these variables through the use of Exploratory Factor Analysis (EFA), and the modifications to them by Bonanno and Kommers (2008) and this researcher, must be understood first before explaining the independent variables of gender, age, education level, military class, and perceived gaming competence, that may control them, that are discussed later.

Factor analysis "represents a complex array of structure-analyzing procedures used to identify the interrelationships among a large set of observed variables and then, through data reduction, to group a smaller set of these variables into dimensions or factors that have common characteristics..." (Pett, Lackey, & Sullivan, 2003, p. 2). Factor analysis is such a complex and labor-intensive task that before the advent of computers, "simply performing a factor analysis was often sufficient to obtain a Ph.D." (Steiger, 1996, p. 617). Therefore before proceeding, it is necessary to briefly explain

factor analysis and Selwyn's (1997b) success at it that underpins this research effort.

A factor is a "linear combination or cluster of related observed variables that represents a specific underlying dimension of a construct, that is as distinct as possible from the other factors in the solution..." (Pett et al., p. 2). Factor analysis can be "used for theory and instrument development and assessing construct validity of an established instrument when administered to a specific population. Once the internal structure of a construct has been established, factor analysis can also be used to identify external variables... that appear to relate to the various dimensions of the construct of interest..." (Pett et al., p. 3). The most prevalent form of factor analysis is Exploratory Factor Analysis (EFA), used when the "researcher does not know how many factors are necessary to explain the inter-relationships among a set of characteristics, indicators, or items..." to "explore the underlying dimensions of the construct of interest" (Pett et al., p. 3). Pett et al. (2003, p. 11) define the steps of EFA as specify the problem, generate the items and initially test the instrument, assess the adequacy of the correlation matrix, extract the initial factors, rotate the factors, refine the solution, interpret the findings, and report and replicate the results. EFA requires measurement, the process of assigning "numbers to objects, events, or situations in accord with some rule" (Kaplan, 1964, p. 177), and instrumentation, a component of measurement, defined as "the development of a measurement device – scale, instrument, test or tool- - following specific rules of psychometrics" (Pett et al., p. 14).

The remainder of this dependent variable section concentrates on Selwyn's EFA, providing additional EFA explanatory material as needed, and explaining minor modifications made for this research with the rational for the changes and the analytical

results from this research that demonstrated no loss of validity due to the modifications.

Selwyn specified the EFA problem as, "the strong need... to be aware of student's attitudes toward using" computer technology requiring "development of an instrument for measuring the attitudes toward" computer use. Because a "fundamental outcome measure of students' computer use is their attitude toward using the technology," for students that "find themselves free to choose whether... to continue to use IT," their attitudes "will have a very strong influence on their future pattern of IT use" (1997b, p. 35).

For this research, the problem is the need to inform the Army of learner demographic factors that influence Soldier's general attitude toward the use of Army serious gaming for instructional purposes, because understanding these attitudes should help the Army to tailor serious game pedagogical design where possible or make different training investments where it is not possible.

Selwyn generated the initial 49 item norm-referenced pool following Likert's example "by both writing new items and adapting items from available scales... covering subjects' affective responses toward using computers; cognitive attitudes toward using computers both in college and in work; perceived usefulness; perceived control and behavioural attitudes toward using computers both in college and in work" (1997b, p. 36). The 49-item initial size for four factors is well within the Pett, et al. guidance for "10-15 initial items per suspected sub-scale" (Pett et al., p. 45) for Likert scale items. Selwyn's Likert values ranged from Strongly Agree to Strongly Disagree. Selwyn initially tested the 49-item instrument on 266 students. That figure falls between the 200-subject figure Comrey and Lee (1992), ascribe "fair" adequacy to and the 300-subject figure they ascribe "good" adequacy to, being closer to good than to fair.

This 2015 research's 709 respondents sample size fell between the 500-subject figure Comrey and Lee (1992), ascribe "very good" adequacy to and the 1000-subject figure that they ascribe "excellent" adequacy to. For the 2010 research that preceded it, the 21 Likert scale items Selwyn concluded with shown in Table 1 in the literature review, that Bonanno and Kommers (2008) slightly modified as shown in Table 8 in the literature review, were modified slightly further based on qualitative research methods in unpublished research in 2010. The concept analysis phase of factor analysis can, and often should, benefit from qualitative methods that "study fact, observations, and experiences that can be used as empirical indicators when developing an instrument… for conceptualizing and operationalizing constructs" (Pett et al., 2003, p. 25) that are not visible, such as attitude. For that reason, this 2010 research used both the phenomenology and focus group qualitative research methods to determine the empirical indicators that demonstrated the existence of the attitude phenomena in question. The perceptions of (independent variable) learner factors that may influence attitude toward the use of serious military games were obtained from first a focus group and later from several professional instructional designers. The instructional designer's perceptions of the attitudinal dependent variables within the Bonanno and Kommers instrument, that was slightly modified from Selwyn's instrument (1997b), were also obtained and analyzed. The Consensual Qualitative Research (CQR) technique was used to obtain their perceptions, with the interviews recorded, transcribed verbatim, and then coded and analyzed using the Max QDA software tool. This section will very briefly discuss this 2010 qualitative research's findings regarding the dependent variable data with additional dependent variable finding and independent variable finding discussed in the instrument

design section.

Within the qualitative research in 2010, as shown in table 9, the CQR coding of the CQR Tradition domain annotated the categories of participant's consensus on theories, the presence of relevant personnel experiences, and the presence of relevant shared experiences (with other participants). The CQR coding of the CQR Post-positivism Paradigm domain annotated the categories of participant's evaluation (good or bad) of relevant personnel experiences, their perception (less or more plausible) of claims, their understanding (did or did not) of the topic being discussed, and if they perceived a universal truth in a statement.

Table 9

*CQR Coding of the Tradition and Post-positivism Paradigm Domains*

| Code | Description |
|---|---|
| Code System | |
| CQR Tradition | |
| CQR Theories | |
| CQR Consensus<br>Consensus No<br>Consensus Yes | Evaluated coded section for consensus between CQR researchers; Yes or No indicates if consensus on coded section was, or was not, observed. |
| CQR Experience | |
| CQR Personal Experience<br>Personal Experience Yes<br>Personal Experience No | Evaluated coded section for relevant personal experiences of CQR researchers; Yes or No indicates if relevant personal experience was, or was not, observed. |
| CQR Shared Experience<br>Shared Yes<br>Shared No | Evaluated coded section for relevant shared experiences between CQR researchers; Yes or No indicates if relevant shared experience was, or was not, observed. |
| Post-positivism Paradigm | |
| PPP Experience<br>Bad Experience<br>Good Experience | Evaluated coded section for good or bad experiences of CQR researchers; Bad or Good indicates if the experience was, or was not evaluated to be such. |
| PPP Perception<br>Less Plausible Claim<br>More Plausible Claim | Evaluated coded section for more or less plausibility per CQR researchers; More or Less indicates if the claim (usually a theory) was, or was not evaluated to be such. |
| PPP Understanding<br>Did Not Understand<br>Did Understand | Evaluated coded section as to whether the CQR researcher initially understood the question or concept; Did or Did Not indicates if he or she did initially understood it. |
| PPP Universal Truth<br>Is a UT<br>Is not a UT | Evaluated coded section for CQR researchers expression of a universal truth; Is or Is Not indicates if the coded section was, or was not evaluated to be such. |

Within the qualitative research in 2010, as shown in table 10, the CQR coding of the Instrument (Influences on Attitude) domain annotated participant opinions of Bonanno and Kommers instrument's categories of the affective, behavioral, perceived

control, and perceived usefulness components construct validity.

Table 10

*CQR Coding of the Instrument (Influences on Attitude) Domain*

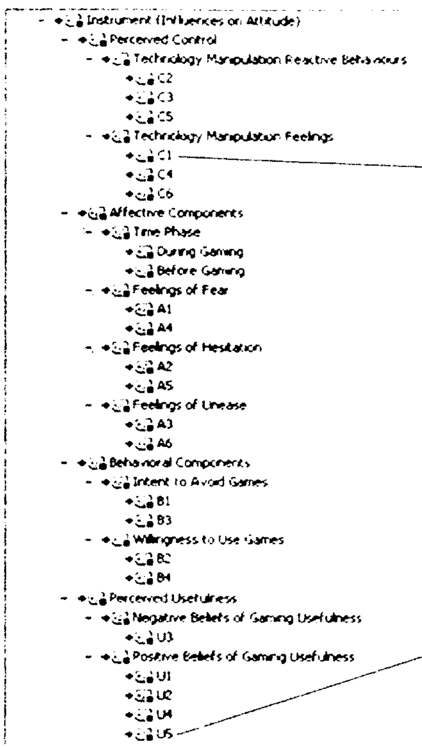


*Table 2: Statistical data for the 21 separate variables*

| Statement | | |
|---|---|---|
| *No* | *Code* | *Description* |
| **1** | **$A_1$** | **Given the opportunity to use a game such as *Empire Earth* or *SIMS*. I am afraid that I might have trouble in navigating through it.** |
| 2 | $U_1$ | Games help me relax and thus do my work better. |
| 3 | $C_1$ | I could probably teach myself most of the things I need to know about games. |
| **4** | **$B_1$** | **I would avoid learning a topic if it involves Games.** |
| **5** | **$A_2$** | **I hesitate to use a game in case I look stupid.** |
| 6 | $U_2$ | Games can enhance the learning experience to a degree which justifies the extra effort. |
| 7 | $C_2$ | I am not in complete control when I use a computer for games. |
| 8 | $A_3$ | I don't feel uneasy about using a game. |
| 9 | $C_3$ | I can make the computer do what I want it to do while playing a Game. |
| **10** | **$B_2$** | **I only use games when told to.** |
| **11** | **$C_4$** | **I need an experienced person nearby when I'm using a game.** |
| 12 | $A_4$ | Playing games does not scare me at all. |
| **13** | **$U_3$** | **Most things that one can get from a game can be obtained or arrived at through other means.** |
| **14** | **$B_3$** | **I avoid playing games.** |
| 15 | $C_5$ | If I get problems using a game. I can usually solve then one way or the other. |
| **16** | **$A_5$** | **I hesitate to use a computer for playing games as I'm afraid of making mistakes I can't correct.** |
| 17 | $U_4$ | Games provide more interesting and imaginative ways for learning. |
| 18 | $B_4$ | I will use games regularly throughout school/college. |
| 19 | $C_6$ | I do not need somebody to tell me the best way to use a game. |
| **20** | **$A_6$** | **Games make me feel uncomfortable.** |
| 21 | $U_5$ | Games make it possible to learn more productively. |



As shown at table 11 the general judgments for this pilot of the Instrument (Influences on Attitude) domain were that all items in all categories were agreed to establish a relationship between the operationalized attitude concept and the learner factors. For this quantitative part of the 2010 research, each participant used a three point Likert scale to rate each hypotheses on whether a potential learner factor did (yes), did not (no), or might (maybe) establish a relationship between the operationalized attitude concept and the four attitude factors under examination. An evaluation then determined the degree of agreement. General agreement means agreement in all or all but one of the cases, there being four cases of examination of the attitudinal dependent variables with

general agreement at the right end of the Likert scale.

Table 11

*General Judgments for the Instrument (Influences on Attitude) Domain*

| **As of 28 Nov 2010** | **Does item establish a relationship between operationalized attitude concept and learner factors?** | | | | | |
|---|---|---|---|---|---|---|
| **Item # addresses:** | **B&K (2008)** | **P001** | **P002** | **P003** | **Agreement** | **Judgement** |
| Feelings of fear, hesitation, and uneasiness experienced before and during gaming. | | | | | | |
| A1 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| A2 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| A3 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| A4 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| A5 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| A6 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| Willingness to use games for learning as a positive behavior and avoidance tendencies as a negative behavior. | | | | | | |
| B1 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| B2 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| B3 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| B4 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| One's feelings and reactive behaviours while manipulating technological tools. | | | | | | |
| C1 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| C2 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| C3 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| C4 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| C5 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| C6 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| Behaviours arising from beliefs about the advantages of using games for learning. | | | | | | |
| U1 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| U2 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| U3 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| U4 | Yes | Yes | Maybe | Yes | Yes | [redacted] |
| U5 | Yes | Yes | Yes | Yes | Yes | [redacted] |
| **Item # addresses:** | **B&K (2008)** | **P001** | **P002** | **P003** | **Agreement** | **Judgement** |

General agreement on an item establishing a relationship between the operationalized attitude concept and the four attitude factors under examination in CQR is unusual, indicating that the 2010 qualitative analysis supports their use.

Typical agreement includes more than half of the cases being the usual assessment, with variant including at least two cases and rare being one case. The transcripts, codes, and analysis were then sent to an external auditor (assessor), who agreed with all judgments except that participant 002's statement that the "during" aspect

of the Time Phase within the Affective Components category in the instrument (Influences on Attitude) domain were not well designed (discussed in the instrument section). The 2015 instrument for the current research mitigated all 2010 concerns four years before its use.

Although Selwyn's research article (1997b) does not detail how the adequacy of the correlation matrix for the four factors was assessed, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were run on this research's four factors that were derived from Selwyn's (1997b) and Bonanno and Kommers (2008) four factors.

For the affective component's factor for this research, as shown at table 12 Bartlett's test of sphericity was significant ($\chi^2$ = 1068.001, *df* = 15, *p* = 000) indicating the correlation matrix was not an identity matrix that "would imply that there were no interrelationships among the items" (Pett et al., p. 63). The KMO measure of sampling adequacy was .839, greater than the .70 recommended value (Pett et al., p. 81), suggesting that the sample size was sufficient relative to the six items in that factor.

Table 12

*KMO and Bartlett's Test for Affective Component*

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .839 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1068.001 |
| | df | 15 |
| | Sig. | .000 |

Anti-Image Correlation (AIC) matrices calculated the Individual Measures of Sampling Accuracy (MSA) for each item (A1 = .851; A2 = .860; A3 = .886; A4 = .881; A5 = .817; A6 = .798) were greater than the recommended .70 threshold (Pett et al., p.

82), indicating that for this factor "the correlations among the individual items are strong enough to suggest that the correlation matrix is factorable" (Pett et al., p. 81).

For the behavioral component's factor for this research, as shown at table 13 Bartlett's test of sphericity was significant ($\chi^2 = 962.841$, $df = 6$, $p = 000$) indicating the correlation matrix was not an identity matrix. The KMO measure of sampling adequacy was .770, suggesting that the sample size was sufficient relative to the four items in that factor.

Table 13

*KMO and Bartlett's Test for Behavioral Component*

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .770 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 962.841 |
| | df | 6 |
| | Sig. | .000 |

AIC matrices calculated the MSA for each item (B1 = .797; B2 = .847; B3 = .730; B4 = .753) indicating that for this factor "the correlations among the individual items are strong enough to suggest that the correlation matrix is factorable" (Pett et al., p. 81).

For the perceived control component's factor for this research, as shown at table 14 Bartlett's test of sphericity was significant ($\chi^2 = 843.762$, $df = 15$, $p = 000$) indicating the correlation matrix was not an identity matrix. The KMO measure of sampling adequacy was .772, suggesting that the sample size was sufficient relative to the six items in that factor. AIC matrices calculated the MSA for each item (C1 = .833; C2 = .733; C3 = .750; C4 = .811; C5 = .777; C6 = .742) indicating that for this factor "the correlations among the individual items are strong enough to suggest that the correlation matrix is factorable" (Pett et al., p. 81).

Table 14

*KMO and Bartlett's Test for Perceived Control Component*

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .772 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 843.762 |
| | df | 15 |
| | Sig. | .000 |

For the perceived usefulness component's factor for this research, as shown at table 15 Bartlett's test of sphericity was significant ($\chi^2$ = 2501.867, *df* = 10, *p* = 000) indicating the correlation matrix was not an identity matrix. The KMO measure of sampling adequacy was .874, suggesting that the sample size was sufficient relative to the five items in that factor.

Table 15

*KMO and Bartlett's Test for Perceived Usefulness Component*

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .874 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 2501.867 |
| | df | 10 |
| | Sig. | .000 |

AIC matrices calculated the MSA for each item (U1 = .898; U2 = .888; U3 = .946; U4 = .835; U5 = .842) indicating that for this factor "the correlations among the individual items are strong enough to suggest that the correlation matrix is factorable" (Pett et al., p. 81).

In summary, factor analysis was suitable for all four factors with all items for this research that were slightly modified from Selwyn's, leading to the conclusion that Selwyn's four factors were also factorable.

Selwyn, having determined that the matrix was factorable, selected the Principal Component Analysis (PCA) method of factor extraction (Selwyn, 1997b, p. 36) to identify and compute composite scores for the factors. PCA "assumes that there is as much variance to be analyzed as the number of observed variables and that all of the variance in an item can be explained by the extracted factors" (Pett et al., p. 91) and Selwyn's use of Likert scales met the PCA requirement "that the variables being examined be based on similar units of measurement" (Pett et al., p. 90).

Selwyn (1997b), beyond stating that PCA was used to extract the initial factors for the 49 items presented to the 226 students in the sample population, did not describe in detail how the first stage for the factor extraction, that of defining the number of initial factors, was conducted. Typically, extraction begins by "providing an initial estimate of the total amount of variance in each individual item that is explained by the factors" about to be extracted, the explained variance called the item's communality, that can range from 0 to 1.00 "higher values indicating that the extracted factors explain more of the variance of an individual item" (Pett et al., p. 88). A communality value of zero explains none of the variance of an item and a value of 1.00 explains all of the variance. PCA assigns an initial communality estimate of 1.00 for each item because the actual item communality value cannot be determined until after factor analysis is complete. Eigenvalues that can be positive or negative values, represent the amount of item variance explained by a principal component or factor, with values greater than zero being factorable. Eigenvector correlation matrices are columns of weights, that when multiplied by the square root of a principal components eigenvalue are referred to as factor loadings, that are used to compute the proportion of a factor's total item variance.

For this research, the initial PCA extraction procedure for this research's four factors, that were derived from Selwyn's (1997b) and Bonanno and Kommers (2008) four factors, was conducted to determine if similar results would occur as had for Selwyn. They did, producing the results that follow in the SPSS generated correlation matrices.

For the affective component's factor for this research, as shown at table 16 all six item means lie to the right of the five point Likert distribution midpoint "suggesting the items are indeed a concern" (Pett et al., p. 95) to the 709 respondents. In the correlation matrix item A4 loaded below .3 against A1 (.258), A2 (.267), and A3 (.259) but loaded more strongly against A5 (.382) and A6 (.376). In ascending order (A1 to A6), table 17 shows initial eigenvalues and total variance explained by the six items.

Table 16

*Descriptive Statistics for Affective Component Factor Analysis*

**Descriptive Statistics**

| | Mean | Std. Deviation | Analysis N |
|---|---|---|---|
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | 4.1848 | 1.04746 | 709 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | 4.2581 | .91886 | 709 |
| I do not feel uneasy about learning using a Army serious game. | 3.9464 | 1.11990 | 709 |
| Playing Army serious games does not scare me at all. | 4.3230 | .98795 | 709 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes. | 4.3131 | .83909 | 709 |
| Army serious games DO NOT make me feel uncomfortable in learning. | 4.1425 | .92104 | 709 |

Table 17

*Total Variance Explained for Affective Component Factor Analysis*

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.932 | 48.868 | 48.868 | 2.932 | 48.868 | 48.868 |
| 2 | .785 | 13.091 | 61.959 | .785 | 13.091 | 61.959 |
| 3 | .740 | 12.337 | 74.296 | .740 | 12.337 | 74.296 |
| 4 | .616 | 10.261 | 84.556 | .616 | 10.261 | 84.556 |
| 5 | .535 | 8.913 | 93.470 | .535 | 8.913 | 93.470 |
| 6 | .392 | 6.530 | 100.000 | .392 | 6.530 | 100.000 |

Extraction Method: Principal Component Analysis.

Because all six eigenvalues were greater than zero all six items were factorable.

For the behavioral component's factor for this research, as shown at table 18 three of the four item means lie to the right of the midpoint of the Likert distribution

Table 18

*Descriptive Statistics for Behavioral Component Factor Analysis*

**Descriptive Statistics**

| | Mean | Std. Deviation | Analysis N |
|---|---|---|---|
| I would NOT avoid training on a topic if it involves training using Army serious games. | 4.0635 | 1.06706 | 709 |
| I DO NOT only use Army serious games when I am told to. | 2.7504 | 1.10776 | 709 |
| I DO NOT avoid playing Army serious games. | 3.7334 | 1.18048 | 709 |
| I will use Army serious games regularly throughout my military career. | 3.3738 | 1.13119 | 709 |

As before this suggests a concern (Pett et al., 2003) to the 709 respondents. The outlier's wording, that is a reversal item, may have been confusing. In the correlation matrix however all items loaded above .3 against their three companions. In ascending

order (B1 to B4), table 19 shows initial eigenvalues and total variance explained by the four items.

Table 19

*Total Variance Explained for Behavioral Component Factor Analysis*

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.538 | 63.448 | 63.448 | 2.538 | 63.448 | 63.448 |
| 2 | .686 | 17.152 | 80.600 | .686 | 17.152 | 80.600 |
| 3 | .449 | 11.231 | 91.831 | .449 | 11.231 | 91.831 |
| 4 | .327 | 8.169 | 100.000 | .327 | 8.169 | 100.000 |

Extraction Method: Principal Component Analysis.

Because all four eigenvalues were greater than zero all four items were factorable.

For the perceived control component's factor, as shown at table 20 all six item means lie to the right of the midpoint of the Likert distribution suggesting a concern to the 709 respondents.

In the correlation matrix, four of the six items displayed degrees of weak loading against their peers, three using reversal language that may have confused. Item C1 loaded below .3 against C2 (.170), C3 (.298), and C6 (.198) but loaded more strongly against C4 (.315) and C5 (.338). Item C2 loaded below .3 against C1 (.170) and C6 (.085) but loaded more strongly against C3 (.483), C4 (.330), and C5 (.366). Item C3 loaded below .3 against C1 (.298) and C6 (.193) but loaded more strongly against C2 (.330), C4 (.333), and C5 (.428). Item C6 loaded below .3 against C1 (.198), C2 (.085), and C3 (.193) but loaded more strongly against C4 (.312) and C5 (.361).

In ascending order (C1 to C6), table 21 shows initial eigenvalues and total variance explained by the six items.

Table 20

*Descriptive Statistics for Perceived Control Component Factor Analysis*

**Descriptive Statistics**

| | Mean | Std. Deviation | Analysis N |
|---|---|---|---|
| I could probably teach myself most things I need to know about Army serious games. | 3.9901 | .91049 | 709 |
| I AM in complete control of my avatar when I train using Army serious games. | 3.2609 | 1.02009 | 709 |
| I can make the computer do what I want it to do while playing an Army serious game. | 3.6389 | 1.02343 | 709 |
| I DO NOT need an experienced person nearby when I am using an Army serious game. | 3.6812 | 1.11738 | 709 |
| If I experience problems training on an Army serious game, I can usually solve them. | 3.7250 | .91855 | 709 |
| I do not need somebody to tell me the best way to use an Army serious game. | 3.2863 | 1.05557 | 709 |

Table 21

*Total Variance Explained for Perceived Control Component Factor Analysis*

**Total Variance Explained**

| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.612 | 43.526 | 43.526 | 2.612 | 43.526 | 43.526 |
| 2 | .999 | 16.652 | 60.179 | .999 | 16.652 | 60.179 |
| 3 | .789 | 13.147 | 73.325 | .789 | 13.147 | 73.325 |
| 4 | .640 | 10.673 | 83.998 | .640 | 10.673 | 83.998 |
| 5 | .514 | 8.566 | 92.564 | .514 | 8.566 | 92.564 |
| 6 | .446 | 7.436 | 100.000 | .446 | 7.436 | 100.000 |

Extraction Method: Principal Component Analysis.

Because all six eigenvalues were greater than zero all six items were factorable.

For the perceived usefulness component's factor for this research, as shown in

table 22 four of the five item means lie to the right of the midpoint of the Likert distribution suggesting a concern (Pett et al., 2003) to the 709 respondents.

Table 22

*Descriptive Statistics for Perceived Usefulness Component Factor Analysis*

**Descriptive Statistics**

| | Mean | Std. Deviation | Analysis N |
|---|---|---|---|
| Army serious games help me to train for my individual and collective tasks better. | 3.6643 | 1.09706 | 709 |
| Army serious games can enhance training enough to justify possible extra effort. | 3.8082 | 1.07482 | 709 |
| Most tasks Army serious games train can NOT be trained better through other means. | 2.9676 | 1.07110 | 709 |
| Army serious games provide a more useful way to train. | 3.5712 | 1.10957 | 709 |
| Army serious games make it possible to train more productively. | 3.5980 | 1.10241 | 709 |

The outlier's wording may have been confusing. In the correlation matrix, all items loaded above .3 against their three companions.

In ascending order (U1 to U5), table 23 shows initial eigenvalues and total variance explained by the five items. Because all five eigenvalues were greater than zero all five items were factorable.

In summary, all 21 of the item eigenvalues for this research that were slightly modified from Selwyn's items supported factoring of the items, leading to the conclusion that Selwyn's 21 items were also factorable.

Table 23

*Total Variance Explained for Perceived Usefulness Component Factor Analysis*

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 3.709 | 74.175 | 74.175 | 3.709 | 74.175 | 74.175 |
| 2 | .512 | 10.237 | 84.412 | .512 | 10.237 | 84.412 |
| 3 | .356 | 7.116 | 91.527 | .356 | 7.116 | 91.527 |
| 4 | .258 | 5.169 | 96.696 | .258 | 5.169 | 96.696 |
| 5 | .165 | 3.304 | 100.000 | .165 | 3.304 | 100.000 |

Extraction Method: Principal Component Analysis.

Selwyn (1997b) rotated the factors in the factor extraction second stage, possibly because unrotated factor solutions "often do not provide meaningful and easily interpretable clusters of items" (Pett et al., p. 131), using an orthogonal rotation that "assumes the generated factors are independent of each other (i.e. they are uncorrelated)" (Pett et al., p. 134). Selwyn used the varimax rotation approach that "maximizes the variances of the loadings within the factors whilc also maximizing differences between the high and low loadings on a particular factor" (Pett et al., p. 142). Following the initial 49 items rotation Selwyn reported that the 21items retained after the rotation "loaded greater than ±0.40 on the relevant factor, fulfilling Hair et al.'s (1995), criterion of a significant item, and loaded less than 0.30 on non-relevant factors" (1997b, p. 36). To refine the solution that was now reduced to the four independent and distinct underlying constructs solution shown on the left side of Figure 9 in the literature review Selwyn conducted a second factor analysis on the retained 21 items shown in Table 1 in the literature review.

Selwyn interpreted the findings and the results of the factor analysis placed six items in factor 1 (Affective) and factor 3 (Perceived Control), five in factor 2

(Behavioral) and four in factor 4 (Perceived Usefulness) as shown at Table 24.

Table 24

*Retained Items Loadings and Eigenvalues on Selwyn's Scale*

| Item | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|
| AFF1 | 0.65 | | | |
| AFF2 | 0.78 | | | |
| AFF3 | 0.80 | | | |
| AFF4 | 0.74 | | | |
| AFF5 | 0.79 | | | |
| AFF6 | 0.70 | | | |
| BEH1 | | | | 0.60 |
| BEH2 | | | | 0.71 |
| BEH3 | | | | 0.56 |
| BEH4 | | | | 0.45 |
| CON1 | | | 0.59 | |
| CON2 | | | 0.53 | |
| CON3 | | | 0.50 | |
| CON4 | | | 0.58 | |
| CON5 | | | 0.41 | |
| CON6 | | | 0.44 | |
| USE1 | | 0.67 | | |
| USE2 | | 0.73 | | |
| USE3 | | 0.69 | | |
| USE4 | | 0.52 | | |
| USE5 | | 0.46 | | |

Before reporting the results Selwyn piloted the revised scale with an 87-student sample population to satisfy reliability and validity concerns (1997b). A Cronbach's coefficient a was calculated "for each of the four sub-scales and the overall scale as a whole… the coefficients for all sub-scales were significantly high; suggesting that the internal consistency of the constructs and overall scale is satisfactory" (Selwyn, 1997b, p. 36). Cronbach's alphas for the 6 affective, 5 perceived usefulness, 6 perceived control, and 4 behavioral components items were .93, .82, .88 and .79, respectively, or .90 overall.

A Cronbach's coefficient a was calculated for the dependent variable Likert scales

used in this research using the data from its 709 respondents.

The reliability of the affective component subscale for this research as shown at table 25 was found per George and Mallery (2003) to be acceptable (6 items; a = .78).

Table 25

*Item Analysis for Affective Component*

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | 20.9831 | 11.491 | .519 | .302 | .747 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | 20.9097 | 12.000 | .538 | .318 | .742 |
| I do not feel uneasy about learning using a Army serious game. | 21.2214 | 11.647 | .441 | .204 | .770 |
| Playing Army serious games does not scare me at all. | 20.8449 | 12.385 | .419 | .194 | .771 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes. | 20.8547 | 12.059 | .602 | .406 | .730 |
| Army serious games DO NOT make me feel uncomfortable in learning. | 21.0254 | 11.231 | .679 | .482 | .707 |

The reliability of the behavioral component subscale for this research as shown at table 26 was found per George and Mallery (2003) to be good (4 items; a = .81).

Table 26

*Item Analysis for Behavioral Component*

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| I would NOT avoid training on a topic if it involves training using Army serious games. | 9.8575 | 7.834 | .627 | .421 | .753 |
| I DO NOT only use Army serious games when I am told to. | 11.1707 | 8.419 | .478 | .241 | .821 |
| I DO NOT avoid playing Army serious games. | 10.1876 | 7.017 | .689 | .522 | .721 |
| I will use Army serious games regularly throughout my military career. | 10.5472 | 7.209 | .697 | .500 | .718 |

The reliability of the perceived control component subscale for this research as shown at table 27 was found per George and Mallery (2003) to be acceptable (6 items; a = .73).

Table 27

*Item Analysis for Perceived Control Component*

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| I could probably teach myself most things I need to know about Army serious games. | 17.5924 | 12.346 | .384 | .168 | .714 |
| I AM in complete control of my avatar when I train using Army serious games. | 18.3216 | 11.648 | .423 | .282 | .705 |
| I can make the computer do what I want it to do while playing an Army serious game. | 17.9436 | 10.915 | .543 | .367 | .669 |
| I DO NOT need an experienced person nearby when I am using an Army serious game. | 17.9013 | 10.617 | .517 | .276 | .676 |
| If I experience problems training on an Army serious game, I can usually solve them. | 17.8575 | 11.029 | .616 | .389 | .652 |
| I do not need somebody to tell me the best way to use an Army serious game. | 18.2962 | 12.101 | .329 | .171 | .733 |

The reliability of the perceived usefulness component subscale for this research as shown at table 28 was found per George and Mallery (2003) to be excellent (5 items; a = .91).

Table 28

*Item Analysis for Perceived Control Component*

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| Army serious games help me to train for my individual and collective tasks better. | 13.9450 | 14.425 | .767 | .608 | .894 |
| Army serious games can enhance training enough to justify possible extra effort. | 13.8011 | 14.371 | .797 | .656 | .888 |
| Most tasks Army serious games train can NOT be trained better through other means. | 14.6417 | 15.436 | .646 | .424 | .918 |
| Army serious games provide a more useful way to train. | 14.0381 | 13.825 | .844 | .748 | .878 |
| Army serious games make it possible to train more productively. | 14.0113 | 13.957 | .831 | .737 | .881 |

Selwyn calculated the coefficient of stability, or test-retest reliability, by "re-administering the scale to the original sample after a period of two weeks had passed since the initial piloting" finding "retest coefficients for all scales were high, with an overall Pearson's test-retest coefficient of r=0.93 (P<0.001)" (Selwyn, 1997b, p. 36). Actual Pearson's test-retest coefficient results for the 6 affective, 5 perceived usefulness, 6 perceived control, and 4 behavioral components items were .94, .94, .95 and .88, respectively.

To assess criterion validity, Spearman's rank order correlations "were performed on the attitude and usage data obtained from the pilot sample" to determine if it met "Bear's criterion of a low-level positive correlation to provide a measure of construct

validity for the scale" (Selwyn, 1997b, p. 36). Selwyn found significant correlations between computer usage and all four subscales as well as the overall scale. Spearman's rank order correlation results for the 6 affective, 5 perceived usefulness, 6 perceived control, and 4 behavioral components items were .41, .72, .64 and .61, respectively, and .74 overall. All of Selwyn's findings and correlations were significant at the 0.001 level.

In summary, for the dependent variables, Selwyn (1997b) performed EFA to develop and validate a theoretically sound measure of student's attitude toward computer use, resulting in Selwyn's valid and reliable four factor 21 item instrument. That same instrument was slightly modified by Bonanno and Kommers (2008) for their research of students attitude toward serious game use and by this researcher for this research of Soldier's attitude toward Army serious game use.

As demonstrated in this research, the modifications did not affect the instrument's validity.

***Independent variables***

The independent variables that affected the four components of Soldier attitude toward Army Serious Gaming (ASG) were gender, age, perceived gaming competence, education level, and military class.

As indicated earlier, the 2010 research used both the focus group and phenomenology qualitative research methods to determine the perceptions, first from a focus group and later from several professional instructional designers, of the (independent variable) learner factors they believed may influence attitude toward the use of serious military games. As before, interviews were recorded, transcribed verbatim, and then coded and analyzed using the Max QDA software tool.

Within the qualitative research in 2010, as shown in table 29, the CQR coding of the independent variables Rival Hypothesis (Learner Factors) domain annotated the categories of participant's opinions of the theories developed by Bonanno and Kommers, this researcher, the small research focus group, and the three CQR instructional systems designer participants. As before, for this quantitative part of the 2010 research, each participant used a three point Likert scale to rate each hypotheses on whether a potential learner factor did (yes), did not (no), or might (maybe) influence Soldier's attitudes to using serious military games. An evaluation then determined the degree of agreement.

Table 29

*CQR Coding of the Rival Hypothesis (Learner Factors) Domain*

| | |
|---|---|
| Code System | |
| Rival Hypotheses (Learner Factors) | |
| Hypotheses (BK): Gender; PGC | Evaluated coded section for CQR researchers' experiences and discussion of these gaming attitude Learner Factor hypotheses; in these cases, they were Bonanno and Kommers theories on Gender and Perceived Gaming |
| Hypotheses (Bonnett): Age; Ed Level; Military Class | Evaluated coded section for CQR researchers' experiences and discussion of these gaming attitude Learner Factor hypotheses; in these cases, they were Bonnett's theories on Age, Education Level, and Military Class. |
| Hypotheses (ISDers): Intrinsic Motivation; Hobby; Past Work History; SE Class; Time Available | Evaluated coded section for CQR researchers' experiences and discussion of their gaming attitude Learner Factor contributed theories and hypotheses; in these cases, they were Intrinsic Motivation, Hobbies, Past Work History, Socio-Economic Class, and Time Available. |
| Hypotheses (RG): Ethnic Gp; Race | Evaluated coded section for CQR researchers' experiences and discussion of the Research Group gaming attitude Learner Factor contributed theories and hypotheses; in these cases, they were Ethnic Group and Race. |

In addition to gender and perceived gaming competence (Bonanno & Kommers, 2008), the first research focus group of educators developed two rival hypotheses, that of ethnic group and race. Three experienced Army Instructional Systems Designers in the Army Training Command headquarters then proposed additional rival hypotheses of age, education level, hobby, military class, past working history, socio economic class, and time available for Soldiers using Army serious games. All personnel then voted all hypotheses, the focus group (being the "RG" column in table 30) voting as a block.

The analysis of the frequency judgments for the 11 rival hypotheses produced the results shown at table 30.

Table 30

*General Judgments for the Rival Hypothesis (Learner Factors) Domain*

| As of 28 Nov 2010 | Is this a learner factor affecting attitude towards serious military game use? | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Learner Factors | First Factor Cite | B&K | RG | P001 | P002 | P003 | Aggreement | Judgement |
| Age | P003 | Unknown | Maybe | Maybe | No | Maybe | Maybe | [redacted] |
| Education Level | P003 | Unknown | Maybe | Maybe | No | Maybe | Maybe | [redacted] |
| Ethnic Group | Research Group | Unknown | Yes | No | No | No | No | [redacted] |
| Gender | B&K | Yes | Maybe | Maybe | No | Maybe | Maybe | Typical |
| Hobby | P001 | Unknown | Maybe | Yes | Yes | Yes | Yes | [redacted] |
| Military Class | P003 | Unknown | Maybe | Maybe | Maybe | Maybe | Maybe | [redacted] |
| Past Work History | P001 | Unknown | Maybe | Yes | Maybe | Maybe | Maybe | Typical |
| Percieved Gaming Competence | B&K | Yes | Maybe | Maybe | Yes | Yes | Yes | [redacted] |
| Race | Research Group | Unknown | Yes | No | No | No | No | [redacted] |
| Socio Economic Class | P002 | Unknown | Maybe | Maybe | Yes | Yes | Yes | Typical |
| Time Available | P002 | Unknown | Maybe | Maybe | Yes | No | Unknown | [redacted] |

There was general agreement, meaning agreement in all or all but one case, that perceived gaming competence and hobby were learner factors that influence Soldiers to use Army serious games; that age, education level, and military class might be; and that ethnic group and race were not. There was typical agreement, meaning agreement in over half of the cases, that socio economic class was a learner factor that influenced Soldiers to use Army serious games and that gender and past working history might be. Time available was determined to be unknown as a learner factor that influenced Soldiers to use Army serious games. An independent auditor agreed that the analysis accurately represented the findings.

This study eliminated ethnic group, race, and time available as learner factors based on their ratings. It eliminated socio economic class because military class, that closely ties social status and pay, replaces it for Soldiers and the military class structure is already exhaustive and mutually exclusive. It eliminated hobby and past working history

because operationalizing them as variables that are both exclusive and exhaustive (Trochim, 2006) would be too difficult and the perceived gaming competence variable that measures gaming experience could be so operationalized. Perceived gaming competence might also be more useful because Bonanno and Kommers (Bonanno & Kommers, 2008) had used it. These deletions reduced the learner factors to study to five operationalized exhaustive and mutually exclusive independent variables.

Gender was defined as being of the male or female sex because the U.S. Army does not recognize other gender distinctions. Age was defined as younger, being 28 years of age and younger, or older, being older than 28 years of age, because the average Soldier is 29 years of age as last reported by the Defense Manpower Data Center (DMDC) in 2011 (Statistic Brain Research Institute, 2013). Perceived gaming competence was defined as the time dedicated to playing games based upon the assumption that enthusiastic gamers dedicate more time to play and gain experience doing it, understanding that the perception of competence that may positively affect attitude toward the behavior may not reflect actual competence. The three perceived gaming competence categories were: enthusiastic—play more than 8 hours per week; moderate—play 2–7 hours per week; and non-gamers—play less than 2 hours per week. Education level was defined as lesser-educated, being Soldiers who have not obtained at least a Bachelor's degree, or better-educated, being Soldiers who obtained a Bachelor's degree or better. The Bachelor's degree was selected as the breakpoint because 85.8 percent of Soldiers, whether officer, NCO or enlisted, had already achieved or surpassed the Associate degree according to 2011 DMDC data (Statistic Brain Research Institute, 2013). Military class was defined as enlisted, being Soldiers in enlisted grades E-4 and

lower, non-commissioned officers, being Soldiers in enlisted grades E-5 and higher, and commissioned officers, being Soldiers in all officer grades. Soldiers in enlisted grades E-4 defined as enlisted because in the Army most are now Specialists instead of Corporals, reversing a trend to appoint most Corporals, as is the case for all USMC E-4s.

The study researched five Army Serious Gaming (ASG) behavior questions:

$RQ_1$: Do Soldiers general attitude towards ASG differ as a function of gender?

$RQ_2$: Do Soldiers general attitude towards ASG differ as a function of age?

$RQ_3$: Do Soldiers general attitude towards ASG differ as a function of education?

$RQ_4$: Do Soldiers general attitude towards ASG differ as a function of perceived gaming competence?

$RQ_5$: Do Soldiers general attitude towards ASG differ as a function of military class?

**Instrument Design**

This design at Figure 14 was a quantitative non-experimental descriptive method based on Selwyn (1997b) and Bonanno and Kommers (2008). For the independent variables, the instrument collected gender, age, hours spent playing computer games a week, education level, and military grade. When collected, gender was at the nominal level of measurement, education level and military grade were at the ordinal level of measurement, and age and perceived gaming competence were at the ratio level of measurement. SPSS was used to recode and process the variable datum to arrive at the necessary variables. For the dependent variable construct, the instrument collected 21 sampling variables for the affective components, perceived control components, perceived usefulness components, and behavioral components constructs. SPSS was used to recode and process the variable datum to arrive at the necessary variable data groups.

Kay (1993), Davis (1993), and Selwyn (1997b) used quantitative non-experimental descriptive design survey instruments to measure user attitudes toward computing behavior. Bonanno and Kommers (2008) used a similar design survey instrument, based upon those of Kay, Davis, and Selwyn, to measure user attitude toward gaming behavior.

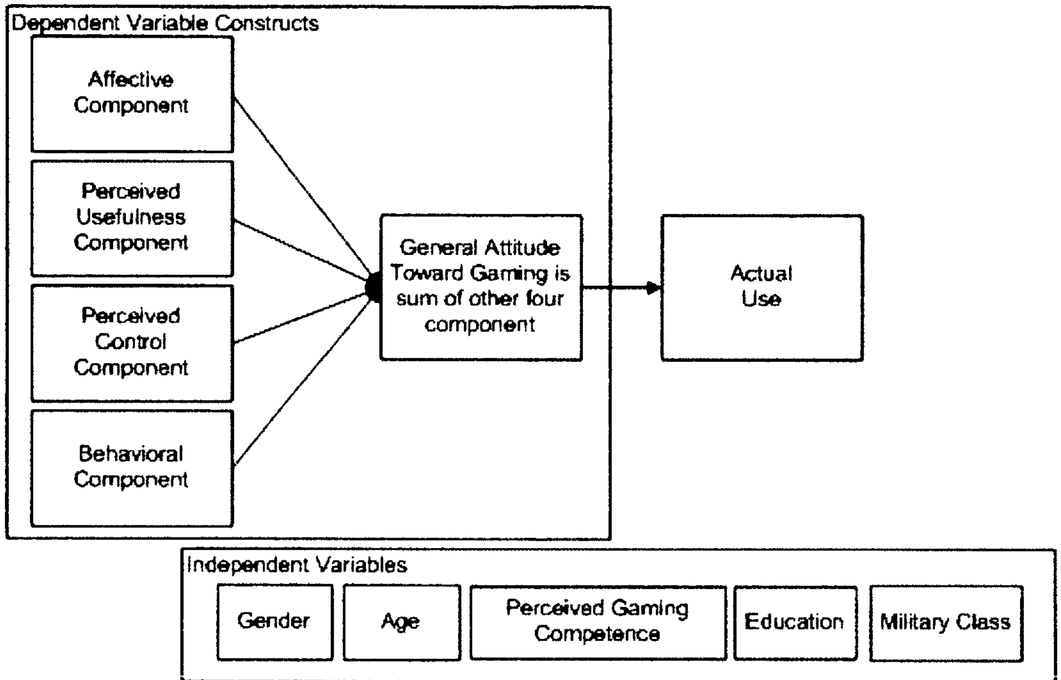


*Figure 14.* Independent and dependent variables collected to determine General Attitude Toward Gaming.

The current 21 item dependent variable scale instrument was originally developed and validated by Selwyn (1997b), and was then slightly modified from that used by Bonanno and Kommers (2008). The current instrument corrected Bonanno and Kommers double barrel or double-direct informal fallacy items (U1, U3, C5, U4, and B4). Those items combined two or more issues or attitudinal objects in a single question that might have resulted in a response bias. The current instrument at Appendix A used terms familiar to the population to determine more definitively at their attitude toward ASG.

The dependent variable construct, the general attitude towards Army serious

gaming data group (GATASGDG), is a computed data variable that is the sum of four computed data variables that measured the four separate attitudinal components constructs toward the use of instructional gaming. The four components together used 21 sampling data dependent variables.

***Affective components construct***

The affective components construct dependent variable measures feelings of fear, hesitation, and uneasiness experienced before and during gaming. As seen in Table 31, six dependent variables measured those feelings of fear (A1, A4), hesitation (A2, A5), and uneasiness (A3, A6) towards the use of Army serious games. During the 2010 research one expert judge had reservations about whether the affective component construct items A1 to A6 related only to the during aspect of game play, stating that if the item stems were modified to reflect only before gaming, he would then rate all Affective component items "Yes," as the other judges had previously. Because the external auditor confirmed the other judges did not have the same issue, the items were not changed.

Table 31

*Survey Instrument Affective Component Construct Items A1 to A6*

| |
|---|
| 01 A1 Given the chance to train using an Army serious game such as *Virtual BattleSpace2 or Tactical Iraqi*, I am afraid that I might have trouble learning in navigating through it. |
| 05 A2 I hesitate to train using an Army serious game in case I might look stupid. |
| 08 A3 I do not feel uneasy about learning using a Army serious game. |
| 12 A4 Playing Army serious games does not scare me at all. |
| 16 A5 I hesitate to play Army serious games because I am afraid of making learning mistakes. |
| 20 A6 Army serious games make me feel uncomfortable in learning. |

***Perceived control components construct***

The perceived control components construct dependent variable measures feelings (C1, C2, C4, and C6) and reactive behaviours (C3, C5) while manipulating technological

tools. As seen in Table 32 six dependent variables measured those feelings and reactive behaviors while manipulating Army serious games. During the 2010 research the same expert judge that commented on the affective component construct stated reservations about perceived control component items C2 and C3 unrelated to their construct validity but rather to whether a learner needs control in a game to learn from it (C2) or knows how to regain control when it is lost (C3). Because the question was unrelated to the construct's validity and the external auditor confirmed the other judges did not have the same issue the items were not changed.

Table 32

*Survey Instrument Perceived Control Component Construct Items C1 to C6*

| | | |
|---|---|---|
| 03 | C1 | I could probably teach myself most things I need to know about Army serious games. |
| 07 | C2 | I am not in complete control of my avatar when I train using Army serious games. |
| 09 | C3 | I can make the computer do what I want it to do while playing an Army serious game. |
| 11 | C4 | I need an experienced person nearby when I am using an Army serious game. |
| 15 | C5 | If I experience problems training on an Army serious game, I can usually solve them. |
| 19 | C6 | I do not need somebody to tell me the best way to use an Army serious game. |

***Perceived usefulness components construct***

The perceived usefulness components construct dependent variable measures behaviors arising from beliefs about the advantages of using games for learning. As seen in Table 33 the text used for this study's instrument, five dependent variables measured those behaviours arising from beliefs about the advantages of using Army serious games for training. During the 2010 research the same expert judge that commented on the affective and perceived control component constructs stated reservations about perceived usefulness component items U2 and U3 related to assumptions that he inferred in them that learning using a game requires more effort than other learning (U2) or that learning

using a game is better than other learning (U4). Insertion of the word "possible" satisfied the concern that the other experts did not share.

Table 33

*Survey Instrument Perceived Usefulness Component Construct Items U1 to U5*

| | |
|---|---|
| 02 U1 | Army serious games help me to train for my individual and collective tasks better. |
| 06 U2 | Army serious games can enhance training enough to justify possible extra effort. |
| 13 U3 | Most tasks Army serious games train can be trained better through other means. |
| 17 U4 | Army serious games provide a more useful way to train. |
| 21 U5 | Army serious games make it possible to train more productively. |

***Behavioral components construct***

The behavioral components construct dependent variable measures willingness to use games for learning as a positive behavior and avoidance tendencies as a negative behavior. As seen in Table 34, four dependent variables measured the positive behavior of willingness to use Army serious games for learning (B4) and the negative behavior of tending to avoid the use of Army serious games for learning (B1, B2, B3). During the 2010 research, there were no expert concerns on this construct.

Table 34

*Survey Instrument Behavioral Component Construct Items B1 to B4*

| | |
|---|---|
| 04 B1 | I would avoid training on a topic if it involves training using Army serious games. |
| 10 B2 | I only use Army serious games when I am told to. |
| 14 B3 | I avoid playing Army serious games. |
| 18 B4 | I will use Army serious games regularly throughout my military career. |

***Scale comparisons between studies***

Because this study uses items slightly modified from Bonanno and Kommers (2008), that were slightly modified from Selwyn (1997b), tables 35, 36, 37, and 38 are used to show the insignificance of the modifications made from one scale to the next.

Table 35

*Instrument Affective Component Comparisons Items A1 to A6*

| Item | Selwyn | | Bonanno and Kommers | | Bonnett |
|---|---|---|---|---|---|
| AFF1 | If given the opportunity to use a computer I am afraid that I might damage it in some way | A1 | Given the opportunity to use a game such as Empire Earth or SIMS, I am afraid that I might have trouble in navigating through it | A1 | Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am afraid that I might have trouble learning in navigating through it |
| AFF2 | I hesitate to use a computer for fear of making mistakes I can't correct | A2 | I hesitate to use a game in case I look stupid | A2 | I hesitate to train using an Army serious game in case I might look stupid |
| AFF3 | I don't feel apprehensive about using a computer | A3 | I don't feel uneasy about using a game | A3 | I do not feel uneasy about learning using a Army serious game |
| AFF4 | Computers make me feel uncomfortable | A4 | Playing games does not scare me at all | A4 | Playing Army serious games does not scare me at all |
| AFF5 | Using a computer does not scare me at all | A5 | I hesitate to use a computer for playing games as I'm afraid of making mistakes I can't correct | A5 | I hesitate to play Army serious games because I am afraid of making learning mistakes |
| AFF6 | I hesitate to use a computer in case I look stupid | A6 | Games make me feel uncomfortable | A6 | Army serious games make me feel uncomfortable in learning |

Table 36

*Instrument Perceived Usefulness Component Comparisons Items U1 to U5*

| Item | Selwyn | | Bonanno and Kommers | | Bonnett |
|---|---|---|---|---|---|
| USE1 | Computers help me organize my work better | U1 | Games help me relax and thus do my work better | U1 | Army serious games help me to train for my individual and collective tasks better |
| USE2 | Computers make it possible to work more productively | U2 | Games can enhance the learning experience to a degree which justifies the extra effort | U2 | Army serious games can enhance training enough to justify possible extra effort |
| USE3 | Computers can allow me to do more interesting and imaginative work | U3 | Most things that one can get from a game can be obtained or arrived at through other means | U3 | Most tasks Army serious games train can be trained better through other means |
| USE4 | Most things that a computer can be used for I can do just as well myself | U4 | Games provide more interesting and imaginative ways for learning | U4 | Army serious games provide a more useful way to train |
| USE5 | Computers can enhance the presentation of my work to a degree that justifies the extra effort | U5 | Games make it possible to learn more productively | U5 | Army serious games make it possible to train more productively |

Table 37

*Instrument Perceived Control Component Comparisons Items C1 to C6*

| Item | Selwyn | | Bonanno and Kommers | | Bonnett |
|---|---|---|---|---|---|
| CON1 | I could probably teach myself most of the things I need to know about computers | C1 | I could probably teach myself most of the things I need to know about games | C1 | I could probably teach myself most things I need to know about Army serious games |
| CON2 | I can make the computer do what I want it to | C2 | I am not in complete control when I use a computer for games. | C2 | I am not in complete control of my avatar when I train using Army serious games |
| CON3 | If I get problems using the computer, I can usually solve them one way or another | C3 | I can make the computer do what I want it to do while playing a Game | C3 | I can make the computer do what I want it to do while playing an Army serious game |
| CON4 | I am not in complete control when using a computer | C4 | I need an experienced person nearby when I'm using a game | C4 | I need an experienced person nearby when I am using an Army serious game |
| CON5 | I need an experienced person nearby when using a computer | C5 | If I get problems using a game, I can usually solve then one way or the other | C5 | If I experience problems training on an Army serious game, I can usually solve them |
| CON6 | I do not need someone to tell me the best way to use a computer | C6 | I do not need somebody to tell me the best way to use a game | C6 | I do not need somebody to tell me the best way to use an Army serious game |

Table 38

*Instrument Behavioral Component Comparisons Items B1 to B4*

| Item | Selwyn | | Bonanno and Kommers | | Bonnett |
|---|---|---|---|---|---|
| BEH1 | I would avoid taking a job if I knew it involved working with computers | B1 | I would avoid learning a topic if it involves Games | B1 | I would avoid training on a topic if it involves training using Army serious games |
| BEH2 | I avoid coming into contact with computers in college/school | B2 | I only use games when told to | B2 | I only use Army serious games when I am told to |
| BEH3 | I will only use computers at college/school when told to | B3 | I avoid playing games | B3 | I avoid playing Army serious games |
| BEH4 | I will use computers regularly throughout college/school | B4 | I will use games regularly throughout school/college | B4 | I will use Army serious games regularly throughout my military career |

***Scale***

Because this study uses quantitative units to measure qualitative constructs about attitude toward ASG, a five-point interval response (Likert) scale was used for the 21

collected dependent variables, 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5= strongly agree. Reversal items that required inverting scale values for evaluation, were items A1, A2, A5, A6, B1, B2, B3, C2, C4, and U3 (see Table 39 for the complete list of collected dependent variable constructs).

Table 39

*Survey Instrument Constructs Collected in Order of Presentation*

| | | |
|---|---|---|
| 1 | A1 | Given the chance to train using an Army serious game such as *Virtual BattleSpace2 or Tactical Iraqi*, I am afraid that I might have trouble learning in navigating through it. |
| 2 | U1 | Army serious games help me to train for my individual and collective tasks better. |
| 3 | C1 | I could probably teach myself most things I need to know about Army serious games. |
| 4 | B1 | I would avoid training on a topic if it involves training using Army serious games. |
| 5 | A2 | I hesitate to train using an Army serious game in case I might look stupid. |
| 6 | U2 | Army serious games can enhance training enough to justify possible extra effort. |
| 7 | C2 | I am not in complete control of my avatar when I train using Army serious games. |
| 8 | A3 | I do not feel uneasy about learning using a Army serious game. |
| 9 | C3 | I can make the computer do what I want it to do while playing an Army serious game. |
| 10 | B2 | I only use Army serious games when I am told to. |
| 11 | C4 | I need an experienced person nearby when I am using an Army serious game. |
| 12 | A4 | Playing Army serious games does not scare me at all. |
| 13 | U3 | Most tasks Army serious games train can be trained better through other means. |
| 14 | B3 | I avoid playing Army serious games. |
| 15 | C5 | If I experience problems training on an Army serious game, I can usually solve them. |
| 16 | A5 | I hesitate to play Army serious games because I am afraid of making learning mistakes. |
| 17 | U4 | Army serious games provide a more useful way to train. |
| 18 | B4 | I will use Army serious games regularly throughout my military career. |
| 19 | C6 | I do not need somebody to tell me the best way to use an Army serious game. |
| 20 | A6 | Army serious games make me feel uncomfortable in learning. |
| 21 | U5 | Army serious games make it possible to train more productively. |

## Data Collection

The data collection procedure was AKO routed Soldiers who answered yes to the question asking if they agree to participate to the on-line survey instrument. This informed consent notice appeared at the top, "This under five minute survey investigates Soldier attitudes towards the use of Army Serious Gaming (ASG). We want you to participate because your opinion matters in determining the extent to which gaming may

be used for future training. There are no risks associated with your participation and you may stop at any time without penalty. We will not ask any question that might identify you and all responses that you provide will be destroyed at the conclusion of the research. If you have any questions about the research study, please contact Mitchell Bonnett at mbonn006@odu.edu. This research has been reviewed according to Old Dominion University IRB procedures for research involving human subjects." At the conclusion of the 21 Likert items, the instrument asked participants to select their gender, age, rank, education level, and number of hours they play computer games in a typical week, and thanked them for participating in this valuable research. Because the Army was drawing down AKO capabilities as part of federal budget reductions, the automated AKO survey utility was not available during the research window, so the AKO homepage instead routed the Soldier to the identical back-up SurveyMonkey instrument that had the same level of security protection as the Army instrument. The letter from SurveyMonkey Inc. granting permission to conduct research using SurveyMonkey is available.

## Statistical Analysis

### *Independent variable collection*

For the independent variables, the instrument collected gender at the nominal measurement level, education level and military grade at the ordinal measurement level, and age and perceived gaming competence at the ratio measurement level.

### *Independent variable recoding*

After collection, SPSS functions imported, recoded, and stored them as follows. Independent variable learner factors were imported as nominal (independent variable named GENDER), ordinal (independent variables named EDLVL and GRADE), and

interval (independent variables named AGE and PGCHRS) data. GENDER stands for the participant's gender expressed as male or female. AGE stands for the participant's age expressed in whole completed years. EDLVL stands for the participant's selected education level expressed in ordinal values determined by the US government (OPM, 2013, pp. A128-A131). PGCHRS stands for the participant's time spent playing computer games a week in number of complete hours. GRADE stands for the participant's military grade expressed as O-1 to O-10 for commissioned officers, WO-1 to WO-4 for warrant officers and E-1 to E-9 for enlisted and non-commissioned officer (NCO) personnel.

***Independent variable recoding***

An SPSS function recoded participant's independent variable AGE data into a new independent variable called AGEGROUPS, recoding participants 28 years of age and younger into age group 1 (1 = younger) and recoding participants over 28 years of age as age group 2 (2 = older). Next, an SPSS function recoded participant's independent variable EDLVL data into a new independent variable called EDUGROUPS. SPSS recoded participants who have not obtained a Bachelor's degree into education level group 1 (1 = lesser) (OPM Code 12 and under) and recoded participants that have obtained a Bachelor's degree or better as education level group 2 (2 = better) (OPM Code 13 and over). Next, an SPSS function recoded participant's independent variable PGCHRS data into a new independent variable called PGCGROUPS. This involved recoding one hour or less a week gamers into perceived gaming competence group 1 (1 = less) (number 1 or under), two to eight hours a week gamers into group 2 (2 = average) (number 2 to 8) and over eight hours a week gamers into group 3 (3 = more) (number 9 or higher). Next, an SPSS function recoded participant's independent variable (military)

GRADE data into a new independent variable called CLASSGROUPS. This involved recoding enlisted grades E-1 to E-3 into military class group 1 (1 = enlisted) (instrument numbers 1 to 3), enlisted grades E-4 to E-9 into military class group 2 (2 = NCO) (instrument numbers 4 to 9), and commissioned and warrant officer grades into military class group 3 (3 = officer) (instrument numbers 10 and up).

***Dependent variable collection***

For the dependent variables, the instrument collected 21 sampling variables for the affective components, perceived control components, perceived usefulness components, and behavioral components constructs (A1-A6, C1-C6, U1-U5, and B1-B4).

***Dependent variable recoding***

After collection, an SPSS function imported, recoded and stored them as ratio (scalar) data using the item alphanumeric as the dependent variable name, and inverted the scalar values for reversal items A1, A2, A5, A6, B1, B2, B3, C2, C4, and U3. Next, an SPSS function summed the dependent variables values and transformed that (scalar) data into four new dependent variable data groups that were also scalar data. These four new data groups were the Affective Component Data Group (ACDG - items A1-A6), the Perceived Control Data Group (PCDG - items C1-C6), the Perceived Usefulness Data Group (PUDG - items U1-U5), and the Behavioral Component Data Group (BCDG - items B1-B4).

***Dependent variable processing***

An SPSS function then summed all values for the original 21 sampling dependent variables and transformed that scalar data into a new dependent variable called the General Attitude Towards Army Serious Gaming (ASG) Data Group (GATASGDG) that

was also scalar data. Finally, an SPSS function recoded participant's GATASGDG data, which is the sum of each responder's attitude Likert response data, into one of five Attitude Toward Gaming Groups (ATTGROUPS). Attitude group 1 (strongly disagree) was scores 21-38 (21 being the lowest possible score); Attitude group 2 (disagree) was scores 39 to 55; Attitude group 3 (undecided) was scores 56 to 72; Attitude group 4 (agree) was scores 73 to 89; and Attitude group 5 (strongly agree) was scores 90 to 105 (105 being the highest possible score).

**Data Analysis Plan**

All significance tests assumed a two-tailed alternative hypothesis and an alpha level of .05. To answer $RQ_1$, $RQ_2$, and $RQ_3$, the inferential parametric statistical method of the t-test for 2 Independent Means was used to first separately evaluate if there is a significant difference in the dependent variable General Attitude Towards Army Serious Gaming (GATASDG is dependent variable) between the independent means of the two groups representing each research question. For $RQ_1$ that is male and female Soldiers (gender is independent variable), for $RQ_2$ that is younger and older Soldiers (AGEGROUPS is independent variable) and for $RQ_3$ that is lesser and better-educated Soldiers (EDUGROUPS is independent variable). While under these circumstances the t-test for 2 Independent Means produces the same result as One-Way ANOVA in SPSS, ANOVA cannot be used for this test because there were only two independent means for each research question, and ANOVA in SPSS cannot perform the One-Way ANOVA post-hoc tests necessary to establish the "t" with only two groups. The same test was then performed for the same reasons to evaluate differences for each of the ACDG, PCCDG, PUCDG, and BCDG data groups (dependent variables) between male and female ($RQ_1$),

younger and older ($RQ_2$), and lesser and better-educated Soldiers ($RQ_3$). Finally, the same test for the same reasons was used to evaluate differences for each of the 21 sampled items (21 dependent variables) between male and female ($RQ_1$), younger and older ($RQ_2$), and lesser and better-educated Soldiers ($RQ_3$).

To answer $RQ_4$ and $RQ_5$, the inferential parametric statistical method of the One-Way ANOVA was used to first separately evaluate if there is a significant difference in the dependent variable GATASDG between the independent means of the three groups representing each research question. For $RQ_4$ that was Soldiers who spend less, average, or higher time playing computer games a week (PGCGROUPS is independent variable) and for $RQ_5$ that was enlisted, NCO or officer Soldiers (CLASSGROUPS was independent variable). Under these circumstances, the One-Way ANOVA in SPSS can be used for this test because there were three independent means for each research question, and ANOVA in SPSS can perform the One-Way ANOVA post-hoc tests necessary to establish the "t" with three groups. Although One-Way ANOVA and regression are equally valid and produce equivalent results (Barnes, 2012), ANOVA was used because the research sought to answer whether particular categories had different effects rather than whether the categories had any effect at all. Put simply by Barnes, "...regression asks, "Do the categories have an effect?" and ANOVA asks "Is the effect significantly different across categories?" (Barnes, 2012, p. 2). The same test was then performed for the same reasons to evaluate differences for each of the ACDG, PCCDG, PUCDG, and BCDG data groups (dependent variables) between Soldiers who spend less, average, or higher time playing computer games a week ($RQ_4$) and enlisted, NCO or officer Soldiers ($RQ_5$). Finally, the researcher used the same test for the same reasons to evaluate

differences for each of the 21 sampled items (21 dependent variables) between male and female, younger and older, and lesser and better-educated Soldiers. Finally, the same test for the same reasons was used to evaluate differences for each of the 21 sampled items (21 dependent variables) between Soldiers who spend less, average, or higher time playing computer games a week ($RQ_4$) and enlisted, NCO or officer Soldiers ($RQ_5$).

**Ethical Consideration (Human Subject Protections)**

The Old Dominion University Education Human Subjects Review Committee reviewed and approved the exempt research application 11 June 2015, filing it "[683261-1] Influence of Learner Factors on Soldier Attitude toward Army Serious Gaming." Conforming to that approval, the research used no federal funds and collected no personally identifying data. The Internet survey method used to collect the data did not reveal any personally identifying data to the researcher because the system did not collect that data. The subject (gender, age, education level, perceived gaming competence, and military class) and survey response data were stored on an encrypted computer hard drive, accessible only by the researcher under lock and key. The study reported all data in aggregate and the researcher destroyed the data after the study was complete.

# CHAPTER IV

# Findings

## Introduction

The purpose of this study was to inform the Army of learner demographic factors that influence Soldier's general attitude toward the use of Army serious gaming for instructional purposes. This chapter contains the data collected to answer the questions:

$RQ_1$: Do Soldiers general attitude towards ASG differ as a function of gender?

$RQ_2$: Do Soldiers general attitude towards ASG differ as a function of age?

$RQ_3$: Do Soldiers general attitude towards ASG differ as a function of education?

$RQ_4$: Do Soldiers general attitude towards ASG differ as a function of perceived gaming competence?

$RQ_5$: Do Soldiers general attitude towards ASG differ as a function of military class (commissioned officer, non-commissioned officer, or enlisted)?

## Data Overview

During the 2-17 July 2015 window, 3,969 Soldiers opened the "Serious Gaming Technology Survey Home" page that they saw on the AKO Home Page. Of that number, 1,709 clicked the link and started the survey, 829 reached the end of the survey, and 709 completed every item of the survey. Those responses for the 709 Soldiers who completed every response was the data set used for the analysis. This response set of 709 Soldiers exceeded the 384 minimum sample size required to achieve a 95% confidence level for the population size of 498,642 Soldiers on active duty on 31 December 2014. Data recoding and transformation occurred as described in the data collection section.

**Survey Findings**

This chapter discusses significant differences found in the General Attitude Towards Army Serious Gaming Data Group (GATASGDG) and its child components and items by Soldiers attributed to the learner factors of gender, age, education level, military class, and perceived gaming confidence, the findings ordered here by these factors. Dependent variable construct items are at table 40 in order of attitude group.

Table 40

*Survey Instrument Constructs in Order of Attitude Group*

General Attitude Towards Army Serious Gaming Data Group (GATASGDG)

Affective Component Data Group (ACDG)
A1 Given the chance to train using an Army serious game such as *Virtual BattleSpace2 or Tactical Iraqi*, I am NOT* afraid that I might have trouble learning in navigating through it.
A2 I DO NOT* hesitate to train using an Army serious game in case I might look stupid.*
A3 I do not feel uneasy about learning using a Army serious game.
A4 Playing Army serious games does not scare me at all.
A5 I DO NOT* hesitate to play Army serious games because I am afraid of making learning mistakes.
A6 Army serious games DO NOT* make me feel uncomfortable in learning.

Perceived Control Data Group (PCDG)
C1 I could probably teach myself most things I need to know about Army serious games.
C2 I AM* in complete control of my avatar when I train using Army serious games.
C3 I can make the computer do what I want it to do while playing an Army serious game.
C4 I DO NOT* need an experienced person nearby when I am using an Army serious game.
C5 If I experience problems training on an Army serious game, I can usually solve them.
C6 I do not need somebody to tell me the best way to use an Army serious game.

Perceived Usefulness Data Group (PUDG)
U1 Army serious games help me to train for my individual and collective tasks better.
U2 Army serious games can enhance training enough to justify possible extra effort.
U3 Most tasks Army serious games train can NOT* be trained better through other means.
U4 Army serious games provide a more useful way to train.
U5 Army serious games make it possible to train more productively.

Behavioral Component Data Group (BCDG)
B1 I would NOT* avoid training on a topic if it involves training using Army serious games.
B2 I DO NOT* only use Army serious games when I am told to.
B3 I DO NOT* avoid playing Army serious games.
B4 I will use Army serious games regularly throughout my military career.
* Indicates reversal item from survey converted back to positive statement for analysis.

The frequencies for each of the 21 independent variable responses are at table 41.

Table 41

*Survey Instrument Frequencies in Order of Attitude Group*

| General Attitude Towards Army Serious Gaming Data Group (GATASGDG) | | | | | | |
|---|---|---|---|---|---|---|
| Affective Component Data Group (ACDG) | | | | | | |
| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree | Total |
| A1 | 024 03.4% | 042 05.9% | 065 09.2% | 226 31.9% | 352 49.6% | 709 |
| A2 | 014 02.0% | 025 03.5% | 072 10.2% | 251 35.4% | 347 48.9% | 709 |
| A3 | 040 05.6% | 050 07.1% | 074 10.4% | 289 40.8% | 256 36.1% | 709 |
| A4 | 025 03.5% | 018 02.5% | 064 09.0% | 198 27.9% | 404 57.0% | 709 |
| A5 | 008 01.1% | 014 02.0% | 083 11.7% | 247 34.8% | 357 50.9% | 709 |
| A6 | 009 01.3% | 030 04.2% | 113 15.9% | 256 36.1% | 301 42.5% | 709 |
| Perceived Control Data Group (PCDG) | | | | | | |
| C1 | 009 01.3% | 042 05.9% | 117 16.5% | 320 45.1% | 221 31.2% | 709 |
| C2 | 036 05.1% | 088 12.4% | 344 48.5% | 137 19.3% | 104 14.7% | 709 |
| C3 | 024 03.4% | 054 07.6% | 239 33.7% | 229 32.3% | 163 23.0% | 709 |
| C4 | 031 04.4% | 129 18.2% | 255 36.0% | 194 27.4% | 100 14.1% | 709 |
| C5 | 016 02.3% | 038 05.4% | 213 30.0% | 300 42.3% | 142 20.0% | 709 |
| C6 | 031 04.4% | 129 18.2% | 255 36.0% | 194 27.4% | 100 14.1% | 709 |
| Perceived Usefulness Data Group (PUDG) | | | | | | |
| U1 | 044 06.2% | 047 06.6% | 180 25.4% | 270 38.1% | 168 23.7% | 709 |
| U2 | 041 05.8% | 037 05.2% | 133 18.8% | 304 42.9% | 194 27.4% | 709 |
| U3 | 084 11.8% | 101 14.2% | 342 48.4% | 116 16.4% | 065 09.2% | 709 |
| U4 | 052 07.3% | 042 05.9% | 215 30.3% | 249 35.1% | 151 21.3% | 709 |
| U5 | 045 06.3% | 049 06.9% | 213 30.0% | 241 34.0% | 161 22.7% | 709 |
| Behavioral Component Data Group (BCDG) | | | | | | |
| B1 | 031 04.4% | 036 05.1% | 088 12.4% | 256 36.1% | 298 42.0% | 709 |
| B2 | 096 13.5% | 200 28.2% | 255 36.0% | 101 14.2% | 057 08.0% | 709 |
| B3 | 053 07.5% | 045 06.3% | 160 22.6% | 231 32.6% | 220 31.0% | 709 |
| B4 | 065 09.2% | 053 07.5% | 265 37.4% | 204 28.8% | 122 17.2% | 709 |

This chapter also discusses significant differences found in the four GATASGDG child groups that are the Affective Component Data Group (ACDG), Perceived Control Data Group (PCDG), Perceived Usefulness Data Group (PUDG), and Behavioral Component Data Group (BCDG). For the 21 independent variable question items that when summed produced the GATASGDG (all 21 items), ACDG (six items), PCDG (six items), PUDG (five items), and BCDG (four items) child groups, this chapter discusses

those individual items that demonstrated significant differences within each child group.

For analysis of learner factors independent variables where each dependent variable consists of two different groups such as gender (male or female), age (younger or older), and education level (lesser or better educated) four assumptions were satisfied before running the independent samples t-test comparisons. The first two assumptions were that each comparison tested only two groups and that the dependent variable was continuous. The third assumption (normality) tested visually and with normality tests, was that the dependent variable was normally distributed within each category of the independent variable. The fourth assumption (homogeneity of variance) tested by Laverne's test, was that similar variation existed within each category of the independent variable. The gender, age, and education level t-tests satisfied these assumptions.

For analysis of learner factors independent variables where each dependent variable consisted of three different groups such as perceived gaming confidence (less, average, or more) and military class (enlisted, NCO, or officer) similar assumptions, with three groups being tested vice two, had to be satisfied before running one-way analysis of variance (ANOVA) tests. The PGC and military class tests satisfied these assumptions.

Detailed analysis results supporting significant and non-significant findings are in Appendix B, ordered by learner factor as they are here.

***Gender***

The first research question asked do Soldiers general attitude towards ASG differ as a function of gender. The two gender groups tested were male and female and the dependent variable was continuous satisfying the first two assumptions for the t-test.

Soldiers who identified as male represent 690 (97.3%) of the 709 Soldiers who

completed every response in the data set used for the analysis. Soldiers who identified as female represent 19 (2.7%) of the Soldiers who completed every response. The low percentage of female Soldiers who completed the instrument initially caused concern because female Soldiers represent 13.6% of active duty Soldiers.

Regarding the assumption of normality necessary to use the t-test, a more important concern was the question of whether the low frequency of female Soldiers in the sampling distribution were normally distributed or whether they were not and thus might have violated the normality assumption. Because sample sizes can adversely affect the results of the Independent samples t-test when the sample size is as small as it is for female Soldiers, separating the male and female Soldier's data and then testing the data visually and with normality tests was necessary. Because the size of the male Soldier sample was larger than the 30 samples that would normally preclude the necessity of determining if the sample violates the assumption of normality, the visual tests of male Soldiers data was necessary in this case to overcome the limitations of the normality test used when one of the sample group exceeds 50 samples.

First, a histogram determined if the female and male Soldier distribution curves visually appeared to be normal (bell-shaped). Those histograms that are at figure 15 appeared to be normal.

Next, quantile - quantile (Q-Q) graphs determined if the female and male Soldiers quantiles visually appeared to be normal (fell close to the diagonal lines). As shown at figure 16 the female and male Soldiers values both fell on the diagonal of their plots indicating that they shared the same distribution.

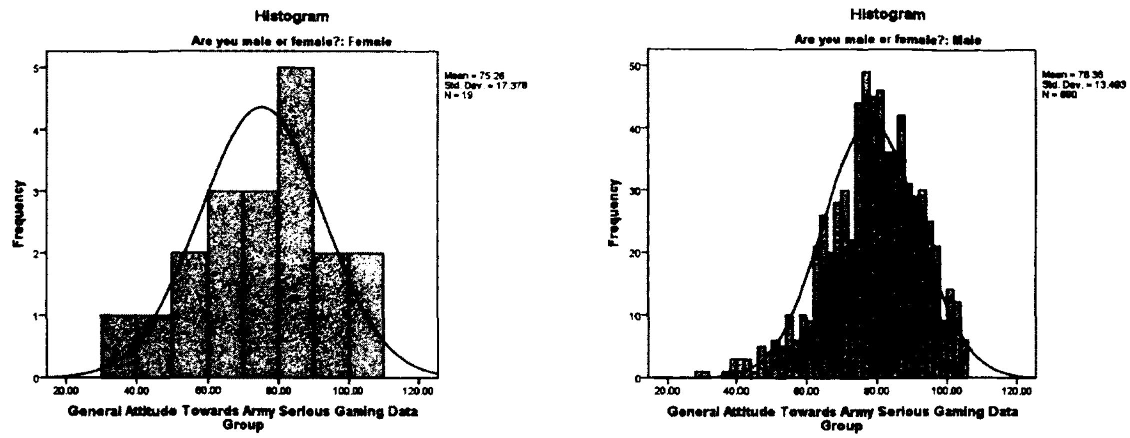


*Figure 15.* Histograms GATASGDG by Gender

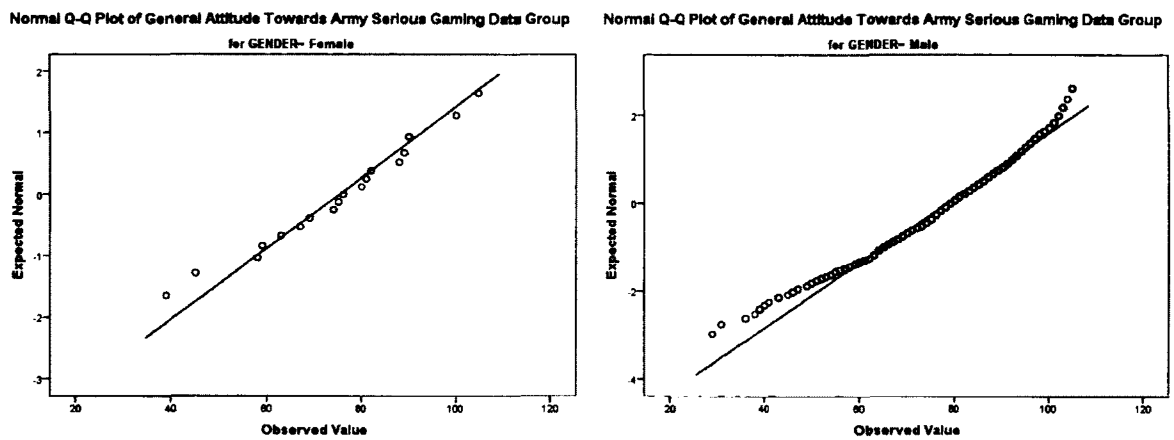


*Figure 16.* Q-Q Plots GATASGDG by Gender

Because visual inspection of the distribution can be unreliable and does not guarantee that the distribution is normal, supplemental normality testing was conducted using the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests to determine if the female Soldier's distribution of scores deviated from a comparable normal distribution as shown at table 42.

It is important to note that large samples considerably affect the K-S and S-W tests causing small deviations from normality to yield significant results. Normally, sample sizes larger than 50 samples preclude their use and SPSS recommends them only for sample sizes smaller than 50 samples as is the case with female Soldiers. Normality

was assumed for the male Soldier data because its size was larger than 30 samples.

Table 42

*Kolmogorov–Smirnov and Shapiro-Wilk Normality Test Results for Gender*

**Tests of Normality**

| | | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | Are you male or female? | Statistic | df | Sig. | Statistic | df | Sig. |
| General Attitude Towards Army Serious Gaming Data Group | Male | .062 | 690 | .000 | .981 | 690 | .000 |
| | Female | .103 | 19 | .200* | .976 | 19 | .880 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

For the K-S test, the female Soldiers GATASGDG scores, $D(19) = 0.103$, $p = .200$, did not deviate significantly from normal. As stated earlier although the test seemed to suggest that male Soldiers GATASGDG scores, $D(690) = 0.062$, $p = .000$, may have deviated significantly from normal this is a known issue with the limitations of the K-S test when measuring large samples and the male Soldier's test finding should be ignored.

For the S-W test the female Soldiers GATASGDG scores, $D(19) = 0.976$, $p = .880$, still did not deviate significantly from normal. Again although the test seemed to suggest that the male Soldiers GATASGDG scores, $D(690) = 0.981$, $p = .000$, may have deviated significantly from normal this is a known issue with the limitations of the S-W test when measuring large samples and the male Soldier's test finding should be ignored.

The histograms, Q-Q plots, and K-S and S-W tests indicated that the female Soldier's distribution of scores were normal and the assumption of normality for those scores was justified. The histograms and Q-Q plots confirmed that the male Soldier's distribution of scores were normal and their assumption of normality was justified.

Regarding the assumption of homogeneity of variance, for this analysis Laverne's test for equality of variances was not violated $F(1, 707) = 2.235$, $p = .135$, proving that

similar variation existed within each category of the independent variable and satisfying the last assumption required to perform the parametric test.

An independent samples t-test comparison of the GATASGDG for male ($M$ = 78.36, $SD$ = 13.49) and female Soldiers ($M$ = 75.26, $SD$ = 17.38) revealed no significant difference between the male and female Soldiers in that data group $t(707) = .980$, ns.

Independent samples t-test comparisons of the ACDG, PCDG, PUDG, and BCDG child groups for male and female Soldiers revealed no significant difference between the male and female Soldiers in these four child data groups, as seen in Table 43.

Table 43

*Independent Samples t-test Data Group Statistics for Gender*

| Data Group | Male Soldiers | Female Soldiers | Finding |
|---|---|---|---|
| GATASGDG | $M$ = 78.36, $SD$ = 13.49 | $M$ = 75.26, $SD$ = 17.38 | $t(707) = 0.980, p = .327$ |
| ACDG | $M$ = 25.21, $SD$ = 03.99 | $M$ = 23.79, $SD$ = 05.41 | $t(707) = 1.511, p = .131$ |
| PCDG | $M$ = 21.60, $SD$ = 03.96 | $M$ = 20.95, $SD$ = 03.95 | $t(707) = 0.710, p = .478$ |
| PUDG | $M$ = 17.62, $SD$ = 04.65 | $M$ = 17.21, $SD$ = 06.07 | $t(707) = 0.375, p = .708$ |
| BCDG | $M$ = 13.94, $SD$ = 03.53 | $M$ = 13.32, $SD$ = 04.67 | $t(707) = 0.576, p = .571$ |

Independent samples t-test comparisons of the 21 independent variable question items revealed no significant difference between the male and female Soldiers in any of the 21 items.

Gender was the only learner factor that revealed no significant difference between male and female Soldiers in all independent variable items. The finding for this research question is that Soldiers general attitude towards ASG does not statistically differ significantly as a function of gender. Neither does it statistically differ significantly as a function of gender in the affective, perceived control, perceived usefulness, and behavioral components, nor in the 21 individual items.

### *Age*

The second research question asked do Soldiers general attitude towards ASG differ as a function of age. The two age groups tested were younger and older and the dependent variable was continuous satisfying the first two assumptions for the t-test.

Soldiers who identified as an age in the younger category (under 29 years old) represent 642 (90.6%) of the 709 Soldiers who completed every response in the data set used for the analysis. Soldiers who identified as an age in the older category (29 years old and up) represent 67 (9.4%) of the 709 Soldiers who completed every response. As was the case for gender, the lower percentage of older Soldiers who completed the instrument initially caused concern because older Soldiers represent 50% of active duty Soldiers.

Regarding the assumption of normality necessary to use the t-test, although the question of whether the lower frequency of older Soldiers in the sampling distribution were normally distributed was much less a concern due their sample size being over twice the 30 sample size normally required for the t-test the same tests were run as were run for gender.

First, a histogram determined if the older and younger Soldier distribution curves visually appeared to be normal (bell-shaped). Those histograms that are at figure 17 appeared to be normal.

Next, quantile - quantile (Q-Q) graphs determined if the younger and older Soldiers quantiles visually appeared to be normal (fell close to the diagonal lines). As shown at figure 18 the younger and older Soldiers values both fell on the diagonal of their plots indicating that they shared the same distribution.

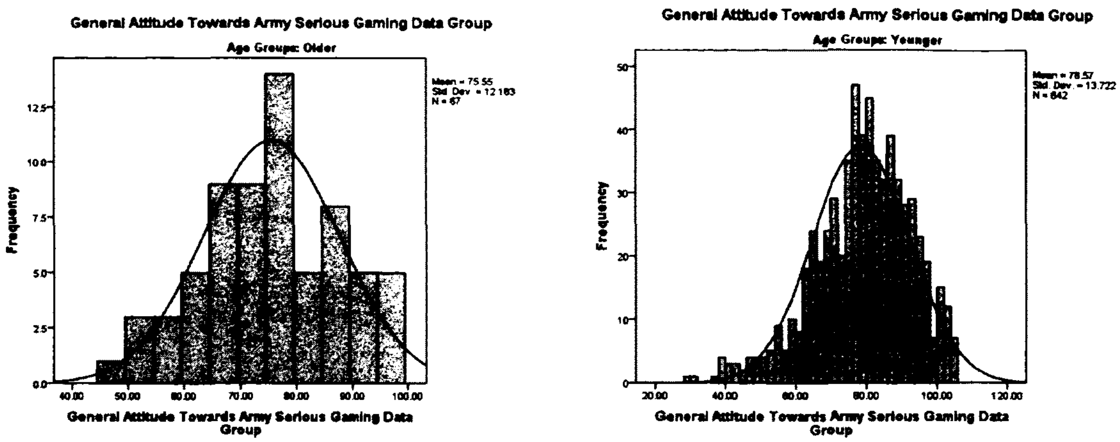


*Figure 17.* Histograms GATASGDG by Age

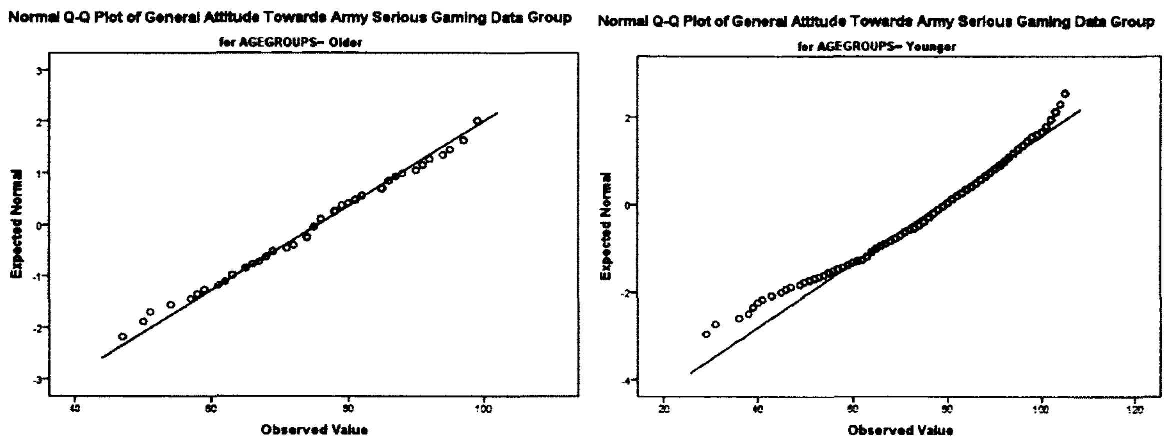


*Figure 18.* Q-Q Plots GATASGDG by Age

Supplemental normality testing was conducted using the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests to determine if the older Soldier's distribution of scores deviated from a comparable normal distribution as shown at table 44. For the reasons earlier indicated, only the older Soldier's sample results are read.

For the K-S test, the older Soldiers GATASGDG scores, $D(67) = 0.091, p = .200$, did not deviate significantly from normal. As stated earlier although the test suggests that the younger Soldiers GATASGDG scores, $D(642) = 0.064, p = .000$, may have deviated significantly from normal this is a known issue with the limitations of the K-S test when measuring large samples and the younger Soldier's test finding should be ignored.

Table 44

*Kolmogorov–Smirnov and Shapiro-Wilk Normality Test Results for Age*

**Tests of Normality**

| | Age Groups | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | | Statistic | df | Sig. | Statistic | df | Sig. |
| General Attitude Towards Army Serious Gaming Data Group | Younger | .064 | 642 | .000 | .977 | 642 | .000 |
| | Older | .091 | 67 | .200* | .985 | 67 | .623 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

For the S-W test the older Soldiers GATASGDG scores, $D(67) = 0.985, p = .623$, still did not deviate significantly from normal. Again, although the test suggests that the younger Soldiers GATASGDG scores, $D(642) = 0.977, p = .000$, may have deviated significantly from normal this is a known issue with the limitations of the S-W test when measuring large samples and the younger Soldier's test finding should be ignored

The histograms, Q-Q plots, and K-S and S-W tests indicated that the older Soldier's distribution of scores were normal and the assumption of normality for those scores was justified. The histograms and Q-Q plots confirmed that the younger Soldier's distribution of scores were normal and their assumption of normality was justified.

Regarding the assumption of homogeneity of variance, for this analysis Laverne's test for equality of variances was not violated $F(1, 707) = 1.365, p = .243$, proving that similar variation existed within each category of the independent variable and satisfying the last assumption required to perform the parametric test.

An independent samples t-test comparison of the GATASGD for younger ($M =$ 78.57, $SD = 13.72$) and older ($M = 75.55$, $SD = 12.18$) Soldiers revealed no significant difference between the younger and older Soldiers in that data group $t(707) = .085$, ns.

Independent samples t-test comparisons of the PUDG and BCDG child groups for

younger and older Soldiers revealed no significant difference between them in these two child data groups. Independent samples t-test comparisons of the ACDG and PCDG child groups as seen in Table 45 did reveal significant differences in these two child data groups, with younger Soldiers having more positive attitudes than older Soldiers.

Table 45

*Independent Samples t-test Data Group Statistics for Age*

| Data Group | Younger Soldiers | Older Soldiers | Finding |
|---|---|---|---|
| GATASGDG | $M = 78.57, SD = 13.72$ | $M = 75.55, SD = 12.18$ | $t(707) = 1.727, p = .085$ |
| ACDG | $M = 25.29, SD = 04.05$ | $M = 24.03, SD = 03.72$ | $t(707) = 2.435, p = .015$* |
| PCDG | $M = 21.70, SD = 04.01$ | $M = 20.49, SD = 03.22$ | $t(707) = 2.842, p = .006$* |
| PUDG | $M = 17.66, SD = 04.65$ | $M = 17.10, SD = 04.21$ | $t(707) = 0.925, p = .355$ |
| BCDG | $M = 13.92, SD = 03.60$ | $M = 13.93, SD = 03.27$ | $t(707) = -.011, p = .992$ |

*significant statistical difference

Independent samples t-test comparisons of the 21 independent variable question items separately revealed significant differences in seven items between the younger and older Soldiers as shown at table 46.

Table 46

*Instrument Items Demonstrating Significant Difference by Age*

A1 Given the chance to train using an Army serious game such as *Virtual BattleSpace2 or Tactical Iraqi*, I am NOT* afraid that I might have trouble learning in navigating through it.
A4 Playing Army serious games does not scare me at all.
A5 I DO NOT* hesitate to play Army serious games because I am afraid of making learning mistakes.
C1 I could probably teach myself most things I need to know about Army serious games.
C3 I can make the computer do what I want it to do while playing an Army serious game.
C5 If I experience problems training on an Army serious game, I can usually solve them.
B2 I DO NOT* only use Army serious games when I am told to.
* Indicates reversal item from survey converted back to positive statement for analysis.

Independent samples t-test statistics of the significant differences between the younger and older Soldiers in the seven items are at table 47. In six of these items, three

each in the Affective Component Data Group (ACDG) and the Perceived Control Data Group (PCDG), younger Soldiers had more positive attitudes than older Soldiers did.

Table 47

*Independent Samples t-test Item Statistics Significantly Different for Age*

| Item | Younger Soldiers | Older Soldiers | Finding |
|---|---|---|---|
| A1 | $M$ = 04.22, $SD$ = 01.04 | $M$ = 03.85, $SD$ = 01.03 | $t(707) = 2.756, p = .006$* |
| A4 | $M$ = 04.35, $SD$ = 00.99 | $M$ = 04.07, $SD$ = 00.91 | $t(707) = 2.168, p = .030$* |
| A5 | $M$ = 04.34, $SD$ = 00.84 | $M$ = 04.06, $SD$ = 00.75 | $t(707) = 2.198, p = .005$* |
| C1 | $M$ = 04.02, $SD$ = 00.92 | $M$ = 03.75, $SD$ = 00.78 | $t(707) = 2.311, p = .021$* |
| C3 | $M$ = 03.66, $SD$ = 01.04 | $M$ = 03.40, $SD$ = 00.84 | $t(707) = 2.368, p = .020$* |
| C5 | $M$ = 03.75, $SD$ = 00.92 | $M$ = 03.51, $SD$ = 00.88 | $t(707) = 2.041, p = .042$* |
| B2 | $M$ = 02.72, $SD$ = 01.11 | $M$ = 03.07, $SD$ = 00.97 | $t(707) = -2.528, p = .012$* |

*significant statistical difference

The item in the Behavioral Component Data Group (BCDG) that revealed a significant difference between younger and older Soldiers, older Soldiers being more positive, was item B2 that before conversion to a positive statement and conversion of responses to ensure fidelity of data read, "I only use Army serious games when I am told to." The item was not significant enough to outweigh the other three items in the BCDG to find the BCDG different enough between younger and older Soldiers to be statistically significant at the group level. Notably, this was the only item of the 21 independent variable items that older Soldiers had a more positive attitude than younger Soldiers did.

The finding for this research question is that Soldiers general attitude towards ASG (GATASG) does not statistically differ significantly as a function of age.

Their attitudes within the child groups that when summed formed their general attitude did statistically differ significantly in two of the four groups.

Soldier's responses in the affective components data group that measured feelings of fear (items A1, A4), hesitation (items A2, A5), and uneasiness (item A3) experienced

before and during gaming did differ statistically significantly with younger Soldiers expressing more positive attitudes than older Soldiers did.

Soldier's responses in the perceived control components data group that measured feelings (items C1, C2, C4, and C6) and reactive behaviours (items C3, C5) while manipulating technological tools did differ statistically significantly with younger Soldiers expressing more positive attitudes than older Soldiers did.

Soldier's responses in the perceived usefulness components data group that measured behaviours arising from beliefs about the advantages of using Army serious games for training (items U1, U2, U3, U4, and U5) did not differ statistically significantly with younger Soldiers and older Soldiers expressing similar attitudes.

Soldier's responses in the behavioral components data group that measured the positive behavior of willingness to use Army serious games for learning (item B4) and the negative behavior of tending to avoid the use of ASG for learning (items B1, B2, and B3) did not differ statistically significantly with younger Soldiers and older Soldiers expressing similar attitudes.

***Education level***

The third research question asked if Soldiers general attitude towards ASG differ as a function of education. The two education level groups tested were lesser and better and the dependent variable was continuous satisfying the first two assumptions for the t-test.

Soldiers who identified as an education level in the lesser-educated category (have not obtained a Bachelor's degree) represent 464 (65.4%) of the 709 Soldiers who completed every response in the data set used for the analysis. Soldiers who identified as an education level in the better-educated category (obtained a Bachelor's degree or

better) represent 245 (34.6%) of the 709 Soldiers who completed every response. Over a third of the Soldiers (245 Soldiers or 34.6%) that completed the instrument were better educated. This frequency was slightly higher than expected because in 2013 Soldiers who had obtained a Bachelor's degree or better only represented 21.49% of active duty Soldiers (DOD, 2013). The frequency of lesser-educated Soldiers (464 or 65.4%) was slightly smaller than expected because in 2013 78.09% of active duty Soldiers had not obtained a Bachelor's degree (DOD, 2013).

Regarding the assumption of normality necessary to use the t-test, the large sizes of the lesser and better-educated Soldier's samples in the sampling distribution should presume no violation on the assumption. In addition, although the large size of both samples prevent the use of the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests visual tests were performed to confirm no violation of the assumption.

First, a histogram determined if the better and lesser-educated Soldier distribution curves visually appeared to be normal (bell-shaped). Those histograms that are at figure 19 appeared to be normal.

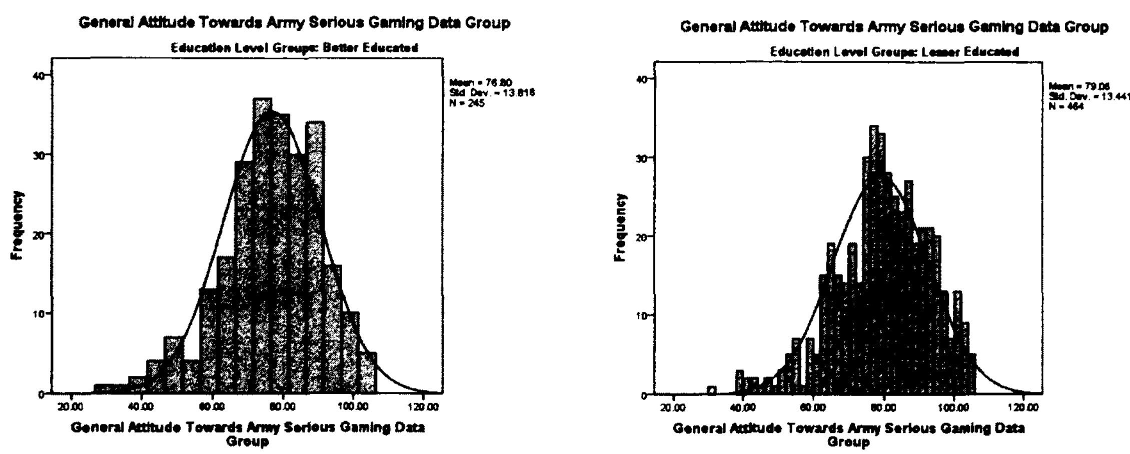


*Figure 19.* Histograms GATASGDG by Education Level

Next, quantile - quantile (Q-Q) graphs determined if the better and lesser-

educated Soldiers quantiles visually appeared to be normal (fell close to the diagonal lines). As shown at figure 20 the better and lesser-educated Soldiers values both fell on the diagonal of their plots indicating that they shared the same distribution.

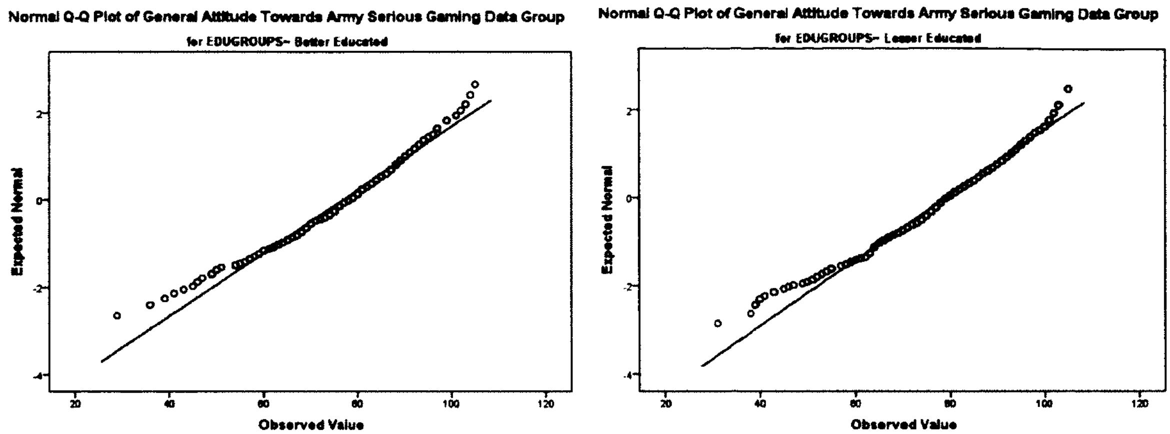


*Figure 20.* Q-Q Plots GATASGDG by Education Level

The histograms and Q-Q plots confirmed that the better and lesser-educated Soldier's distribution of scores were normal and the assumption of normality for those scores was justified.

Regarding the assumption of homogeneity of variance, for this analysis Laverne's test for equality of variances was not violated $F(1, 707) = 0.189, p = .663$, proving that similar variation existed within each category of the independent variable and satisfying the last assumption required to perform the parametric test.

An independent samples t-test comparison of the GATASGDG for lesser-educated ($M = 79.06$, $SD = 13.44$) and better-educated ($M = 76.80$, $SD = 13.82$) Soldiers revealed a significant difference between lesser and better-educated Soldiers in the data group $t(707) = 2.105, p < .05$.

Independent samples t-test comparisons of the ACDG and BCDG child groups for lesser and better-educated Soldiers revealed no significant difference between them in

these two child data groups. Independent samples t-test comparisons of the PCDG and PUDG child groups as seen in Table 48 did reveal significant differences in these two child data groups, with lesser-educated Soldiers having more positive attitudes than better-educated Soldiers.

Table 48

*Independent Samples t-test Data Group Statistics for Education Level*

| Data Group | Lesser-educated | Better-educated | Finding |
|---|---|---|---|
| GATASGDG | $M = 79.06$, $SD = 13.44$ | $M = 76.80$, $SD = 13.82$ | $t(707) = 2.105$, $p = .036$* |
| ACDG | $M = 25.25$, $SD = 03.98$ | $M = 25.01$, $SD = 04.14$ | $t(707) = 0.766$, $p = .444$ |
| PCDG | $M = 21.83$, $SD = 03.96$ | $M = 21.11$, $SD = 03.91$ | $t(707) = 2.318$, $p = .021$* |
| PUDG | $M = 17.97$, $SD = 04.57$ | $M = 16.92$, $SD = 04.85$ | $t(707) = 2.863$, $p = .004$* |
| BCDG | $M = 14.00$, $SD = 03.48$ | $M = 13.77$, $SD = 03.73$ | $t(707) = 0.883$, $p = .405$ |

*significant statistical difference

Independent samples t-test comparisons of the 21 independent variable question items separately revealed significant differences in five items between the lesser and better educated Soldiers as shown at table 49.

Table 49

*Instrument Items Demonstrating Significant Difference by Education Level*

C6 I do not need somebody to tell me the best way to use an Army serious game.
U1 Army serious games help me to train for my individual and collective tasks better.
U3 Most tasks Army serious games train can NOT* be trained better through other means.
U4 Army serious games provide a more useful way to train.
U5 Army serious games make it possible to train more productively.
* Indicates reversal item from survey converted back to positive statement for analysis.

Independent samples t-test statistics of the significant differences between the lesser and better educated Soldiers in the five items are at table 50. In all five items, four in the Perceived Usefulness Data Group (PUDG) and one in the Perceived Control Data Group (PCDG), lesser-educated Soldiers had more positive attitudes than better-educated

Soldiers did.

Table 50

*Independent Samples t-test Item Statistics Significantly Different for Education Level*

| Item | Lesser-educated | Better-educated | Finding |
|---|---|---|---|
| C6 | $M = 03.38, SD = 01.05$ | $M = 03.11, SD = 01.05$ | $t(707) = 3.250, p = .001$* |
| U1 | $M = 03.73, SD = 01.09$ | $M = 03.52, SD = 01.10$ | $t(707) = 2.551, p = .012$* |
| U3 | $M = 03.07, SD = 01.07$ | $M = 02.77, SD = 01.05$ | $t(707) = 3.572, p = .000$* |
| U4 | $M = 03.66, SD = 01.08$ | $M = 03.41, SD = 01.15$ | $t(707) = 2.786, p = .005$* |
| U5 | $M = 03.67, SD = 01.08$ | $M = 03.65, SD = 01.13$ | $t(707) = 2.337, p = .020$* |

*significant statistical difference

The finding for this research question is that Soldiers general attitude towards ASG (GATASG) does statistically differ significantly as a function of education level.

Their attitudes within the child groups that when summed formed their general attitude did statistically differ significantly in two of the four groups.

Soldier's responses in the affective components data group that measured feelings of fear (items A1, A4), hesitation (items A2, A5), and uneasiness (item A3) experienced before and during gaming did not differ statistically significantly with lesser-educated Soldiers and better-educated Soldiers expressing similar attitudes.

Soldier's responses in the perceived control components data group that measured feelings (items C1, C2, C4, and C6) and reactive behaviours (items C3, C5) while manipulating technological tools did differ statistically significantly with lesser-educated Soldiers expressing more positive attitudes than better-educated Soldiers did.

Soldier's responses in the perceived usefulness components data group that measured behaviours arising from beliefs about the advantages of using Army serious games for training (items U1, U2, U3, U4, and U5) did differ statistically significantly with lesser-educated Soldiers expressing more positive attitudes than better-educated

Soldiers did.

Soldier's responses in the behavioral components data group that measured the positive behavior of willingness to use Army serious games for learning (item B4) and the negative behavior of tending to avoid the use of ASG for learning (items B1, B2, and B3) did not differ statistically significantly with lesser-educated Soldiers and better-educated Soldiers expressing similar attitudes.

***Perceived gaming competence***

The fourth research question asked if Soldiers general attitude towards ASG differ as a function of perceived gaming competence. The three PGC groups tested were less, average and more and the dependent variable was continuous satisfying the first two assumptions for the ANOVA.

Soldiers who stated they spent one hour or less a week playing computer games that placed them in the less Perceived Gaming Competence (PGC) category represent 113 (15.9%) of the 709 Soldiers who completed every response in the data set used for the analysis. Soldiers who stated they spent two to eight hours a week playing computer games that placed them in the average PGC category represent 256 (36.1%) of the 709 Soldiers who completed every response. Soldiers who stated they spent an more than eight hours a week time playing computer games that placed them in the more PGC category represent 340 (48.0%) of the 709 Soldiers who completed every response. There were no Army expectations for the frequency of Soldiers PDC or their percentages as PGC data was not collected in the Army before this study.

Regarding the assumption of normality necessary to use the t-test, the large sizes of the less, average, or more PGC Soldier's samples in the sampling distribution should

presume no violation on the assumption. In addition, although the large size of all three samples prevent the use of the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests visual tests were performed to confirm no violation of the assumption.

For each PGC group a histogram determined if the distribution curve visually appeared to be normal (bell-shaped) and a quantile - quantile (Q-Q) graph determined if the quantiles visually appeared to be normal (fell close to the diagonal lines). Those histograms and graphs that are at figures 21, 22, and 23 appeared to be normal.

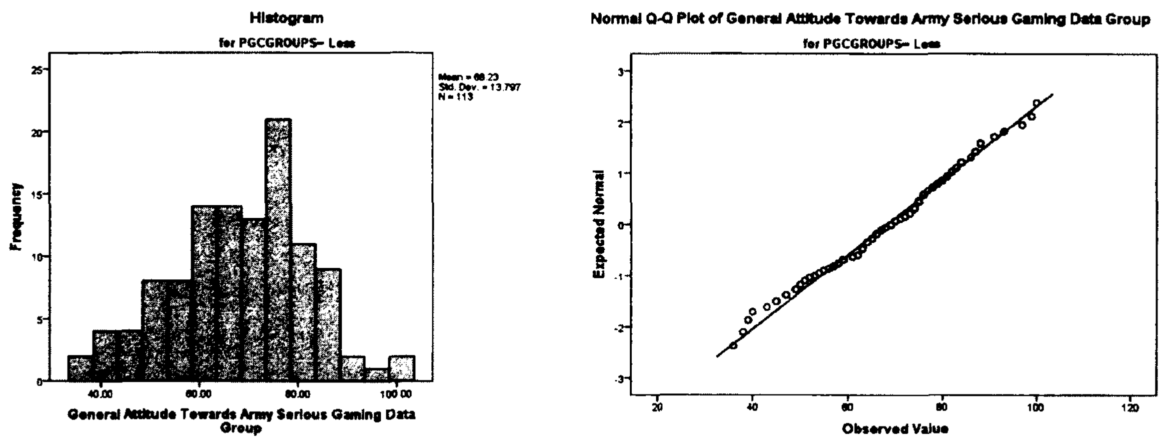


*Figure 21.* Less PGC Soldiers Histogram and Q-Q Plot GATASGDG by PGC

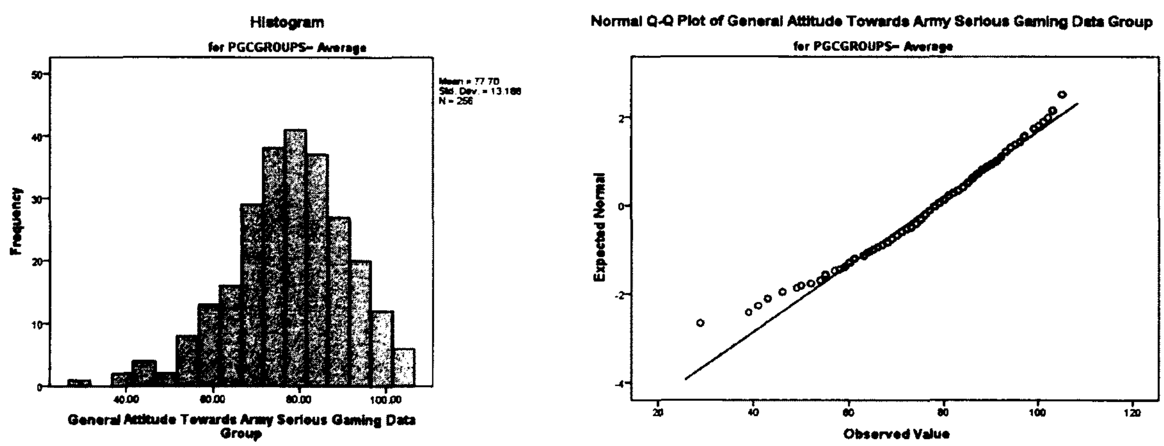


*Figure 22.* Average PGC Soldiers Histogram and Q-Q Plot GATASGDG by PGC

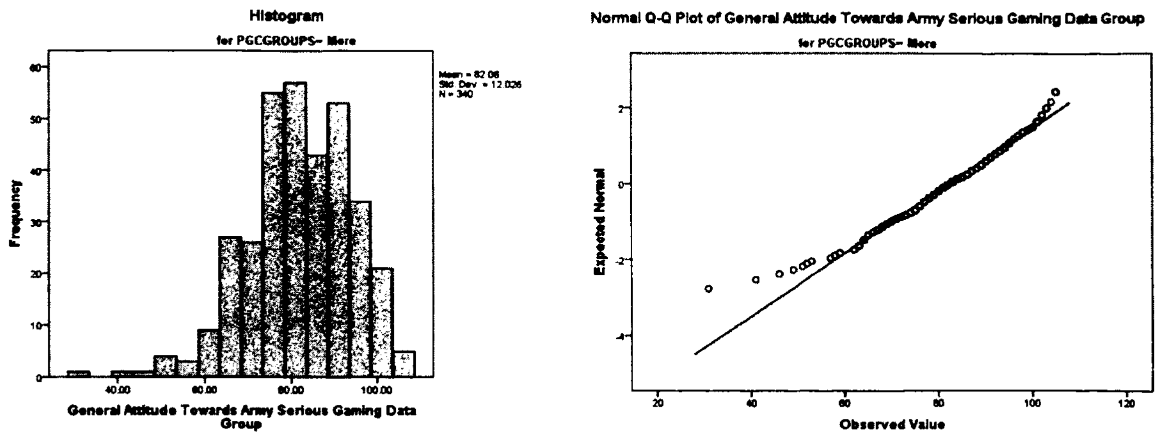


*Figure 23.* More PGC Soldiers Histogram and Q-Q Plot GATASGDG by PGC

The histograms and Q-Q plots confirmed that the less, average and more PGC groups Soldier's distribution of scores were normal and the assumption of normality for those scores was justified.

Regarding the assumption of homogeneity of variance, for this analysis Laverne's test for equality of variances was not violated $F(2, 706) = 1.707$, $p = .182$, proving that similar variation existed within each category of the independent variable and satisfying the last assumption required to perform the parametric test.

A one-way analysis of variance conducted to compare the effects of less, average, and more PGC conditions revealed a significant effect of PGC on GATASGDG between the groups at the $p<.05$ level for the three PGC groups $F(2,706) = 50.33$, $p = 0.000$, as seem in the means plot at figure 24.

Post hoc comparisons using the Tukey HSD test for GATASGDG indicated that the mean score for the less PGC condition ($M = 68.23$, $SD = 13.80$) was significantly different from the average PGC condition ($M = 77.70$, $SD = 13.19$). The less PGC condition ($M = 68.23$, $SD = 13.80$) was significantly different from the more PGC condition ($M = 82.06$, $SD = 12.03$). The average PGC condition ($M = 77.70$, $SD = 13.19$)

was significantly different from the more PGC condition (*M* = 82.06, *SD* = 12.03). The means and standard deviations are in Table 51.

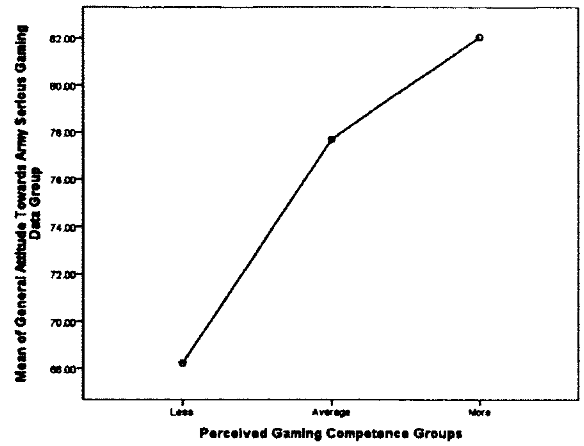


*Figure 24.* Means Plot GATASGDG by PGC Groups.

Table 51

*ANOVA Data Group Statistics for Perceived Gaming Competence*

| Data Group | Less | | Average | | More | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | Finding |
| GATASGDG | 68.23 | 13.80 | 77.70 | 13.19 | 82.06 | 13.19 | $F(2,706) = 50.33, p = .000$* |
| ACDG | 22.80 | 04.54 | 25.21 | 03.98 | 25.92 | 03.58 | $F(2,706) = 27.41, p = .000$* |
| PCDG | 19.50 | 03.38 | 21.18 | 03.84 | 22.57 | 03.90 | $F(2,706) = 29.84, p = .000$* |
| PUDG | 14.49 | 05.14 | 17.45 | 04.54 | 18.76 | 04.14 | $F(2,706) = 39.30, p = .000$* |
| BCDG | 11.44 | 03.66 | 13.85 | 03.41 | 14.80 | 03.26 | $F(2,706) = 41.94, p = .000$* |

*significant statistical difference

One-way analysis of variance did reveal a significant effect in the ACDG $F(2,706) = 27.41, p = 0.00$, PCDG $F(2,706) = 29.84, p = 0.000$, PUDG $F(2,706) = 39.30$, $p = 0.000$, and BCDG $F(2,706) = 41.94, p = 0.000$, between PGC groups at the $p<.05$ level. Post hoc comparisons of each group were conducted.

Post hoc comparisons of the ACDG using the Tukey HSD test indicated that the mean ACDG score for the less PGC condition (*M* = 22.80, *SD* = 04.54) was significantly different from the means score for the average PGC condition (*M* = 25.21, *SD* = 03.98).

The mean score for the less PGC condition (*M* = 22.80, *SD* = 04.54) was significantly different from the mean score for the more PGC condition (*M* = 25.92, *SD* = 03.58). The mean score for the average PGC condition (*M* = 25.21, *SD* = 03.98) was not significantly different from the mean score for the more PGC condition (*M* = 25.92, *SD* = 03.58).

Taken together these results indicate that the higher the PGC the higher the Affective Component Data Group (ACDG) mean score but the rise is not as statistically significant between the average and more PGC conditions as it is between the less PGC conditions and the average and more PGC conditions as shown in the means plot at figure 25.

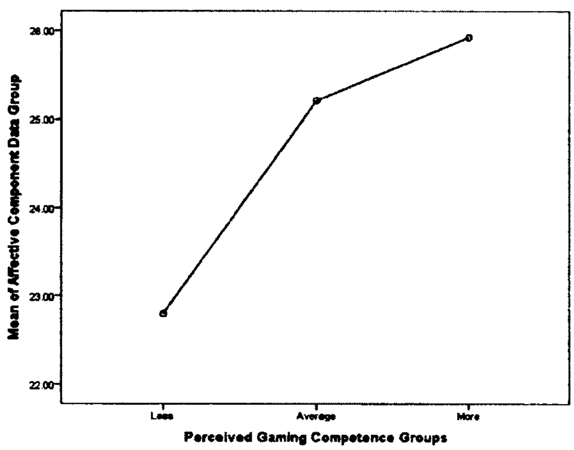


*Figure 25.* Means Plot ACDG by PGC Groups.

Post hoc comparisons of the PCDG using the Tukey HSD test indicated that the mean PCDG score for the less PGC condition (*M* = 19.50, *SD* = 03.38) was significantly different from the mean score for the average PGC condition (*M* = 21.18, *SD* = 03.84). The mean score for the less PGC condition (*M* = 19.50, *SD* = 03.38) was significantly different from the mean score for the more PGC condition (*M* = 22.57, *SD* = 03.90). The mean score for the average PGC condition (*M* = 21.18, *SD* = 03.8) was significantly different from the mean score for the more PGC condition (*M* = 22.57, *SD* = 03.90).

Taken together these results indicate that the higher the PGC the higher the Perceived Control Data Group (PCDG) mean score as shown in the means plot at figure 26.

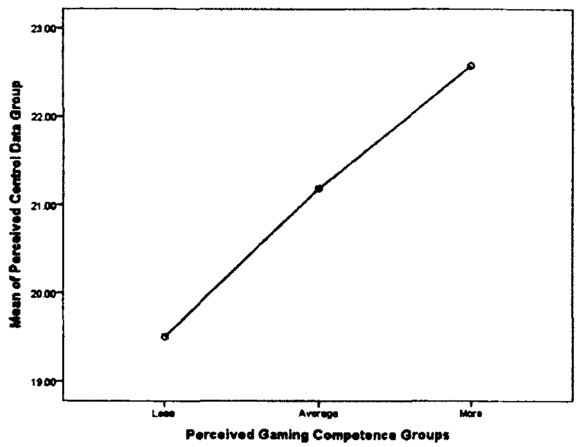


*Figure 26.* Means Plot PCDG by PGC Groups.

Post hoc comparisons of the PUDG using the Tukey HSD test indicated that the mean PUDG score for the less PGC condition ($M$ = 14.49, $SD$ = 05.14) was significantly different from the mean score for the average PGC condition ($M$ = 17.45, $SD$ = 04.54). The mean score for the less PGC condition ($M$ = 14.49, $SD$ = 05.14) was significantly different from the mean score for the more PGC condition ($M$ = 18.76, $SD$ = 04.14). The mean score for the average PGC condition ($M$ = 17.45, $SD$ = 04.54) was significantly different from the mean score for the more PGC condition ($M$ = 18.76, $SD$ = 04.14).

Taken together these results indicate that the higher the PGC the higher the Perceived Usefulness Component Data Group (PUDG) as shown in the means plot at figure 27.

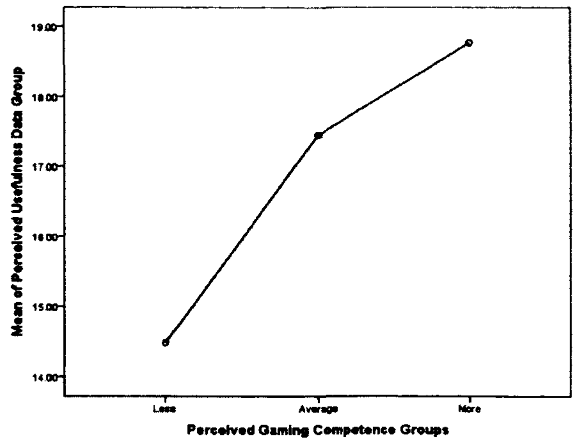


*Figure 27.* Means Plot PUDG by PGC Groups.

Post hoc comparisons of the BCDG using the Tukey HSD test indicated that the mean BCDG score for the less PGC condition (*M* = 11.44, *SD* = 03.66) was significantly different from the mean score for the average PGC condition (*M* = 13.85, *SD* = 03.41). The mean score for the less PGC condition (*M* = 11.44, *SD* = 03.66) was significantly different from the mean score for the more PGC condition (*M* = 14.80, *SD* = 03.26). The mean score for the average PGC condition (*M* = 13.85, *SD* = 03.41) was significantly different from the mean score for the more PGC condition (*M* = 14.80, *SD* = 03.26).

Taken together these results indicate that the higher the PGC the higher the Behavioral Component Data Group (PUDG) as shown in the means plot at figure 28.

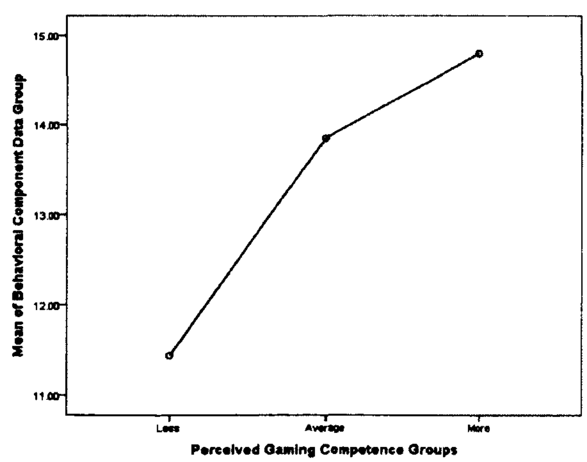


*Figure 28.* Means Plot BCDG by PGC Groups.

One-way analysis of variance of the 21 independent variable question items revealed significant differences between PGC groups in all 21 items shown at table 52.

Table 52

*Instrument Items Demonstrating Significant Difference by PGC*

A1 Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT* afraid that I might have trouble learning in navigating through it.
A2 I DO NOT* hesitate to train using an Army serious game in case I might look stupid.*
A3 I do not feel uneasy about learning using a Army serious game.
A4 Playing Army serious games does not scare me at all.
A5 I DO NOT* hesitate to play Army serious games because I am afraid of making learning mistakes.
A6 Army serious games DO NOT* make me feel uncomfortable in learning.
C1 I could probably teach myself most things I need to know about Army serious games.
C2 I AM* in complete control of my avatar when I train using Army serious games.
C3 I can make the computer do what I want it to do while playing an Army serious game.
C4 I DO NOT* need an experienced person nearby when I am using an Army serious game.
C5 If I experience problems training on an Army serious game, I can usually solve them.
C6 I do not need somebody to tell me the best way to use an Army serious game.
U1 Army serious games help me to train for my individual and collective tasks better.
U2 Army serious games can enhance training enough to justify possible extra effort.
U3 Most tasks Army serious games train can NOT* be trained better through other means.
U4 Army serious games provide a more useful way to train.
U5 Army serious games make it possible to train more productively.
B1 I would NOT* avoid training on a topic if it involves training using Army serious games.
B2 I DO NOT* only use Army serious games when I am told to.
B3 I DO NOT* avoid playing Army serious games.
B4 I will use Army serious games regularly throughout my military career.
* Indicates reversal item from survey converted back to positive statement for analysis.

ANOVA test statistics of the significant differences between the less, average, and more PGC group Soldiers in the 21 items are at table 53.

Post hoc comparisons of the 21 items using the Tukey HSD test indicated that for 12 items, their mean score for the less PGC condition was significantly different from their mean scores for the average and more PGC conditions, and their mean score for the average PGC condition was significantly different from their mean score for the more

PGC condition. Those items were A1, A6, C1, C3, C5, U1, U2, U4, U5, B1, B2, and B3.

Table 53

*ANOVA Item Statistics Significantly Different for PGC*

| Item | Less | | Average | | More | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | Finding |
| A1 | 03.62 | 01.20 | 04.17 | 00.99 | 04.39 | 00.97 | $F(2,706) = 24.209, p = .000$* |
| A2 | 03.88 | 00.98 | 04.25 | 00.86 | 04.39 | 00.91 | $F(2,706) = 13.648, p = .000$* |
| A3 | 03.54 | 01.06 | 03.99 | 01.04 | 04.05 | 01.17 | $F(2,706) = 09.245, p = .000$* |
| A4 | 04.07 | 00.97 | 04.38 | 00.86 | 04.37 | 01.07 | $F(2,706) = 04.426, p = .012$* |
| A5 | 04.02 | 00.95 | 04.33 | 00.79 | 04.40 | 00.82 | $F(2,706) = 09.069, p = .000$* |
| A6 | 03.67 | 00.98 | 04.09 | 00.90 | 04.34 | 00.85 | $F(2,706) = 23.977, p = .000$* |
| C1 | 03.55 | 00.98 | 03.95 | 00.86 | 04.13 | 00.90 | $F(2,706) = 12.226, p = .000$* |
| C2 | 02.94 | 00.91 | 03.25 | 01.00 | 03.38 | 01.05 | $F(2,706) = 08.142, p = .000$* |
| C3 | 03.17 | 00.95 | 03.57 | 01.03 | 03.85 | 00.99 | $F(2,706) = 20.947, p = .000$* |
| C4 | 03.34 | 01.07 | 03.59 | 01.10 | 03.86 | 01.12 | $F(2,706) = 11.134, p = .000$* |
| C5 | 03.26 | 00.84 | 03.66 | 00.91 | 03.93 | 00.89 | $F(2,706) = 25.021, p = .000$* |
| C6 | 03.15 | 00.92 | 03.16 | 01.03 | 03.42 | 01.10 | $F(2,706) = 05.597, p = .004$* |
| U1 | 02.94 | 01.18 | 03.67 | 01.06 | 03.90 | 00.99 | $F(2,706) = 35.882, p = .000$* |
| U2 | 03.10 | 01.19 | 03.80 | 01.06 | 04.05 | 00.93 | $F(2,706) = 36.682, p = .000$* |
| U3 | 02.64 | 01.09 | 02.89 | 01.08 | 03.14 | 01.03 | $F(2,706) = 10.707, p = .000$* |
| U4 | 02.85 | 01.16 | 03.54 | 01.08 | 03.84 | 01.00 | $F(2,706) = 37.361, p = .000$* |
| U5 | 02.96 | 01.13 | 03.56 | 01.09 | 03.84 | 01.02 | $F(2,706) = 29.016, p = .000$* |
| B1 | 03.42 | 01.24 | 04.05 | 01.02 | 04.29 | 00.95 | $F(2,706) = 30.510, p = .000$* |
| B2 | 02.24 | 00.84 | 02.69 | 01.09 | 02.96 | 01.14 | $F(2,706) = 19.765, p = .000$* |
| B3 | 03.10 | 01.35 | 03.72 | 01.13 | 03.95 | 01.08 | $F(2,706) = 23.724, p = .000$* |
| B4 | 02.69 | 01.07 | 03.38 | 01.09 | 03.59 | 01.09 | $F(2,706) = 29.248, p = .000$* |

*significant statistical difference

In all 12 cases, Soldiers with average PGC had more positive attitudes than those with less PGC, and Soldiers with more PGC had more positive attitudes than those with average PGC. Taken together these results indicate that for these 12 items the higher the PGC the higher the positive attitude toward those items as shown in the means plots at figures 29, 30, 31, 32, 33 and 34.

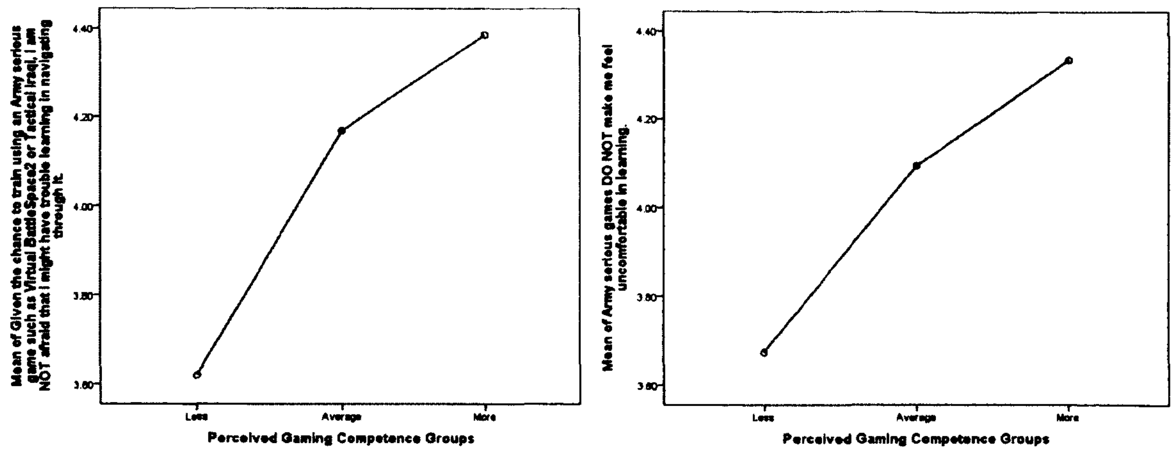


*Figure 29.* Means Plot Items A1 and A6 by PGC Groups.

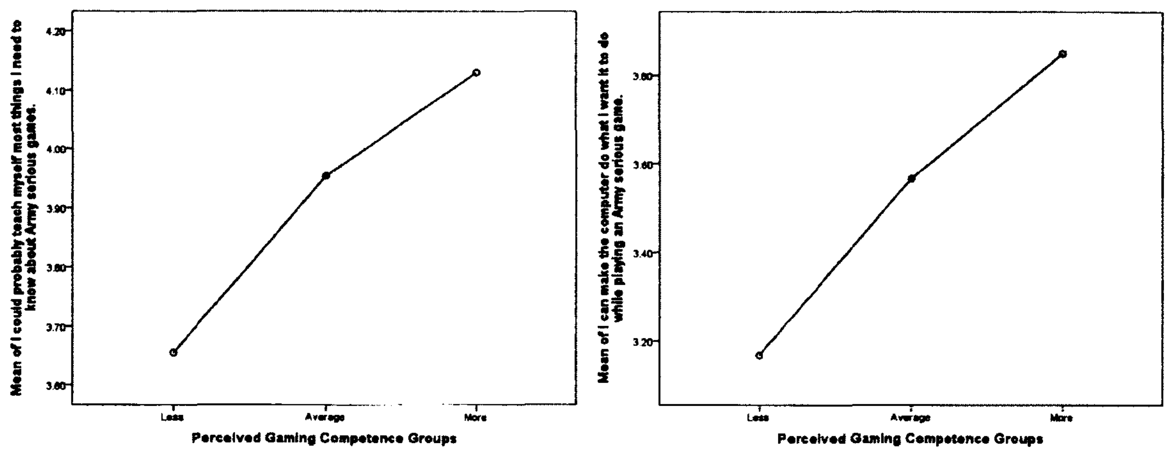


*Figure 30.* Means Plot Items C1 and C3 by PGC Groups.

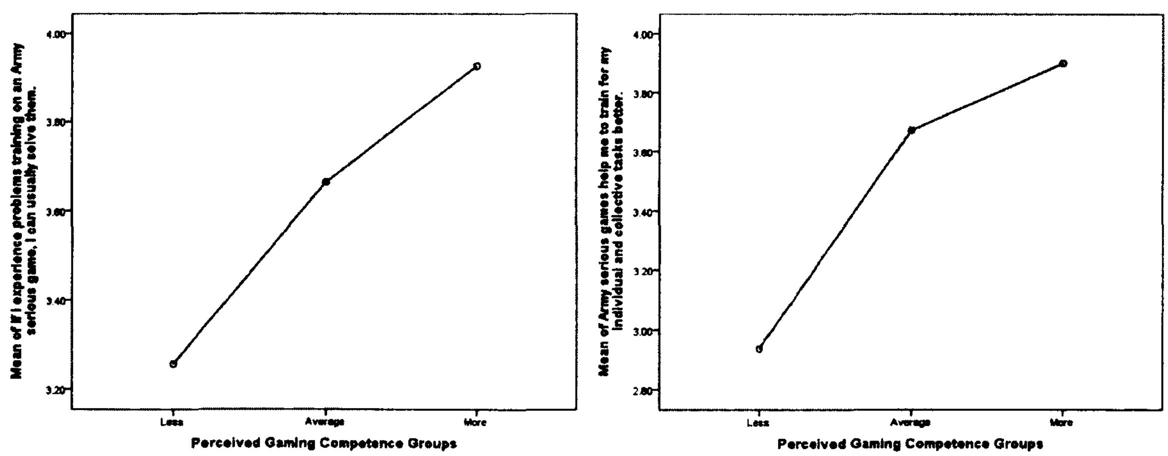


*Figure 31.* Means Plot Items C5 and U1 by PGC Groups.

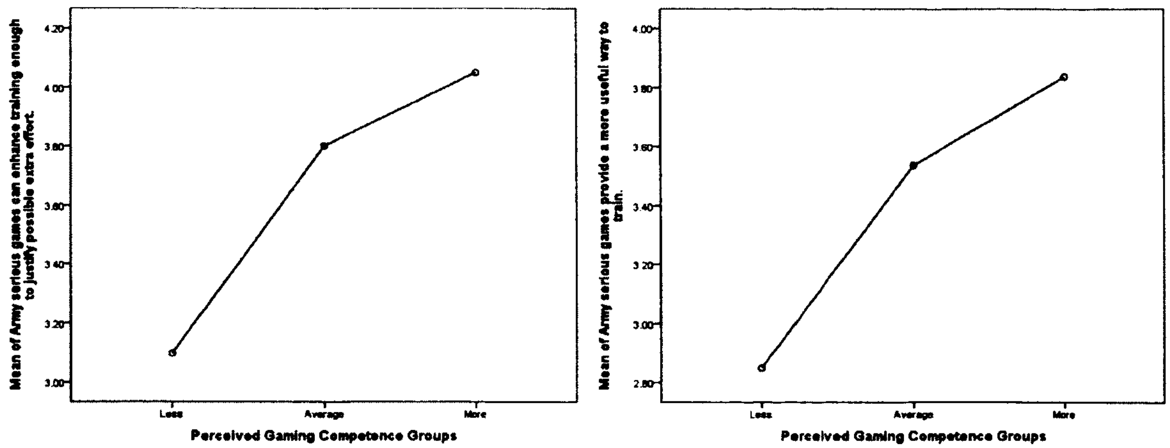


*Figure 32.* Means Plot Items U2 and U4 by PGC Groups.

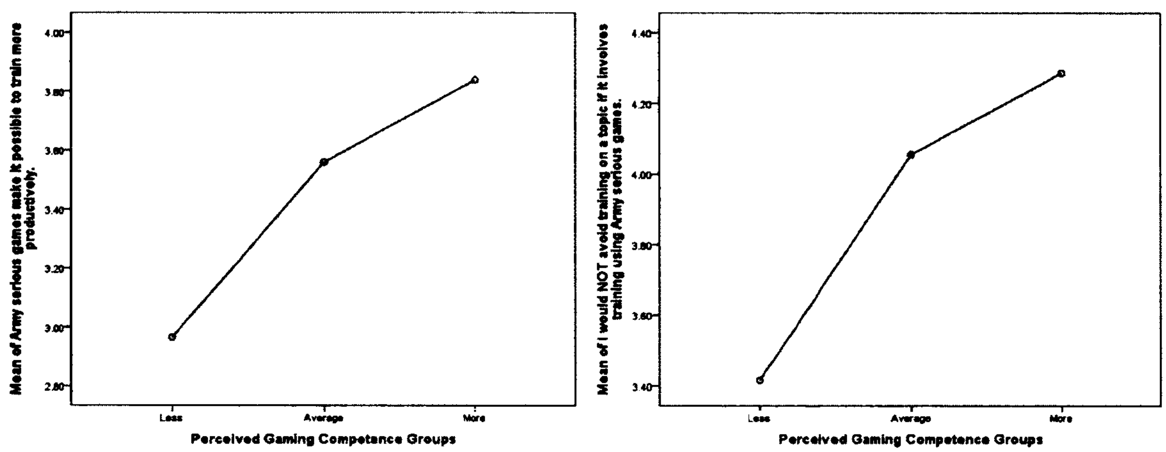


*Figure 33.* Means Plot Items U5 and B1 by PGC Groups.

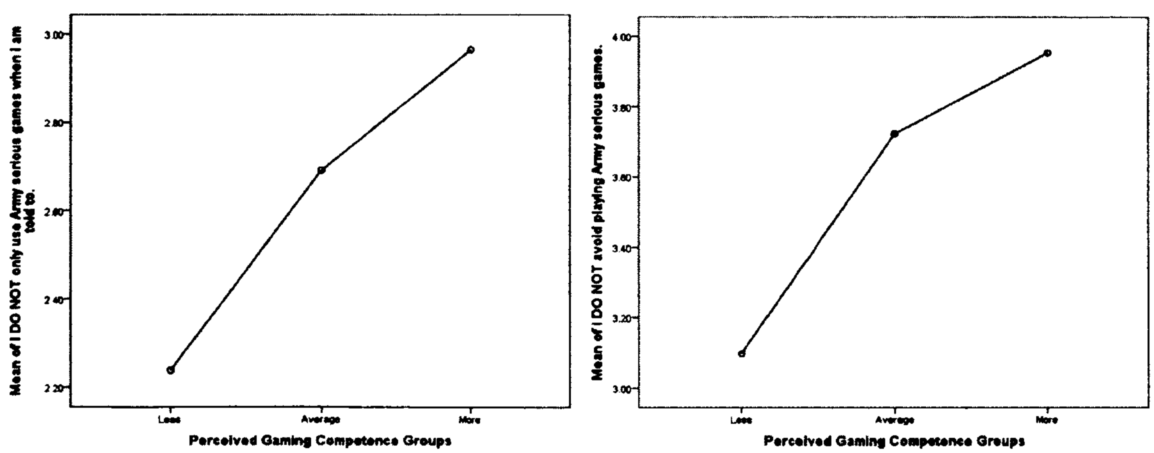


*Figure 34.* Means Plot Items B2 and B3 by PGC Groups.

Post hoc comparisons of A2, A3, A4, A5, and B4 using the Tukey HSD test

indicated their mean score for the less PGC condition was significantly different from their mean score for the average and more PGC conditions, but their mean score for the average PGC condition was not significantly different from their mean score for the more PGC condition. In every case except for item A4, Soldiers with average PGC had more positive attitudes than those with less PGC, and Soldiers with more PGC had more positive attitudes than those with average PGC. In item A4, Soldiers with average PGC had more positive attitudes than those with less PGC, and Soldiers with average PGC had more positive attitudes than those with more PGC. Taken together these results indicate that for 4 of these 5 items the higher the PGC the higher the positive attitude toward those items as shown in the means plots at figures 35, 36, and 37, and that for one of them more analysis may be needed.

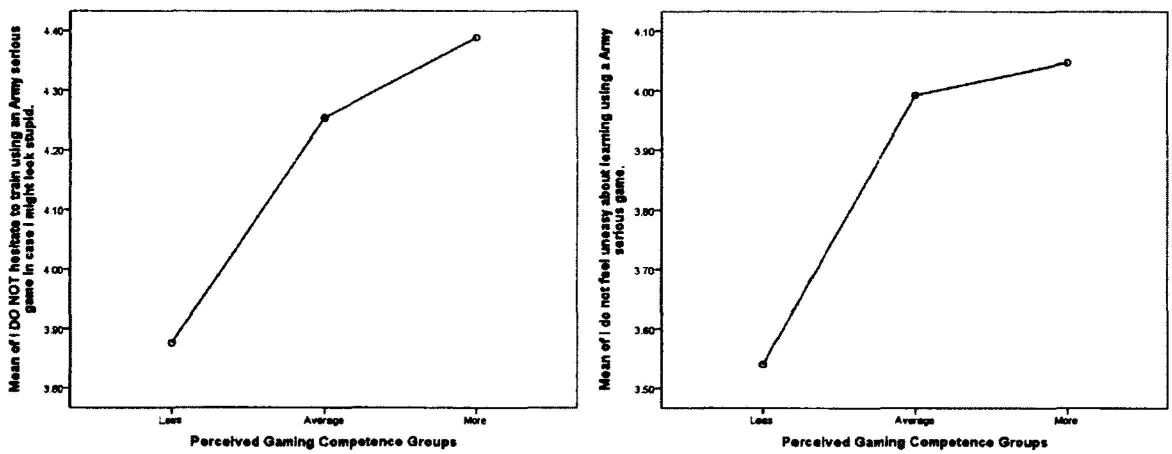


*Figure 35.* Means Plot Items A2 and A3 by PGC Groups.

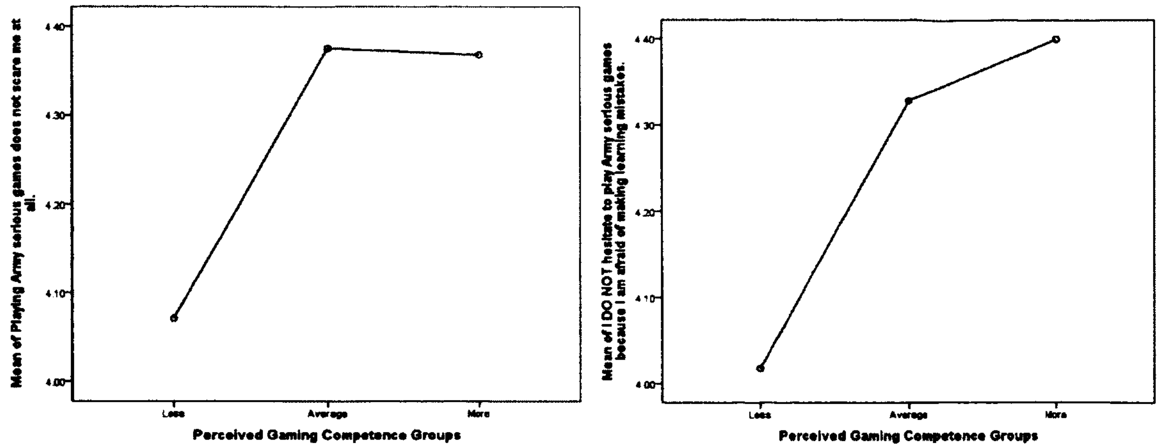


*Figure 36.* Means Plot Items A4 and A5 by PGC Groups.

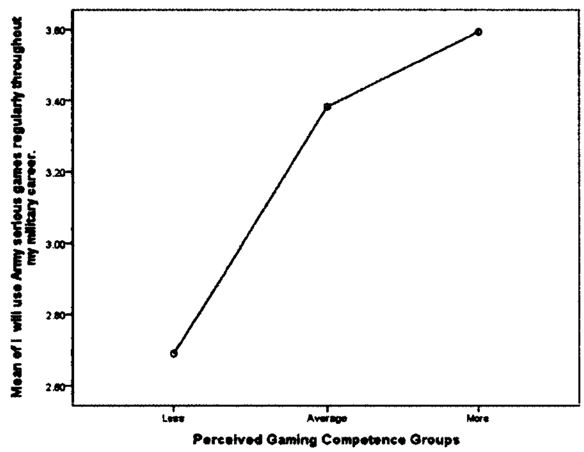


*Figure 37.* Means Plot Items B4 by PGC Groups.

Post hoc comparisons of C2, C4, C6, and U3 using the Tukey HSD test indicated their mean score for the more PGC condition was significantly different from their mean score for the less and average PGC conditions, but their mean score for the less PGC condition was not significantly different from their mean score for the average PGC condition. Taken together these results indicate that for these 4 items the higher the PGC the higher the positive attitude toward those items as shown in the means plots at figures 38 and 39.

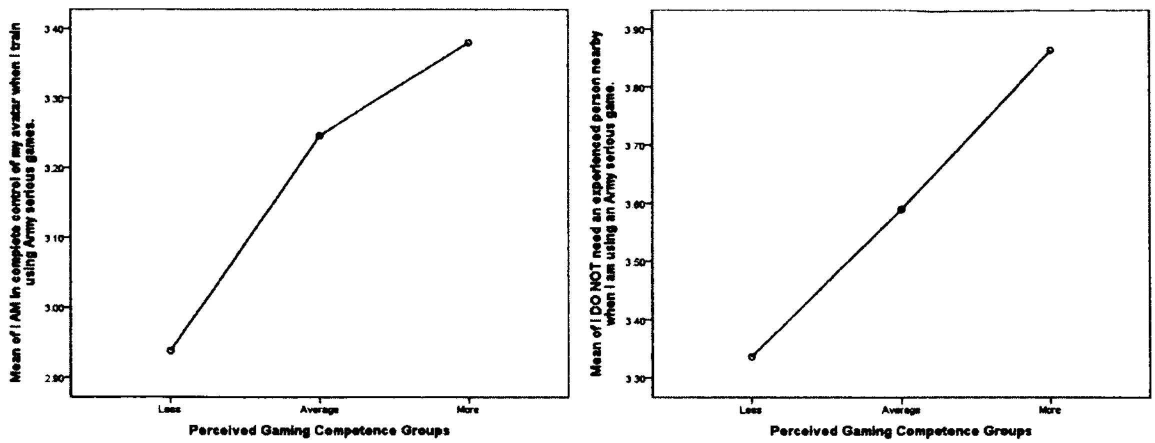


*Figure 38.* Means Plot Items C2 and C4 by PGC Groups.

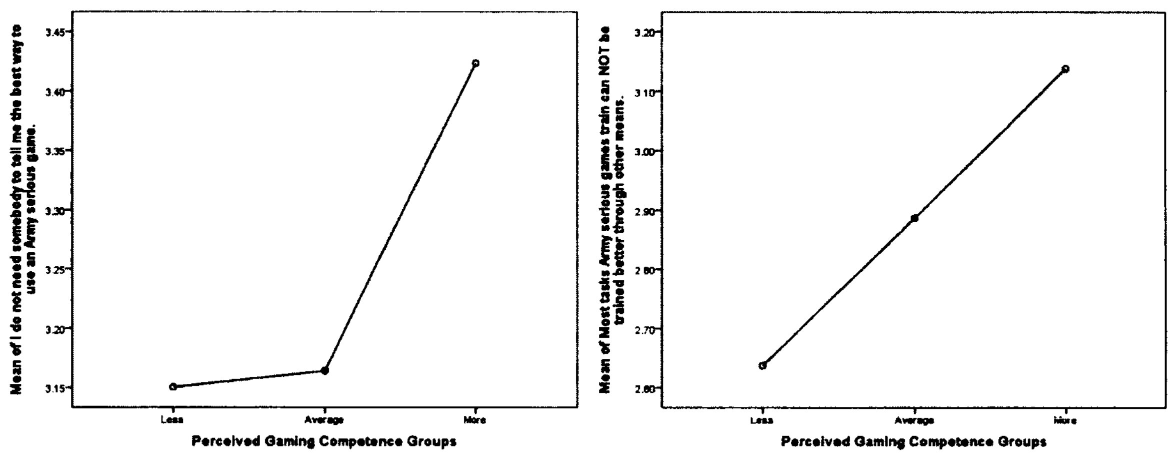


*Figure 39.* Means Plot Items C6 and U3 by PGC Groups.

### *Military class*

The fifth research question asked if Soldiers general attitude towards ASG differ as a function of military class. The three military class groups tested were commissioned officer, non-commissioned officer (NCO), or enlisted and the dependent variable was continuous satisfying the first two assumptions for the ANOVA.

Soldiers who identified as being in grades E-1 to E-4 in the enlisted class category represent 87 (12.3%) of the 709 Soldiers who completed every response in the data set used for the analysis. Soldiers who identified as being in grades E-5 to E-9 in the NCO

class category represent 440 (62.1%) of the 709 Soldiers who completed every response. Soldiers who identified as being in all officer grades in the officer class category represent 182 (25.7%) of the 709 Soldiers who completed every response. Almost two thirds of the Soldiers (440 Soldiers or 62.1%) who completed the instrument identified as NCOs. This frequency was higher than expected because in July of 2015, that was the month that the instrument was taken, Soldiers in the grades of E-5 to E-9 only represented 37.49% of active duty Soldiers (DOD, 2013). The frequency of Soldiers who identified as enlisted (87 or 12.3%) was smaller than the 42.83% of active duty Soldiers in grades E-1 to E-4 in July 2015 (DOD, 2013). The frequency of Soldiers who identified as officers (182 or 25.7%) was slightly larger than the 19.67% of active duty Soldiers in the officer grades in July 2015 (DOD, 2013).

Regarding the assumption of normality necessary to use the t-test, the large sizes of the enlisted, NCO, and officer Soldier's samples in the sampling distribution should presume no violation on the assumption. In addition, although the large size of all three samples prevent the use of the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests visual tests were performed to confirm no violation of the assumption.

For each class a histogram determined if the distribution curve visually appeared to be normal (bell-shaped) and a quantile - quantile (Q-Q) graph determined if the quantiles visually appeared to be normal (fell close to the diagonal lines). Those histograms and graphs that are at figures 40, 41, and 42 appeared to be normal.

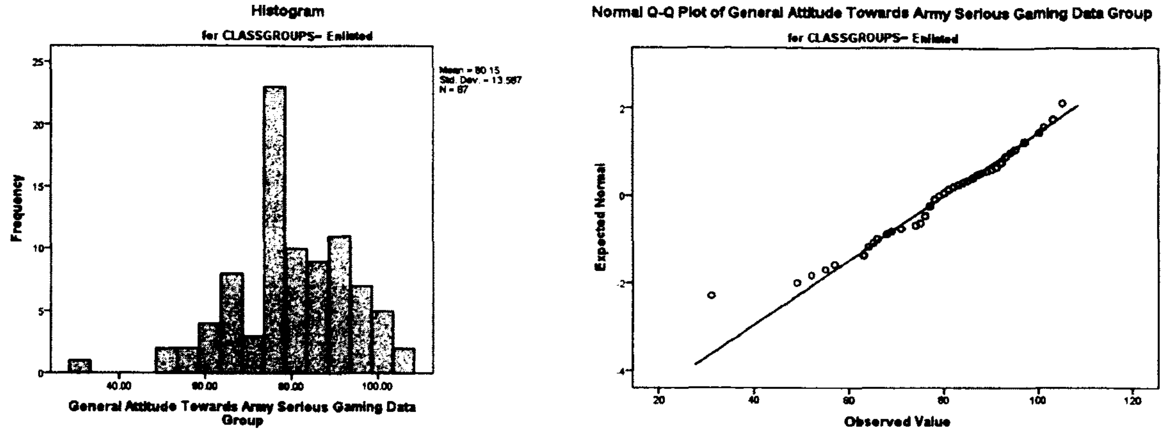


*Figure 40.* Enlisted Soldiers Histogram and Q-Q Plot GATASGDG by Military Class

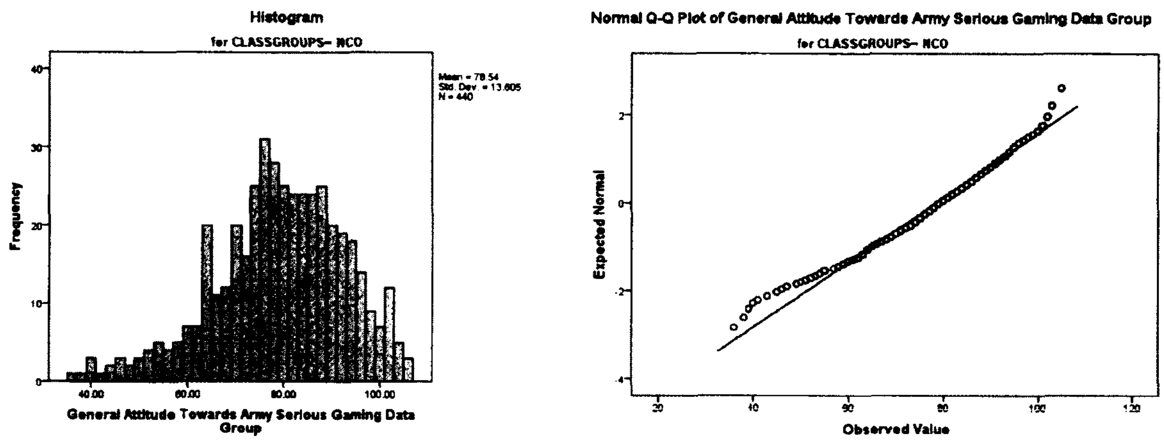


*Figure 41.* NCO Soldiers Histogram and Q-Q Plot GATASGDG by Military Class

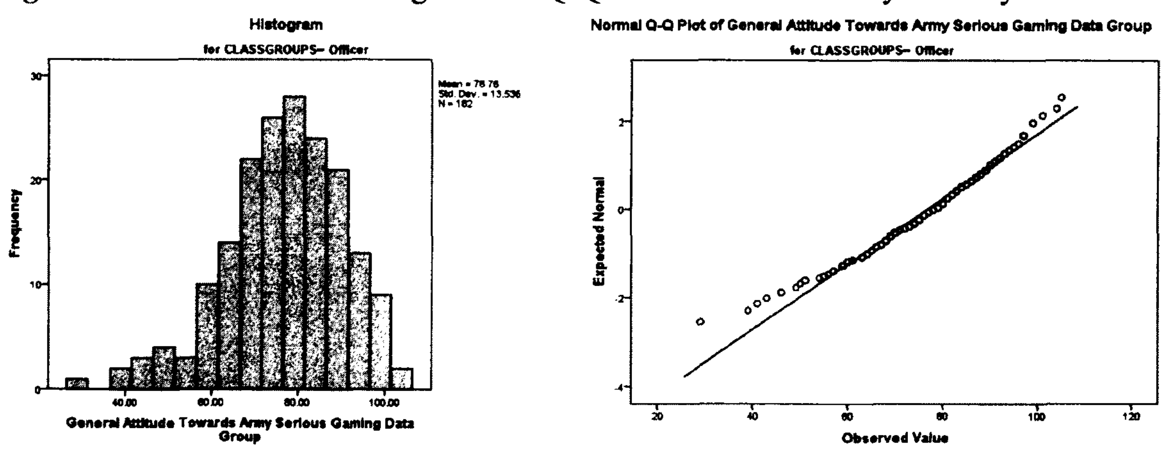


*Figure 42.* Officer Soldiers Histogram and Q-Q Plot GATASGDG by Military Class

The histograms and Q-Q plots confirmed that the enlisted, NCO, and officer military class Soldier's distribution of scores were normal and the assumption of

normality for those scores was justified.

Regarding the assumption of homogeneity of variance, for this analysis Laverne's test for equality of variances was not violated $F(2, 706) = 0.038$, $p = .963$, proving that similar variation existed within each category of the independent variable and satisfying the last assumption required to perform the parametric test.

One-way analysis of variance conducted to compare the effects of enlisted, NCO, and officer class conditions revealed no significant differences in GATASGDG between the class groups $F(2,706) = 2.05$, ns.

One-way analysis of variance conducted to compare the effects of class conditions revealed no significant differences between the class groups in the ACDG $F(2,706) = 0.143$, ns., PCDG $F(2,706) = 2.699$, ns., and BCDG $F(2,706) = 1.770$, ns.

One-way analysis of variance did reveal a significant effect of class in the PUDG between the groups at the $p<.05$ level for the three military class groups $F(2,706) = 4.769$, $p = 0.009$. The means and standard deviations are in Table 54.

Table 54

*ANOVA Data Group Statistics for Military Class*

| Data Group | Enlisted | | NCO | | Officer | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | Finding |
| GATASGDG | 80.15 | 13.60 | 78.55 | 13.61 | 76.76 | 13.54 | $F(2,706) = 2.05, p = .130$ |
| ACDG | 24.95 | 04.02 | 25.21 | 04.06 | 25.18 | 04.00 | $F(2,706) = 2.33, p = .867$ |
| PCDG | 22.18 | 03.97 | 21.68 | 03.93 | 21.07 | 03.96 | $F(2,706) = 2.70, p = .068$ |
| PUDG | 18.43 | 04.42 | 17.80 | 04.67 | 16.75 | 04.77 | $F(2,706) = 4.77, p = .009$* |
| BCDG | 14.59 | 03.43 | 13.85 | 03.49 | 13.76 | 03.78 | $F(2,706) = 1.77, p = .171$ |

*significant statistical difference

Post hoc comparisons of the PUDG using the Tukey HSD test indicated that the mean PUDG score for the enlisted class condition ($M = 18.43$, $SD = 04.42$) was

significantly different from the mean score for the officer class condition (*M* = 16.75, *SD* = 04.77). The mean score for the NCO class condition (*M* = 17.80, *SD* = 04.67) was significantly different from the mean score for the officer class condition (*M* = 16.75, *SD* = 04.77). The mean score for the enlisted class condition (*M* = 18.43, *SD* = 04.42) was not significantly different from the mean score for the NCO class condition (*M* = 17.80, *SD* = 04.67).

These results indicate that the lower the PGC the higher the Perceived Usefulness Data Group (PUDG) mean score but the rise is not as statistically significant between the enlisted and NCO PGC conditions as it is between the NCO and officer PGC conditions and the enlisted and officer PGC conditions as shown in the means plot at figure 43.

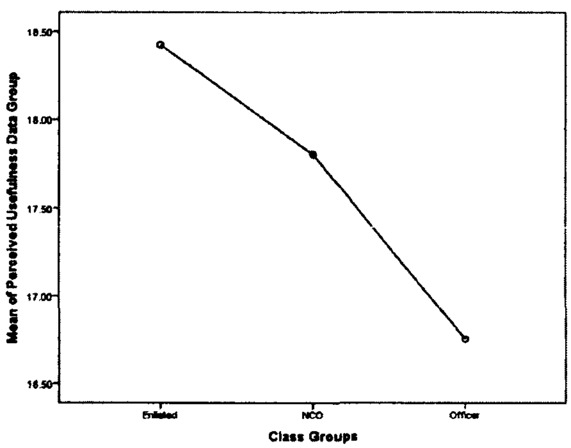


*Figure 43.* Means Plot Perceived Usefulness Data Group by Class Groups.

One-way analysis of variance of the 21 independent variable question items conducted to compare the effects of military class conditions revealed significant differences between the class groups in six items as shown at table 55.

ANOVA test statistics of the significant differences between the enlisted, NCO, and officer class Soldiers in the six items are at table 56.

Table 55

*Instrument Items Demonstrating Significant Difference by Military Class*

C4 I DO NOT* need an experienced person nearby when I am using an Army serious game.
C5 If I experience problems training on an Army serious game, I can usually solve them.
C6 I do not need somebody to tell me the best way to use an Army serious game.
U1 Army serious games help me to train for my individual and collective tasks better.
U3 Most tasks Army serious games train can NOT* be trained better through other means.
U4 Army serious games provide a more useful way to train.
* Indicates reversal item from survey converted back to positive statement for analysis.

Table 56

*ANOVA Item Statistics Significantly Different for Military Class*

| Item | Enlisted | | NCO | | Officer | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | Finding |
| C4 | 03.90 | 00.98 | 03.70 | 01.10 | 03.54 | 01.21 | $F(2,706) = 3.04, p = .048$* |
| C5 | 03.94 | 00.87 | 03.73 | 00.93 | 03.60 | 00.89 | $F(2,706) = 3.91, p = .021$* |
| C6 | 03.25 | 01.06 | 03.38 | 01.05 | 03.09 | 01.04 | $F(2,706) = 4.86, p = .008$* |
| U1 | 03.76 | 00.99 | 03.72 | 01.11 | 03.48 | 01.10 | $F(2,706) = 3.39, p = .034$* |
| U3 | 03.15 | 01.11 | 03.02 | 01.06 | 02.75 | 01.05 | $F(2,706) = 5.76, p = .003$* |
| U4 | 03.81 | 01.04 | 03.60 | 01.11 | 03.38 | 01.12 | $F(2,706) - 5.08, p - .006$* |

*significant statistical difference

Post hoc comparisons of C4, C5, C6, and U4 using the Tukey HSD test indicated their mean score for the enlisted class condition was significantly different from their mean score for the officer class conditions, but their mean score for the NCO class condition was not significantly different from their mean score for the enlisted or officer class conditions.

In items C4, C5, and U4, Soldiers in the enlisted class had more positive attitudes than those in the NCO class, and Soldiers in the NCO class had more positive attitudes than those in the officer class. For item C6, Soldiers in the NCO class had more positive attitudes than those in enlisted class, and Soldiers in the enlisted class had more positive

attitudes than those in the officer class. Taken together these results indicate that for 3 of these 4 items the lower the military class the higher the positive attitude toward those items as shown in the means plots at figures 44 and 45, and that for one of them more analysis may be needed.

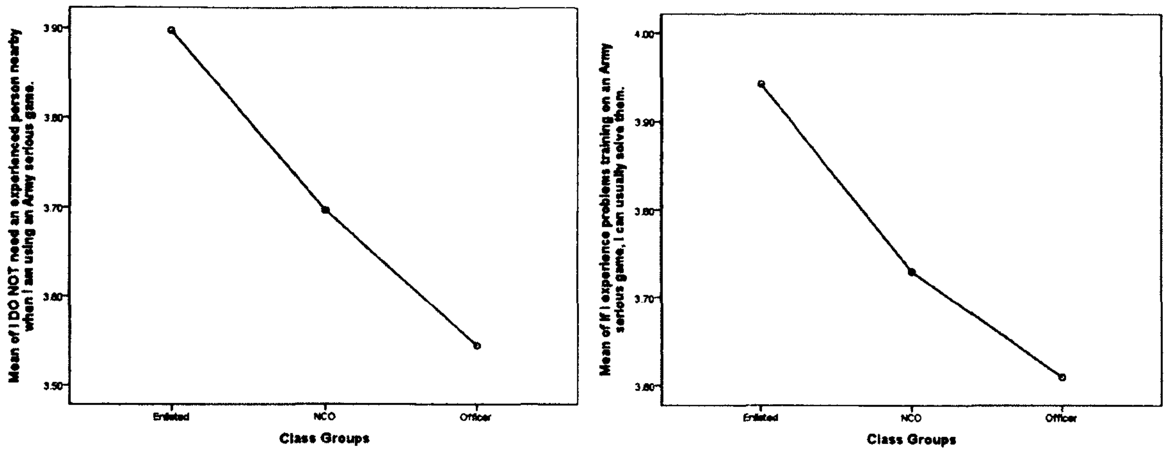


*Figure 44.* Means Plot Items C4 and C5 by Military Class Groups.

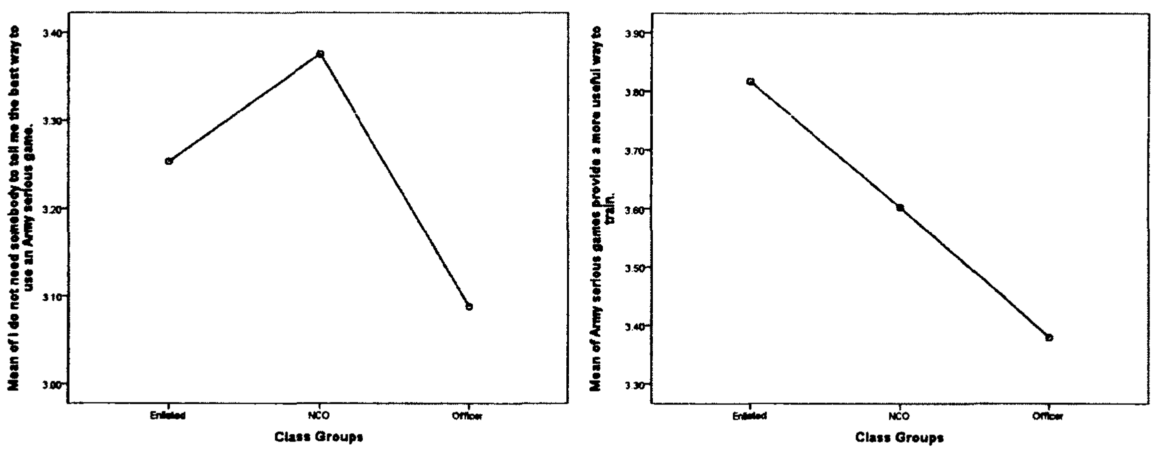


*Figure 45.* Means Plot Items C6 and U4 by Military Class Groups.

Post hoc comparisons of item U1 using the Tukey HSD test indicated the mean score for the NCO class condition was significantly different from the mean score for the officer class conditions, but the mean score for the enlisted class condition was not significantly different from the mean score for the NCO or officer class conditions.

Post hoc comparisons of item U3 using the Tukey HSD test indicated the mean score for the officer class condition was significantly different from the mean score for the enlisted and NCO class conditions, but the mean score for the enlisted class condition was not significantly different from the mean score for the NCO class condition.

For both items U1 and U3, Soldiers in the enlisted class had more positive attitudes than those in the NCO class, and Soldiers in the NCO class had more positive attitudes than those in the officer class. These results indicate that for items U1 and U3 the lower the military class the higher the positive attitude toward those items as shown in the means plot at figure 46.

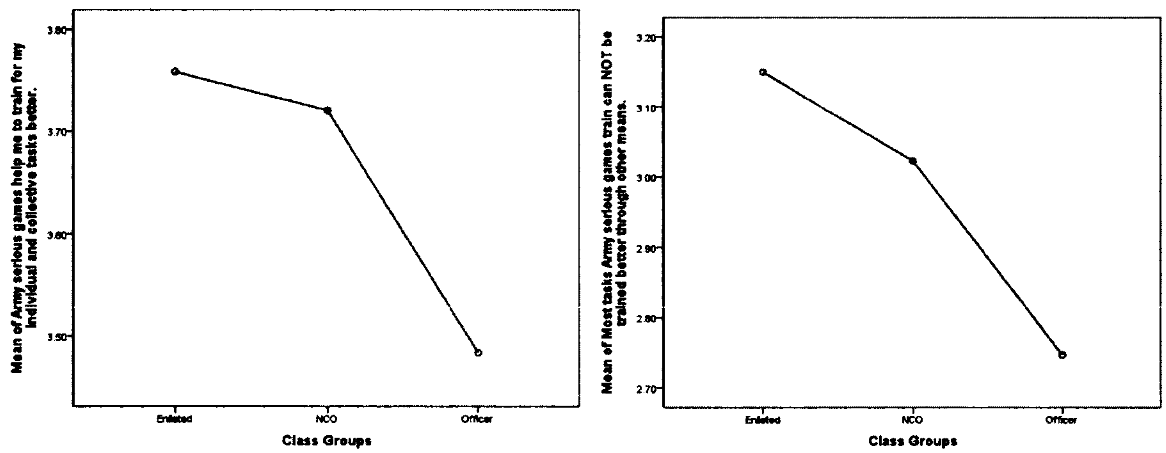


*Figure 46.* Means Plot Items U1 and U3 by Military Class Groups.

**Triangulation**

The General Attitude Towards Army Serious Gaming (ASG) Data Group (GATASGDG) data score is the sum of each Soldier attitude Likert response for the 21 independent variable items that have a Likert range from 1-5. Their score places them into one of five Attitude Toward Gaming Groups called (ATTGROUPS). Attitude group one (strongly disagree) indicates a GATASGDG score range from 21-38 (21 being the lowest possible score). Attitude group two (disagree) indicates a range from 39 to 55.

Attitude group 3 (undecided) indicates a range from scores 56 to 72. Attitude group four (agree) indicates a range from 73 to 89. Attitude group five (strongly agree) indicates a range from 90 to 105 (105 being the highest possible score).

With the sole exception of the less perceived gaming confidence condition, the GATASGDG mean score for the 709 Soldier participants was in the agreement range indicating favorable attitudes toward ASG for every category of the five independent variables. The less PGC condition mean was in the undecided range.

As regards gender, the mean GATASGDG ratings for both male and female Soldiers were in the agreement range indicating favorable attitudes toward ASG. An independent samples t-test comparison of the GATASGDG for male ($M = 78.36$, $SD = 13.49$) and female Soldiers ($M = 75.26$, $SD = 17.38$) revealed no statistically significant difference between the male and female Soldiers in that data group $t(707) = .980$, ns. Gender was the only learner factor that revealed no statistically significant difference between male and female Soldiers attitude ratings in all 21 independent variable items. The finding for this research question is that Soldiers general attitude towards ASG does not statistically differ significantly as a function of gender. Neither does it statistically differ significantly as a function of gender in the affective, perceived control, perceived usefulness, and behavioral components, nor in the 21 individual items.

As regards age, the mean GATASGDG ratings for both younger and older Soldiers were in the agreement range indicating favorable attitudes toward ASG. An independent samples t-test comparison of the GATASGD for younger ($M = 78.57$, $SD = 13.72$) and older ($M = 75.55$, $SD = 12.18$) Soldiers revealed no statistically significant difference between the younger and older Soldiers in that data group $t(707) = .085$, ns.

Although the finding for this research question is that Soldiers general attitude towards ASG (GATASG) does not statistically differ significantly as a function of age, their attitudes within the four child groups that when summed formed their general attitude did statistically differ significantly in two of the four groups. Soldier's responses in the affective components data group that measured feelings of fear (items A1, A4), hesitation (items A2, A5), and uneasiness (item A3) experienced before and during gaming did differ statistically significantly with younger Soldiers expressing more positive attitudes than older Soldiers did for items A1, A4, and A5. Soldier's responses in the perceived control components data group that measured feelings (items C1, C2, C4, and C6) and reactive behaviours (items C3, C5) while manipulating technological tools also differed statistically significantly with younger Soldiers expressing more positive attitudes than older Soldiers did for items C1, C3, and C5. Soldier's responses in the behavioral components data group that measured the positive behavior of willingness to use ASG for learning (item B4) and the negative behavior of tending to avoid the use of ASG for learning (items B1, B2, and B3) differed statistically significantly only on item B2. Item B2 was the only item of the 21 independent variable items that older Soldiers had a more positive attitude of than younger Soldiers did.

As regards education level, the mean GATASGDG ratings for both better and lesser-educated Soldiers were in the agreement range indicating favorable attitudes toward ASG. An independent samples t-test comparison of the GATASGDG for lesser-educated ($M$ = 79.06, $SD$ = 13.44) and better-educated ($M$ = 76.80, $SD$ = 13.82) Soldiers revealed a statistically significant difference between lesser and better-educated Soldiers in the data group $t(707) = 2.105$, $p < .05$. In other words, finding that Soldiers who had

not earned a bachelor's degree had a more favorable general attitude toward ASG than Soldiers who had earned a Bachelor's degree or better. The finding for this research question that Soldiers general attitude towards ASG (GATASG) does statistically differ significantly as a function of education level is based upon the findings for two of the four child groups that when summed formed their general attitude. The PCDG and PUDG child groups revealed significant differences, lesser-educated Soldiers having more positive attitudes than better-educated ones. Soldier's responses in the perceived control components data group differed statistically significantly only on item C6. Soldier's responses in the perceived usefulness components data group that measured behaviours arising from beliefs about the advantages of using Army serious games for training (items U1, U2, U3, U4, and U5) differed statistically significantly on items U1, U3, U4, and U5.

As regards perceived gaming competence, the mean GATASGDG ratings for the Soldiers in the less PGC condition were in the undecided range indicating they were undecided as to whether they agreed with the 21 favorable attitude statements for ASG. Both average and more PGC condition Soldiers were in the agreement range indicating favorable attitudes toward ASG. A one-way analysis of variance conducted to compare the effects of less, average, and more PGC conditions revealed a significant effect of PGC on GATASGDG between the groups at the $p<.05$ level for the three PGC groups $F(2,706) = 50.33$, $p = 0.000$. In other words, Soldiers who played computer games more than eight hours a week had a more favorable general attitude toward ASG than Soldiers who played an average range of two to eight hours a week. Soldiers who played computer games two to eight hours a week had a more favorable general attitude toward ASG than Soldiers who played less than two hours a week. PGC was the only learner factor that

revealed statistically significant differences between less, average, and more PGC condition Soldiers attitude ratings in all 21 independent variable items. The finding for this research question is that Soldiers general attitude towards ASG does statistically differ significantly as a function of PGC. It does statistically differ significantly as a function of PGC in the affective, perceived control, perceived usefulness, and behavioral components, and in each of the 21 individual items.

As regards military class, the mean GATASGDG ratings for the Soldiers in the enlisted, NCO, and officer class conditions were in the agreement range indicating favorable attitudes toward ASG. One-way analysis of variance conducted to compare the effects of enlisted, NCO, and officer class conditions revealed no significant differences in GATASGDG between the class groups $F(2,706) = 2.05$, ns. Although the finding for this research question is that Soldiers general attitude towards ASG (GATASG) does not statistically differ significantly as a function of military class, their attitudes within the four child groups that when summed formed their general attitude did statistically differ significantly in one of the four groups. Although the PCDG child group did not reveal statistically significant differences as a group, Soldier's responses in the PCDG did differ statistically significantly on items C4, C5, and C6 with enlisted class Soldiers having more positive attitudes than officer class Soldiers. The PUDG child group revealed statistically significant differences, enlisted class Soldiers having more positive attitudes than officer class Soldiers with Soldier's responses in the PUDG differing statistically significantly on items U1, U3, and U4.

**Findings summary**

This study found no statistically significant difference between active duty U.S.

Army Soldiers in their general attitude toward Army Serious Gaming (ASG) based on their gender, age or military class. This study found statistically significant differences between active duty U.S. Army Soldiers based on their education level and perceived gaming competence.

Findings of statistically significant difference for the 4 attitude groups and their 21 items summed to create the general attitude score are at table 57.

Table 57

*Findings of Significant Difference by Attitude Data Group and Item*

| | Gender | Age | Ed. Level | PGC | Military Class |
|---|---|---|---|---|---|
| GATASGDG | No | No | Yes | Yes | No |
| ACDG | No | Yes | No | Yes | No |
| A1 | No | Yes | No | Yes | No |
| A2 | No | No | No | Yes | No |
| A3 | No | No | No | Yes | No |
| A4 | No | Yes | No | Yes | No |
| A5 | No | Yes | No | Yes | No |
| A6 | No | No | No | Yes | No |
| PCDG | No | Yes | Yes | Yes | No |
| C1 | No | Yes | No | Yes | No |
| C2 | No | No | No | Yes | No |
| C3 | No | Yes | No | Yes | No |
| C4 | No | No | No | Yes | Yes |
| C5 | No | Yes | Yes | Yes | Yes |
| C6 | No | No | No | Yes | Yes |
| PUDG | No | No | Yes | Yes | Yes |
| U1 | No | No | No | Yes | Yes |
| U2 | No | No | Yes | Yes | No |
| U3 | No | No | Yes | Yes | Yes |
| U4 | No | No | Yes | Yes | Yes |
| U5 | No | No | No | Yes | No |
| BCDG | No | No | No | Yes | No |
| B1 | No | Yes | No | Yes | No |
| B2 | No | No | No | Yes | No |
| B3 | No | No | No | Yes | No |
| B4 | No | No | No | Yes | No |

# CHAPTER V

# Conclusion

## Introduction

If attitudes are "states that are based on aggregates of beliefs and that develop into patterns of stable individual differences" (Snow et al., 1996, p. 290), and changing individuals' behaviour is possible once their attitudes have been identified, (Zimbardo et al., 1977), and social behaviour can be predicted if attitudes are understood (Ajzen & Fishbein, 1980), then understanding the influence of learner factors on Soldier's general attitude towards Army Serious Gaming is important.

The purpose of this study was to inform the Army of learner demographic factors that influence Soldier's general attitude toward the use of Army serious gaming for instructional purposes. The study researched five ASG behavior questions:

$RQ_1$: Do Soldiers general attitude towards ASG differ as a function of gender?

$RQ_2$: Do Soldiers general attitude towards ASG differ as a function of age?

$RQ_3$: Do Soldiers general attitude towards ASG differ as a function of education?

$RQ_4$: Do Soldiers general attitude towards ASG differ as a function of perceived gaming competence?

$RQ_5$: Do Soldiers general attitude towards ASG differ as a function of military class (commissioned officer, non-commissioned officer, or enlisted)?

## Discussion

Previous research in this area of inquiry was often on attitudes, skills, or activity type as separate dependent variables that focused on the independent variable learner factors effect on the learner's dependent variable of skill or activity type rather than the

learner's dependent variable of attitude toward use. This research focuses on the independent variable learner factors effect on attitude. This discussion is not about attitude toward the object ($A_O$) as the dependent variable. This discussion focuses on conclusions regarding five independent variable learner factors effect on attitude toward the behavior involving the object ($A_B$) as the dependent variable, those variables being gender, age, education level, perceived gaming confidence, and military class.

***Gender***

This research supports continued use of ASG for Soldiers of all genders. Selwyn, Gorard, Furlong, and Madden (2003) reported males were more than twice as likely to use information and communication technologies (ICT) that includes home computers. Bonanno and Kommers (2008) found significant gender differences in male and female college students in the four components of attitude towards gaming and in the general attitude toward gaming, with men more positive. Karin A Orvis, Moore, Belanich, Murphy, and Horn (2010) reported Army gameplay gender distinctions were significant with 35% of men and 58.5% of women reporting they had never played a videogame of any type and only 39.1% of men and 10.8% of women playing action/adventure games weekly (Karin A Orvis et al., 2010, p. 149). This study of active duty Soldiers found no statistically significant difference by gender in the general attitude toward Army Serious Gaming (ASG) gaming, in the 4 components of attitude towards gaming, or in the 21 individual items. This difference may reflect male and female Soldiers shared training and combat experiences during the last decade of war or it may reflect changing attitudes towards the role of women in America's Army. The Army population recently witnessed two Soldiers become the first women to complete the Ranger course and may soon

witness the opening of all Army combat military occupational specialties to women. If this occurs, the gender findings of this study suggest that the Army can continue to use ASG to train women Soldiers for their current non-combat positions and to train them for their new combat positions without a negative Return on Investment (ROI) for ASG costs. The findings also suggest that concerns about non-participation for geographically distributed female ASG learners, especially those that train from their home, may be baseless.

***Age***

This research supports continued use of ASG for Soldiers of all ages. After Prensky's (2001a) publication of "Digital Natives, Digital Immigrants," the use of age as a research independent variable increased. Selwyn, Gorard, Furlong, and Madden found young people were more than twice as likely to use ICT (Selwyn et al., 2003). Ching-Chiu, using gender, age, and perceived gaming competence as independent variables for measured "attitudes toward digital game-based learning based upon … learning styles" (Ching-Chiu, 2006, p. 29) finding significant differences only in age. In their study Bonanno and Kommers (2008) sample was students between 16 to 18 years of age. That three-year range may explain why their study could not research age as an independent variable. A potential population limitation of all three of the studies, in extending results to the Army, is that they used either college students or adults too old to serve in the military. Orvis et al. (2010) found that for age, there was a "...significant negative correlation between age and videogame usage... between 27 and 60% of soldiers, regardless of age group, reported that they never play any type of videogame, with the percentage increasing as age increased" (Karin A Orvis et al., 2010, p. 149). For this

study, the mean age for the participating Soldiers was just under 31 years of age. The youngest Soldier was 18 and the oldest was 67 for a range of 49 years. This study found no statistically significant difference in general attitude toward ASG between younger ($M = 78.57$, $SD = 13.72$) and older ($M = 75.55$, $SD = 12.18$) Soldiers, however it was not far off from doing so $t(707) = .085$, $p = .05$. It found statistically significant differences in two of the four attitude constructs - within seven of the 21 independent variable question items. At the group level, the data suggests that older Soldiers perceive that ASG is useful and are willing to use ASG, however statistically significant differences do exist between younger and older Soldiers for the affective components and the perceived control components data groups. Those differences are in the ACDG items that measured feelings of fear and hesitation experienced before and during gaming, and in the PCDG items that measured feelings and reactive behaviours while manipulating technological tools, each accounting for three items with statistically significant differences. These affective and perceived control construct findings may warrant emphasis on familiarizing older Soldiers on how to manipulate ASG to alleviate any fear and hesitation in how to use ASG. Without duplication of these results, these findings do not infer support for digital native theory. That theory, that digital natives that are people born after 1980 (less than 35 years of age at the time of this study) innately possess computer technology knowledge and skills (Prensky, 2001a) and that their brains are somehow physiologically different than their older digital immigrants (Prensky, 2001b) has, because of the absence of empirical evidence to support them, received scathing academic criticism. As stated by Selwyn, "...the overall tenor of these discursive constructions of young people and technology tends towards exaggeration and inconsistency" (Selwyn, 2009, p. 370) with

many of these claims "grounded rarely, if at all, in rigorous, objective empirical studies conducted with representative samples" (Selwyn, 2009, p. 370). Bennett, Maton, and Kervin in their critical review of the digital native claims concluded, "There is no evidence of … a distinctly different learning style the like of which has never been seen before" (Bennett, Maton, & Kervin, 2008, p. 780).

***Education level***

This research supports continued use of ASG for Soldiers of all education levels. This study found a statistically significant difference in general attitude toward ASG between lesser and better-educated Soldiers, finding that Soldiers who had not earned a bachelor's degree had a more favorable general attitude toward ASG than Soldiers who had earned a Bachelor's degree or better. This finding was unexpected. At the group level, the data suggests that better educated Soldiers have no feelings of fear, hesitation, or uneasiness experienced before and during gaming and are willing to use ASG, however statistically significant differences do exist between them and lesser-educated Soldiers for the perceived control and the perceived usefulness components data groups. Those differences are in the PCDG items that measured feelings and reactive behaviours while manipulating technological tools and in the PUDG items that measured behaviours arising from beliefs about the advantages of using Army serious games for training. They may warrant emphasis on familiarizing better-educated Soldiers on how to manipulate ASG to alleviate any fear and hesitation and coaching them on ASG usefulness. It is also possible that the lower PUDG ratings for better-educated Soldiers reflect a capability gap of ASG suitable for personnel that are more senior in rank that are better educated.

***Perceived gaming competence***

This research supports continued use of ASG for Soldiers of all PGC. In 2005 research of United States Military Academy (USMA) cadets, Orvis, et al. found "... a wide range of prior videogame experience across the military participants in this sample, with 17% of cadets reporting they have no experience playing videogames and 44% reporting they have limited videogame experience"(Karin A. Orvis et al., 2005, p. vii). At the conclusion a two-year extension of that research, Orvis, et al. found that "... as many as 60% of the cadets reported that they had no or very limited videogame experience in the past year" (Karin A Orvis et al., 2010, p. 145). Using results from the biennial 2006-2007 Sample Survey of Military Personnel (SSMP) administered to Soldiers worldwide by the U.S. Army Research Institute's (ARI) Personnel Survey Office, Orvis, et al. (2010) later found that less than 43% of responding Soldiers played any type of videogame at least once a week and 38.5% had never played a videogame. For this study, the mean number of hours for the participating Soldiers was just over 9 hours a week. This mean may have been limited because the maximum number of hours that a Soldier could on the instrument was "20 or more," and 48% of the 709 Soldiers who completed the instrument selected that figure. This study found a statistically significant difference in general attitude toward ASG between Soldiers who reported less, average, or more PGC. Moreover, it does statistically differ significantly as a function of PGC in the affective, perceived control, perceived usefulness, and behavioral components, and in each of the 21 individual items. In short, the more hours a Soldier spent playing computer games the higher the PGC reported and the more favorable the Soldier's attitude toward ASG. This suggests that the Army policy of making ASG available to Soldiers to

download and play on their home computers should be encouraged and expanded to other Army learners that might benefit from ASG such as the Army's civilian workforce.

***Military class***

This research supports continued use of ASG for Soldiers of all military classes. Orvis et al. (2010) found for military class, that when restricted to games similar to those in the Army serious games suite, weekly play figures by rank dropped steeply. They dropped to under 50% for E-4s and below, under 30% for E-5 to E-7 and O-1s to O-2s, under 27% for O-3s to O-4s, and under 10% for E8s to E-9s and O-5s to O-6s (Karin A Orvis et al., 2010, p. 150). This study found no statistically significant difference in general attitude toward Army Serious Gaming (ASG) gaming between enlisted, NCO and officer Soldiers. For the PUDG, the data suggests that statistically significant differences exist between officers and other Soldiers. Those differences are in the PUDG items that measured behaviours arising from beliefs about the advantages of using ASG for training. They may warrant further emphasis to officer Soldiers of the advantages of ASG. As indicated earlier, the lower PUDG ratings for officer Soldiers may reflect a capability gap of ASG suitable for personnel that are more senior in rank. This may be because most senior level training uses constructive simulation rather than the virtual simulation capabilities that most closely represent ASG.

**Conclusions**

The first recommendation for further research is that if the Army replicates this research a larger number of female and older Soldiers should be encouraged to participate, and that research should consider using a randomly selected forced sample. This research used the AKO portal to gate learners to the AKO page that explained the

survey purpose that then sent them to the survey on a different website with the survey itself capturing response data permitted capturing the number of Soldiers that completed each stage rather than the normal practice of just counting completers in the last stage. As a result, many Soldiers dropped along the way with no way to categorize them before they completed the survey. Although the statistical tests used indicate that the smaller sample sizes for older Soldiers and female Soldiers that completed were normally distributed and represent the population, there is no way to know how many older Soldiers or women Soldiers dropped on their way to the survey. Nor is there any way to determine how many had no interest in the subject. Thus, if the Army, that has the authority to require a random sample to participate because it is the Army, replicates this research, it should consider requiring completion by all randomly selected participants.

The second recommendation for future research is that any possible version of the instrument that includes PGC should record an integer that the learner may enter for number of hour per week that the learner plays computer games. In the current instrument, the 20 hours or more a week selection was selected far more frequently than had been anticipated.

A separate topic should be the subject of its own research effort is whether Soldiers in all components (Active, Army National Guard, and Army Reserve) would willingly purchase a more expensive home computer capable of running most ASG from their homes than the computer they may be using for distributed learning Interactive Multimedia Instruction (IMI) now.

Although not a component of attitude toward the behavior involving the object ($A_B$) as the dependent variable, and thus not a concern for a future version of the

instrument, the Army should nonetheless research whether a capability gap in ASG exists for training more senior officers (that are better educated) that might better explain the officer class findings.

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# APPENDIX A

## Instrument

**Attitude Toward Army Serious Gaming (ASG)**

**This under five minute survey investigates Soldier attitudes towards the use of Army Serious Gaming (ASG). We want you to participate because your opinion matters in determining the extent to which gaming may be used for future training. There are no risks associated with your participation and you may stop at any time without penalty. We will not ask any question that might identify you and all responses that you provide will be destroyed at the conclusion of the research. If you have any questions about the research study, please contact Mitchell Bonnett at mbonn006@odu.edu. This research has been reviewed according to Old Dominion University IRB procedures for research involving human subjects.**

* 1. ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

• you have read the above information
• you voluntarily agree to participate
• you are at least 18 years of age

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

ELECTRONIC CONSENT: Please select your choice below. Clicking on the "agree" button below indicates that: • you have read the above information • you voluntarily agree to participate • you are at least 18 years of age If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

○ agree

○ disagree

## Attitude Toward Army Serious Gaming (ASG)

2. Please rate the following item below based on a 1-5 scale where 1 is Strongly Disagree and 5 is Strongly Agree.

| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am afraid that I might have trouble learning in navigating through it. | | | | | |
| Army serious games help me to train for my individual and collective tasks better | | | | | |
| I could probably teach myself most things I need to know about Army serious games. | | | | | |
| I would avoid training on a topic if it involves training using Army serious games | | | | | |
| I hesitate to train using an Army serious game in case I might look stupid. | | | | | |
| Army serious games can enhance training enough to justify possible extra effort | | | | | |
| I am not in complete control of my avatar when I train using Army serious games. | | | | | |
| I do not feel uneasy about learning using a Army serious game | | | | | |
| I can make the computer do what I want it to do while playing an Army serious game. | | | | | |
| I only use Army serious games when I am told to | | | | | |
| I need an experienced person nearby when I am using an Army serious game. | | | | | |
| Playing Army serious games does not scare me at all | | | | | |
| Most tasks Army serious games train can be trained better through other means. | | | | | |
| I avoid playing Army serious games. | | | | | |
| If I experience problems training on an Army serious game, I can usually solve them. | | | | | |
| I hesitate to play Army serious games because I am afraid of making learning mistakes. | | | | | |
| Army serious games provide a more useful way to train | | | | | |
| I will use Army serious games regularly throughout my military career. | | | | | |

| | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I do not need somebody to tell me the best way to use an Army serious game. | | | | | |
| Army serious games make me feel uncomfortable in learning. | | | | | |
| Army serious games make it possible to train more productively. | | | | | |

3. In a typical week, how many hours do you play computer games? Round parts of an hour down to the next lower hour.

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20 or more

4. What is your age in years?

- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 26
- 27
- 28
- 29
- 30
- 31
- 32
- 33
- 34
- 35
- 36
- 37
- 38
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60
- 61
- 62
- 63
- 64
- 65
- 66
- 67 or older

5. Are you male or female?

- Male
- Female

6. What is your rank?

- PV1 (E-1)
- PV2 (E-2)
- PFC (E-3)
- CPL/SPC (E-4)
- SGT (E-5)
- SSG (E-6)
- SFC (E-7)
- 1SG/MSG (E-8)
- SMA/CSM/SGM (E-9)
- WO1 (W-1)
- CW2 (W-2)
- CW3 (W-3)
- CW4 (W-4)
- CW5 (W-5)
- 2LT (O-1)
- 1LT (O-2)
- CPT (O-3)
- MAJ (O-4)
- LTC (O-5)
- COL (O-6)
- BG (O-7)
- MG (O-8)
- LTG (O-9)
- GA/GEN (O-10)

7. What is the highest level of school you have completed or the highest degree you have received?

- ( ) No formal education or some elementary school (grades 1-8) --did not complete.
- ( ) Elementary school completed--no high school. Grade 8 or equivalent completed.
- ( ) Some high school--did not graduate. High school means grades 9 through 12, or equivalent.
- ( ) High school graduate or certificate of equivalency.
- ( ) Terminal occupational program (prepares post-grade 12 students for employment)--did not complete.
- ( ) Terminal occupational program--certificate of completion, diploma, or equivalent.
- ( ) Some college--less than one year. Less than 30 semester hours completed.
- ( ) One year college. 30-59 semester hours or 45-89 quarter hours completed.
- ( ) Two years college. 60-89 semester hours or 90-134 quarter hours completed.
- ( ) Associate degree. 2-year college degree program completed.
- ( ) Three years college. 90-119 semester hours or 135-179 quarter hours completed.
- ( ) Four years college. 120 or more semester or 180 or more quarter hours completed--no Bachelor's degree.
- ( ) Bachelor's degree. Requires completion of at least four, but no more than five, years of academic work.
- ( ) Post-Bachelor. Work beyond (at higher level than) Bachelor's degree but no additional higher degree.
- ( ) First professional. Signifies completion of academic requirements for professions requiring at least six academic years of college work, e.g., Dentistry (D.D.S. or D.M.D.), Law (LL. B. or J.D.), Medicine (M.D.), etc.
- ( ) Post-first professional. Work beyond (higher level) first professional degree but no additional higher degree.
- ( ) Master's degree. For liberal arts and sciences successful completion of one to two academic years beyond Bachelor's degree. In professional fields, advanced degree beyond first professional but below Ph.D.
- ( ) Post-Master. Work beyond (at higher level than) Master's degree but no additional higher degree.
- ( ) Sixth-year degree. Degrees such as Advanced Certificate in Education, Advanced Master of Education, Advanced Graduate Certificate, Advanced Specialist in Education Certificate, Certificate of Advanced Graduate Study, Certificate of Advanced Study, Advanced Degree in Education, Specialist in Education, etc.
- ( ) Post-sixth year. Some work beyond (at higher level than) sixth-year degree but no additional higher degree.
- ( ) Doctorate degree. Includes such degrees as Doctor of Education, Doctor of Juridical Science, Doctor of Public Health, and the Ph.D. in any field. Does not include a Doctor's degree that is a first professional degree.
- ( ) Post-Doctorate. Work beyond the Doctorate.

# APPENDIX B

## Gender

```
T-TEST GROUPS=GENDER(1 2)
 /MISSING=ANALYSIS
 /VARIABLES=GATASGDG ACDG A1 A2 A3 A4 A5 A6 PCDG C1 C2 C3 C4 C5 C6 PUDG U1 U2
U3 U4 U5 BCDG B1 B2
   B3 B4
 /CRITERIA=CI(.95).
```

## T-Test

**Notes**

| | | |
|---|---|---|
| Output Created | | 14-SEP-2015 22:20:23 |
| Comments | | |
| Input | Data | D:\Desktop\Fall 2015 Dissertation\Supporting research SPSS\result_modified_15_aug_15_1445_hours_after_deletes_after_converts_after_recodes_after_ord_after_SM_AGE_PGCHRS_Fix (25 Aug 15).sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 709 |
| Missing Value Handling | Definition of Missing | User defined missing values are treated as missing. |
| | Cases Used | Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis. |
| Syntax | | T-TEST GROUPS=GENDER(1 2) /MISSING=ANALYSIS /VARIABLES=GATASGDG ACDG A1 A2 A3 A4 A5 A6 PCDG C1 C2 C3 C4 C5 C6 PUDG U1 U2 U3 U4 U5 BCDG B1 B2 B3 B4 /CRITERIA=CI(.95). |
| Resources | Processor Time | 00:00:00.09 |
| | Elapsed Time | 00:00:00.11 |

**Group Statistics**

| | Are you male or female? | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| General Attitude Towards Army Serious Gaming Data Group | Male | 690 | 78.3638 | 13.49287 | .51366 |
| | Female | 19 | 75.2632 | 17.37764 | 3.98670 |
| Affective Component Data Group | Male | 690 | 25.2058 | 3.98779 | .15181 |
| | Female | 19 | 23.7895 | 5.41170 | 1.24153 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | Male | 690 | 4.1899 | 1.05035 | .03999 |
| | Female | 19 | 4.0000 | .94281 | .21630 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | Male | 690 | 4.2638 | .91591 | .03487 |
| | Female | 19 | 4.0526 | 1.02598 | .23538 |
| I do not feel uneasy about learning using a Army serious game. | Male | 690 | 3.9522 | 1.11555 | .04247 |
| | Female | 19 | 3.7368 | 1.28418 | .29461 |
| Playing Army serious games does not scare me at all. | Male | 690 | 4.3304 | .98218 | .03739 |
| | Female | 19 | 4.0526 | 1.17727 | .27008 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes. | Male | 690 | 4.3232 | .82849 | .03154 |
| | Female | 19 | 3.9474 | 1.12909 | .25903 |
| Army serious games DO NOT make me feel uncomfortable in learning. | Male | 690 | 4.1464 | .91450 | .03481 |
| | Female | 19 | 4.0000 | 1.15470 | .26491 |
| Perceived Control Data Group | Male | 690 | 21.6000 | 3.95541 | .15058 |
| | Female | 19 | 20.9474 | 3.95072 | .90636 |
| I could probably teach myself most things I need to know about Army serious games. | Male | 690 | 3.9986 | .89589 | .03411 |
| | Female | 19 | 3.6842 | 1.33552 | .30639 |
| I AM in complete control of my avatar when I train using Army serious games. | Male | 690 | 3.2565 | 1.02338 | .03896 |
| | Female | 19 | 3.4211 | .90159 | .20684 |
| I can make the computer do what I want it to do while playing an Army serious game. | Male | 690 | 3.6435 | 1.02388 | .03898 |
| | Female | 19 | 3.4737 | 1.02026 | .23406 |
| I DO NOT need an experienced person nearby when I am using an Army serious game. | Male | 690 | 3.6812 | 1.11843 | .04258 |
| | Female | 19 | 3.6842 | 1.10818 | .25423 |
| If I experience problems training on an Army serious game, I can usually solve them. | Male | 690 | 3.7261 | .92162 | .03509 |
| | Female | 19 | 3.6842 | .82007 | .18814 |
| I do not need somebody to tell me the best way to use an Army serious game. | Male | 690 | 3.2942 | 1.05665 | .04023 |
| | Female | 19 | 3.0000 | 1.00000 | .22942 |
| Perceived Usefulness Data Group | Male | 690 | 17.6203 | 4.65415 | .17718 |
| | Female | 19 | 17.2105 | 6.06977 | 1.39250 |

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**Group Statistics**

| | Are you male or female? | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Army serious games help me to train for my individual and collective tasks better. | Male | 690 | 3.6725 | 1.08692 | .04138 |
| | Female | 19 | 3.3684 | 1.42246 | .32633 |
| Army serious games can enhance training enough to justify possible extra effort. | Male | 690 | 3.8116 | 1.06774 | .04065 |
| | Female | 19 | 3.6842 | 1.33552 | .30639 |
| Most tasks Army serious games train can NOT be trained better through other means. | Male | 690 | 2.9638 | 1.07085 | .04077 |
| | Female | 19 | 3.1053 | 1.10024 | .25241 |
| Army serious games provide a more useful way to train. | Male | 690 | 3.5725 | 1.10210 | .04196 |
| | Female | 19 | 3.5263 | 1.38918 | .31870 |
| Army serious games make it possible to train more productively. | Male | 690 | 3.6000 | 1.09465 | .04167 |
| | Female | 19 | 3.5263 | 1.38918 | .31870 |
| Behavioral Component Data Group | Male | 690 | 13.9377 | 3.53427 | .13455 |
| | Female | 19 | 13.3158 | 4.66729 | 1.07075 |
| I would NOT avoid training on a topic if it involves training using Army serious games. | Male | 690 | 4.0710 | 1.05407 | .04013 |
| | Female | 19 | 3.7895 | 1.47494 | .33837 |
| I DO NOT only use Army serious games when I am told to. | Male | 690 | 2.7507 | 1.10489 | .04206 |
| | Female | 19 | 2.7368 | 1.24017 | .28451 |
| I DO NOT avoid playing Army serious games. | Male | 690 | 3.7420 | 1.17180 | .04461 |
| | Female | 19 | 3.4211 | 1.46499 | .33609 |
| I will use Army serious games regularly throughout my military career. | Male | 690 | 3.3739 | 1.12855 | .04296 |
| | Female | 19 | 3.3684 | 1.25656 | .28828 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| General Attitude Towards Army Serious Gaming Data Group | Equal variances assumed | 2.236 | 135 | 980 | 707 | 327 | 3.10061 | 3.16401 | -3.11137 | 9.31259 |
| | Equal variances not assumed | | | 771 | 18.602 | 450 | 3.10061 | 4.01986 | -5.32482 | 11.52604 |
| Affective Component Data Group | Equal variances assumed | 1.024 | 312 | 1.511 | 707 | 131 | 1.41632 | 93725 | -42381 | 3.25646 |
| | Equal variances not assumed | | | 1.132 | 18.542 | 272 | 1.41632 | 1.25078 | -1.20597 | 4.03861 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it | Equal variances assumed | 1.367 | 243 | 779 | 707 | .436 | .18986 | 24366 | -28852 | 66823 |
| | Equal variances not assumed | | | 863 | 19.251 | 399 | 18986 | 21996 | -27012 | 64983 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | Equal variances assumed | 044 | 834 | 988 | 707 | 323 | 21114 | 21369 | -20840 | 63067 |
| | Equal variances not assumed | | | 887 | 18.798 | 386 | 21114 | 23794 | -28725 | 70952 |
| I do not feel uneasy about learning using a Army serious game. | Equal variances assumed | 1.140 | 286 | 827 | 707 | .409 | 21533 | 26050 | -29611 | 72677 |
| | Equal variances not assumed | | | 723 | 18.756 | 478 | 21533 | 29766 | -40822 | 83888 |
| Playing Army serious games does not scare me at all | Equal variances assumed | 041 | 839 | 1.210 | 707 | 227 | 27780 | 22967 | -17312 | 72873 |
| | Equal variances not assumed | | | 1.019 | 18.696 | 321 | 27780 | 27266 | -29351 | 84912 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes | Equal variances assumed | 1.361 | 245 | 1.930 | 707 | 054 | .37982 | 19476 | -00666 | 75820 |
| | Equal variances not assumed | | | 1.440 | 18.538 | 166 | 37982 | 26095 | -17127 | 92291 |
| Army serious games DO NOT make me feel uncomfortable in learning | Equal variances assumed | 801 | 371 | 683 | 707 | 495 | .14638 | 21427 | -27431 | 56706 |
| | Equal variances not assumed | | | 548 | 18.627 | .590 | 14638 | 26718 | -41361 | 70636 |
| Perceived Control Data Group | Equal variances assumed | 112 | 738 | 710 | 707 | 478 | 65263 | 91981 | -1.15326 | 2.45853 |
| | Equal variances not assumed | | | 710 | 19.007 | 486 | .65263 | 91878 | -1.27035 | 2.57561 |
| I could probably teach myself most things I need to know about Army serious games | Equal variances assumed | 5.871 | 016 | 1.486 | 707 | 138 | .31434 | 21156 | -10102 | 72970 |
| | Equal variances not assumed | | | 1.020 | 18.449 | 321 | 31434 | 30828 | -33221 | 96089 |
| I AM in complete control of my avatar when I train using Army serious games | Equal variances assumed | 136 | 713 | -693 | 707 | 488 | -.16453 | 23731 | -63045 | 30139 |
| | Equal variances not assumed | | | -782 | 19.299 | 444 | -16453 | 21048 | -60460 | 27554 |
| I can make the computer do what I want it to do while playing an Army serious game | Equal variances assumed | 098 | 754 | 713 | 707 | 476 | 16879 | 23808 | -29764 | 63723 |
| | Equal variances not assumed | | | 716 | 19.012 | 483 | .16879 | 23729 | -32683 | 66642 |
| I DO NOT need an experienced person nearby when I am using an Army serious game | Equal variances assumed | 048 | 826 | -012 | 707 | 991 | -.00305 | 26003 | -51358 | 50748 |
| | Equal variances not assumed | | | -012 | 19.023 | 991 | -.00305 | 25778 | -54254 | 53643 |
| If I experience problems training on an Army serious game, I can usually solve them | Equal variances assumed | 258 | 612 | 196 | 707 | 845 | .04188 | 21376 | -37780 | 46156 |
| | Equal variances not assumed | | | 219 | 19.273 | 829 | .04188 | 19138 | -35830 | 44206 |
| I do not need somebody to tell me the best way to use an Army serious game. | Equal variances assumed | 1.026 | 311 | 1.199 | 707 | 231 | 29420 | 24540 | -18760 | 77600 |
| | Equal variances not assumed | | | 1.263 | 19.123 | .222 | .29420 | 23292 | -19308 | 78149 |
| Perceived Usefulness Data Group | Equal variances assumed | 3.316 | 069 | 375 | 707 | 708 | 40976 | 1.09195 | -1.73409 | 2.55362 |
| | Equal variances not assumed | | | 292 | 18.587 | .774 | .40976 | 1.40373 | -2.53269 | 3.35222 |
| Army serious games help me to train for my individual and collective tasks better | Equal variances assumed | 4.389 | 037 | 1.192 | 707 | 234 | 30404 | 25505 | -19670 | 80479 |
| | Equal variances not assumed | | | 924 | 18.583 | 367 | .30404 | 32895 | -38560 | 98368 |
| Army serious games can enhance training enough to justify possible extra effort. | Equal variances assumed | 2.453 | 118 | 509 | 707 | 611 | 12738 | 25008 | -36361 | 61838 |
| | Equal variances not assumed | | | 412 | 18.639 | .685 | 12738 | 30907 | -52037 | 77513 |
| Most tasks Army serious games train can NOT be trained better through other means | Equal variances assumed | 033 | 857 | -568 | 707 | 570 | -14150 | 24921 | -63077 | 34778 |
| | Equal variances not assumed | | | -553 | 18.951 | 586 | -14150 | 25568 | -67874 | 39375 |
| Army serious games provide a more useful way to train | Equal variances assumed | 2.243 | 136 | 179 | 707 | 858 | .04615 | 25821 | -46080 | 55310 |
| | Equal variances not assumed | | | 144 | 18.629 | 887 | .04615 | .32145 | -62756 | 71986 |
| Army serious games make it possible to train more productively | Equal variances assumed | 2.333 | 127 | 287 | 707 | 774 | .07368 | 25653 | -42998 | 57735 |
| | Equal variances not assumed | | | 229 | 18.621 | .821 | .07368 | 32141 | -59997 | 74734 |
| Behavioral Component Data Group | Equal variances assumed | 4.315 | .038 | 750 | 707 | 454 | .62189 | 82965 | -1.00698 | 2.25077 |
| | Equal variances not assumed | | | 576 | 18.573 | .571 | .62189 | 1.07917 | -1.64036 | 2.88414 |
| I would NOT avoid training on a topic if it involves training using Army serious games | Equal variances assumed | 5.029 | 025 | 1.136 | 707 | .257 | .28154 | 24810 | -20566 | 76864 |
| | Equal variances not assumed | | | 826 | 18.510 | 419 | .28154 | 34074 | -43293 | 99601 |
| I DO NOT only use Army serious games when I am told to | Equal variances assumed | .630 | 428 | 054 | 707 | 957 | .01388 | 25779 | -49225 | 52002 |
| | Equal variances not assumed | | | 048 | 18.795 | 962 | .01388 | 28761 | -58853 | 61629 |
| I DO NOT avoid playing Army serious games | Equal variances assumed | 3.327 | 069 | 1.170 | 707 | 243 | .32098 | 27445 | -21786 | 85982 |
| | Equal variances not assumed | | | 947 | 18.640 | 356 | .32098 | .33904 | -38957 | 1.03152 |
| I will use Army serious games regularly throughout my military career | Equal variances assumed | .446 | 505 | .021 | 707 | .983 | .00549 | 26325 | -51135 | 52233 |
| | Equal variances not assumed | | | 019 | 18.808 | 985 | .00549 | 29146 | -60496 | 61594 |

# APPENDIX C

## Age Groups

```
T-TEST GROUPS=AGEGROUPS(1 2)
 /MISSING=ANALYSIS
 /VARIABLES=GATASGDG ACDG A1 A2 A3 A4 A5 A6 PCDG C1 C2 C3 C4 C5 C6 PUDG U1 U2
U3 U4 U5 BCDG B1 B2
   B3 B4
 /CRITERIA=CI(.95).
```

### T-Test

**Notes**

| | | |
|---|---|---|
| Output Created | | 14-SEP-2015 22:41:17 |
| Comments | | |
| Input | Data | D:\Desktop\Fall 2015 Dissertation\Supporting research SPSS\result_modified_15_aug_15_1445_hours_after_deletes_after_converts_after_recodes_after_ord_after_SM_AGE_PGCHRS_Fix (25 Aug 15).sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 709 |
| Missing Value Handling | Definition of Missing | User defined missing values are treated as missing. |
| | Cases Used | Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis. |
| Syntax | | T-TEST GROUPS=AGEGROUPS(1 2) /MISSING=ANALYSIS /VARIABLES=GATASGDG ACDG A1 A2 A3 A4 A5 A6 PCDG C1 C2 C3 C4 C5 C6 PUDG U1 U2 U3 U4 U5 BCDG B1 B2 B3 B4 /CRITERIA=CI(.95). |
| Resources | Processor Time | 00:00:00.08 |
| | Elapsed Time | 00:00:00.08 |

**Group Statistics**

| | Age Groups | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| General Attitude Towards Army Serious Gaming Data Group | Younger | 642 | 78.5654 | 13.72244 | .54158 |
| | Older | 67 | 75.5522 | 12.18330 | 1.48843 |
| Affective Component Data Group | Younger | 642 | 25.2866 | 4.04986 | .15984 |
| | Older | 67 | 24.0299 | 3.71716 | .45412 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | Younger | 642 | 4.2196 | 1.04354 | .04119 |
| | Older | 67 | 3.8507 | 1.03358 | .12627 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | Younger | 642 | 4.2664 | .93756 | .03700 |
| | Older | 67 | 4.1791 | .71616 | .08749 |
| I do not feel uneasy about learning using a Army serious game. | Younger | 642 | 3.9502 | 1.13545 | .04481 |
| | Older | 67 | 3.9104 | .96501 | .11790 |
| Playing Army serious games does not scare me at all. | Younger | 642 | 4.3489 | .99283 | .03918 |
| | Older | 67 | 4.0746 | .90977 | .11115 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes. | Younger | 642 | 4.3396 | .84526 | .03336 |
| | Older | 67 | 4.0597 | .73610 | .08993 |
| Army serious games DO NOT make me feel uncomfortable in learning. | Younger | 642 | 4.1620 | .92895 | .03666 |
| | Older | 67 | 3.9552 | .82449 | .10073 |
| Perceived Control Data Group | Younger | 642 | 21.6963 | 4.00814 | .15819 |
| | Older | 67 | 20.4925 | 3.21631 | .39293 |
| I could probably teach myself most things I need to know about Army serious games. | Younger | 642 | 4.0156 | .91941 | .03629 |
| | Older | 67 | 3.7463 | .78515 | .09592 |
| I AM in complete control of my avatar when I train using Army serious games. | Younger | 642 | 3.2679 | 1.04046 | .04106 |
| | Older | 67 | 3.1940 | .80225 | .09801 |
| I can make the computer do what I want it to do while playing an Army serious game. | Younger | 642 | 3.6636 | 1.03852 | .04099 |
| | Older | 67 | 3.4030 | .83593 | .10213 |
| I DO NOT need an experienced person nearby when I am using an Army serious game. | Younger | 642 | 3.6963 | 1.13639 | .04485 |
| | Older | 67 | 3.5373 | .91002 | .11118 |
| If I experience problems training on an Army serious game, I can usually solve them. | Younger | 642 | 3.7477 | .92049 | .03633 |
| | Older | 67 | 3.5075 | .87686 | .10713 |

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**Group Statistics**

| | Age Groups | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| I do not need somebody to tell me the best way to use an Army serious game. | Younger | 642 | 3.3053 | 1.06142 | .04189 |
| | Older | 67 | 3.1045 | .98680 | .12056 |
| Perceived Usefulness Data Group | Younger | 642 | 17.6620 | 4.74032 | .18709 |
| | Older | 67 | 17.1045 | 4.20726 | .51400 |
| Army serious games help me to train for my individual and collective tasks better. | Younger | 642 | 3.6900 | 1.10121 | .04346 |
| | Older | 67 | 3.4179 | 1.03205 | .12609 |
| Army serious games can enhance training enough to justify possible extra effort. | Younger | 642 | 3.8240 | 1.07671 | .04249 |
| | Older | 67 | 3.6567 | 1.05245 | .12858 |
| Most tasks Army serious games train can NOT be trained better through other means. | Younger | 642 | 2.9720 | 1.07843 | .04256 |
| | Older | 67 | 2.9254 | 1.00474 | .12275 |
| Army serious games provide a more useful way to train. | Younger | 642 | 3.5763 | 1.11769 | .04411 |
| | Older | 67 | 3.5224 | 1.03511 | .12646 |
| Army serious games make it possible to train more productively. | Younger | 642 | 3.5997 | 1.11024 | .04382 |
| | Older | 67 | 3.5821 | 1.03205 | .12609 |
| Behavioral Component Data Group | Younger | 642 | 13.9206 | 3.59861 | .14203 |
| | Older | 67 | 13.9254 | 3.26744 | .39918 |
| I would NOT avoid training on a topic if it involves training using Army serious games. | Younger | 642 | 4.0701 | 1.07579 | .04246 |
| | Older | 67 | 4.0000 | .98473 | .12030 |
| I DO NOT only use Army serious games when I am told to. | Younger | 642 | 2.7165 | 1.11605 | .04405 |
| | Older | 67 | 3.0746 | .97411 | .11901 |
| I DO NOT avoid playing Army serious games. | Younger | 642 | 3.7539 | 1.19614 | .04721 |
| | Older | 67 | 3.5373 | 1.00496 | .12278 |
| I will use Army serious games regularly throughout my military career. | Younger | 642 | 3.3801 | 1.14697 | .04527 |
| | Older | 67 | 3.3134 | .97248 | .11881 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | I feel for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| General Attitude Towards Army Serious Gaming Data Group | Equal variances assumed | 1 365 | 243 | 1 727 | 707 | 086 | 3 01318 | 1 74427 | -41139 | 6 43776 |
| | Equal variances not assumed | | | 1 902 | 84 481 | 061 | 3 01318 | 1 58390 | -13631 | 6 16267 |
| Affective Component Data Group | Equal variances assumed | 932 | 336 | 2 436 | 707 | 015 | 1 25675 | 51611 | 24347 | 2 27004 |
| | Equal variances not assumed | | | 2 610 | 83 233 | 011 | 1 25675 | 48143 | 29925 | 2 21426 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it | Equal variances assumed | 114 | 736 | 2 756 | 707 | 006 | 36888 | 13386 | .10607 | 63169 |
| | Equal variances not assumed | | | 2 777 | 80 685 | 007 | 36888 | 13282 | 10460 | 63316 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid | Equal variances assumed | 7 958 | 005 | 739 | 707 | 460 | 08725 | 11801 | -14443 | 31894 |
| | Equal variances not assumed | | | 918 | 91 420 | 361 | 08725 | 09500 | -10144 | 27594 |
| I do not feel uneasy about learning using a Army serious game. | Equal variances assumed | 2 094 | 148 | 276 | 707 | .783 | 03971 | 14387 | -24276 | 32218 |
| | Equal variances not assumed | | | 315 | 86 264 | 754 | 03971 | 12612 | -21101 | 29042 |
| Playing Army serious games does not scare me at all | Equal variances assumed | 1 809 | 179 | 2 168 | 707 | 030 | 27428 | 12651 | 02581 | 52266 |
| | Equal variances not assumed | | | 2 327 | 83 293 | 022 | 27428 | 11785 | 03989 | 50867 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes | Equal variances assumed | 9 646 | 002 | 2 608 | 707 | 009 | 27986 | 10729 | 06922 | 49051 |
| | Equal variances not assumed | | | 2 918 | 95 248 | 005 | 27986 | 09592 | 08916 | 47056 |
| Army serious games DO NOT make me feel uncomfortable in learning | Equal variances assumed | 5 288 | 022 | 1 751 | 707 | 080 | 20677 | 11808 | -02505 | 43859 |
| | Equal variances not assumed | | | 1 929 | 84 493 | 057 | 20677 | 10719 | -00638 | 41992 |
| Perceived Control Data Group | Equal variances assumed | 4 022 | 045 | 2 379 | 707 | .018 | 1 20372 | 50596 | 21035 | 2.19710 |
| | Equal variances not assumed | | | 2 842 | 88 887 | .006 | 1 20372 | 42358 | 36206 | 2 04538 |
| I could probably teach myself most things I need to know about Army serious games | Equal variances assumed | 514 | 474 | 2 311 | 707 | 021 | 26931 | 11654 | 04051 | 49811 |
| | Equal variances not assumed | | | 2 626 | 86 060 | 010 | 26931 | 10256 | 06544 | 47318 |
| I AM in complete control of my avatar when I train using Army serious games | Equal variances assumed | 8 284 | 004 | 564 | 707 | 573 | 07388 | 13103 | -18337 | 33113 |
| | Equal variances not assumed | | | 695 | 90 916 | .489 | 07388 | 10626 | -13720 | 28497 |
| I can make the computer do what I want it to do while playing an Army serious game | Equal variances assumed | 6 172 | 013 | 1 987 | 707 | .047 | 26057 | 13112 | 00313 | 51800 |
| | Equal variances not assumed | | | 2 368 | 88 737 | .020 | 26057 | 11004 | 04190 | 47923 |
| I DO NOT need an experienced person nearby when I am using an Army serious game | Equal variances assumed | 7 709 | 006 | 1 108 | 707 | 268 | 15895 | 14343 | -12266 | 44055 |
| | Equal variances not assumed | | | 1 326 | 88 987 | 188 | 15895 | 11988 | -07925 | 39715 |
| If I experience problems training on an Army serious game, I can usually solve them | Equal variances assumed | 000 | 983 | 2 041 | 707 | 042 | 24020 | 11767 | 00918 | 47122 |
| | Equal variances not assumed | | | 2 123 | 81 942 | 037 | 24020 | 11312 | 01517 | 46523 |
| I do not need somebody to tell me the best way to use an Army serious game. | Equal variances assumed | 638 | 425 | 1 483 | 707 | 138 | 20082 | 13541 | -06503 | 46666 |
| | Equal variances not assumed | | | 1 573 | 82 776 | 119 | 20082 | 12763 | -05304 | 45467 |
| Perceived Usefulness Data Group | Equal variances assumed | 602 | 438 | 925 | 707 | 356 | 55752 | 60253 | -62545 | 1 74048 |
| | Equal variances not assumed | | | 1 019 | 84 493 | 311 | 55752 | 54699 | -53014 | 1 64517 |
| Army serious games help me to train for my individual and collective tasks better | Equal variances assumed | 286 | 593 | 1 936 | 707 | .053 | 27212 | 14057 | -00387 | 54811 |
| | Equal variances not assumed | | | 2 040 | 82 496 | 045 | 27212 | 13337 | 00684 | 53740 |
| Army serious games can enhance training enough to justify possible extra effort | Equal variances assumed | 088 | 766 | 1 213 | 707 | 226 | 16727 | 13795 | -10356 | 43811 |
| | Equal variances not assumed | | | 1 235 | 91 106 | 220 | 16727 | 13542 | -10216 | 43670 |
| Most tasks Army serious games train can NOT be trained better through other means | Equal variances assumed | 177 | 674 | 339 | 707 | 735 | 04659 | 13760 | -22356 | 31674 |
| | Equal variances not assumed | | | 359 | 82 702 | 721 | 04659 | 12992 | -21183 | 30500 |
| Army serious games provide a more useful way to train | Equal variances assumed | 933 | 334 | 378 | 707 | 705 | 05394 | 14254 | -22592 | 33379 |
| | Equal variances not assumed | | | 403 | 82 912 | 688 | 05394 | 13383 | -21245 | 32033 |
| Army serious games make it possible to train more productively | Equal variances assumed | 818 | 366 | 124 | 707 | 901 | 01760 | 14163 | -26047 | 29567 |
| | Equal variances not assumed | | | 132 | 82 781 | 896 | 01760 | 13348 | -24790 | 28310 |
| Behavioral Component Data Group | Equal variances assumed | 610 | 435 | -011 | 707 | 992 | -00481 | 45821 | -90443 | 89480 |
| | Equal variances not assumed | | | -011 | 83 629 | 991 | -00481 | 42363 | -84743 | 83781 |
| I would NOT avoid training on a topic if it involves training using Army serious games | Equal variances assumed | 1 417 | 234 | 511 | 707 | 609 | 07009 | 13707 | -19901 | 33920 |
| | Equal variances not assumed | | | 549 | 83 332 | 584 | 07009 | 12758 | -18364 | 32382 |
| I DO NOT only use Army serious games when I am told to | Equal variances assumed | 2 268 | 133 | -2 528 | 707 | 012 | -35812 | 14168 | -63629 | -07995 |
| | Equal variances not assumed | | | -2 822 | 86 157 | 006 | -35812 | 12690 | -61041 | -10582 |
| I DO NOT avoid playing Army serious games. | Equal variances assumed | 2 800 | 095 | 1 430 | 707 | 153 | 21668 | 15145 | -08076 | 51392 |
| | Equal variances not assumed | | | 1.647 | 86 763 | 103 | 21668 | 13154 | -04488 | 47804 |
| I will use Army serious games regularly throughout my military career | Equal variances assumed | 4 233 | 040 | 459 | 707 | 647 | 06663 | 14631 | -21866 | 35192 |
| | Equal variances not assumed | | | 524 | 86 366 | 602 | 06663 | 12714 | -18610 | 31936 |

# APPENDIX D

## Education Level Groups

```
T-TEST GROUPS=EDUGROUPS(1 2)
 /MISSING=ANALYSIS
 /VARIABLES=GATASGDG ACDG A1 A2 A3 A4 A5 A6 PCDG C1 C2 C3 C4 C5 C6 PUDG U1 U2
U3 U4 U5 BCDG B1 B2
   B3 B4
 /CRITERIA=CI(.95).
```

### T-Test

**Notes**

| | | |
|---|---|---|
| Output Created | | 14-SEP-2015 22 43 37 |
| Comments | | |
| Input | Data | D \Desktop\Fall 2015 Dissertation\Supporting research SPSS\result_modified_15_aug_15_1445_hours_after_deletes_after_converts_after_recodes_after_ord_after_SM_AGE_PGCHRS_Fix (25 Aug 15).sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 709 |
| Missing Value Handling | Definition of Missing | User defined missing values are treated as missing |
| | Cases Used | Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis |
| Syntax | | T-TEST GROUPS=EDUGROUPS(1 2) /MISSING=ANALYSIS /VARIABLES=GATASGDG ACDG A1 A2 A3 A4 A5 A6 PCDG C1 C2 C3 C4 C5 C6 PUDG U1 U2 U3 U4 U5 BCDG B1 B2 B3 B4 /CRITERIA=CI(.95) |
| Resources | Processor Time | 00 00 00.05 |
| | Elapsed Time | 00 00 00.05 |

**Group Statistics**

| | Education Level Groups | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| General Attitude Towards Army Serious Gaming Data Group | Lesser Educated | 464 | 79.0603 | 13.44104 | .62398 |
| | Better Educated | 245 | 76.8041 | 13.81799 | .88280 |
| Affective Component Data Group | Lesser Educated | 464 | 25.2522 | 3.97603 | .18458 |
| | Better Educated | 245 | 25.0082 | 4.14491 | .26481 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | Lesser Educated | 464 | 4.2284 | 1.03271 | .04794 |
| | Better Educated | 245 | 4.1020 | 1.07209 | .06849 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | Lesser Educated | 464 | 4.2457 | .95469 | .04432 |
| | Better Educated | 245 | 4.2816 | .84826 | .05419 |
| I do not feel uneasy about learning using a Army serious game. | Lesser Educated | 464 | 3.9871 | 1.08387 | .05032 |
| | Better Educated | 245 | 3.8694 | 1.18360 | .07562 |
| Playing Army serious games does not scare me at all. | Lesser Educated | 464 | 4.3427 | .96652 | .04487 |
| | Better Educated | 245 | 4.2857 | 1.02829 | .06569 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes. | Lesser Educated | 464 | 4.3103 | .84336 | .03915 |
| | Better Educated | 245 | 4.3184 | .83265 | .05320 |
| Army serious games DO NOT make me feel uncomfortable in learning. | Lesser Educated | 464 | 4.1379 | .92385 | .04289 |
| | Better Educated | 245 | 4.1510 | .91753 | .05862 |
| Perceived Control Data Group | Lesser Educated | 464 | 21.8319 | 3.96063 | .18387 |
| | Better Educated | 245 | 21.1102 | 3.90566 | .24952 |
| I could probably teach myself most things I need to know about Army serious games. | Lesser Educated | 464 | 4.0237 | .90205 | .04188 |
| | Better Educated | 245 | 3.9265 | .92479 | .05908 |
| I AM in complete control of my avatar when I train using Army serious games. | Lesser Educated | 464 | 3.2414 | 1.02345 | .04751 |
| | Better Educated | 245 | 3.2980 | 1.01475 | .06483 |
| I can make the computer do what I want it to do while playing an Army serious game. | Lesser Educated | 464 | 3.6746 | 1.02860 | .04775 |
| | Better Educated | 245 | 3.5714 | 1.01222 | .06467 |
| I DO NOT need an experienced person nearby when I am using an Army serious game. | Lesser Educated | 464 | 3.7392 | 1.07137 | .04974 |
| | Better Educated | 245 | 3.5714 | 1.19425 | .07630 |
| If I experience problems training on an Army serious game, I can usually solve them. | Lesser Educated | 464 | 3.7737 | .92627 | .04300 |
| | Better Educated | 245 | 3.6327 | .89840 | .05740 |
| I do not need somebody to tell me the best way to use an Army serious game. | Lesser Educated | 464 | 3.3793 | 1.04669 | .04859 |
| | Better Educated | 245 | 3.1102 | 1.05198 | .06721 |

**Group Statistics**

| | Education Level Groups | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Perceived Usefulness Data Group | Lesser Educated | 464 | 17.9741 | 4.56952 | .21213 |
| | Better Educated | 245 | 16.9184 | 4.85206 | .30999 |
| Army serious games help me to train for my individual and collective tasks better. | Lesser Educated | 464 | 3.7392 | 1.08738 | .05048 |
| | Better Educated | 245 | 3.5224 | 1.10351 | .07050 |
| Army serious games can enhance training enough to justify possible extra effort. | Lesser Educated | 464 | 3.8405 | 1.03523 | .04806 |
| | Better Educated | 245 | 3.7469 | 1.14575 | .07320 |
| Most tasks Army serious games train can NOT be trained better through other means. | Lesser Educated | 464 | 3.0711 | 1.06653 | .04951 |
| | Better Educated | 245 | 2.7714 | 1.05427 | .06735 |
| Army serious games provide a more useful way to train. | Lesser Educated | 464 | 3.6552 | 1.08078 | .05017 |
| | Better Educated | 245 | 3.4122 | 1.14763 | .07332 |
| Army serious games make it possible to train more productively. | Lesser Educated | 464 | 3.6681 | 1.08483 | .05036 |
| | Better Educated | 245 | 3.4653 | 1.12526 | .07189 |
| Behavioral Component Data Group | Lesser Educated | 464 | 14.0022 | 3.47624 | .16138 |
| | Better Educated | 245 | 13.7673 | 3.73384 | .23855 |
| I would NOT avoid training on a topic if it involves training using Army serious games. | Lesser Educated | 464 | 4.0453 | 1.08001 | .05014 |
| | Better Educated | 245 | 4.0980 | 1.04342 | .06666 |
| I DO NOT only use Army serious games when I am told to. | Lesser Educated | 464 | 2.7823 | 1.08097 | .05018 |
| | Better Educated | 245 | 2.6898 | 1.15664 | .07389 |
| I DO NOT avoid playing Army serious games. | Lesser Educated | 464 | 3.7500 | 1.15439 | .05359 |
| | Better Educated | 245 | 3.7020 | 1.23017 | .07859 |
| I will use Army serious games regularly throughout my military career. | Lesser Educated | 464 | 3.4246 | 1.11669 | .05184 |
| | Better Educated | 245 | 3.2776 | 1.15433 | .07375 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| General Attitude Towards Army Serious Gaming Data Group | Equal variances assumed | 189 | 663 | 2 105 | 707 | 036 | 2 25626 | 1 07185 | 15187 | 4 36066 |
| | Equal variances not assumed | | | 2 087 | 484 922 | 037 | 2 25626 | 1 08106 | 13212 | 4 38040 |
| Affective Component Data Group | Equal variances assumed | 161 | 689 | 766 | 707 | 444 | 24399 | 31867 | -.38165 | 86964 |
| | Equal variances not assumed | | | 756 | 479 101 | 450 | 24399 | 32279 | -.39027 | 87825 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | Equal variances assumed | 141 | 708 | 1 530 | 707 | 127 | .13641 | 08264 | -.03585 | 28866 |
| | Equal variances not assumed | | | 1 512 | 480 833 | 131 | 12641 | 08361 | -.03787 | 29068 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | Equal variances assumed | 2 566 | 110 | -.495 | 707 | 621 | -.03594 | 07260 | -.17849 | 10660 |
| | Equal variances not assumed | | | -.513 | 549 903 | 608 | -.03594 | 07001 | -.17346 | 10157 |
| I do not feel uneasy about learning using a Army serious game | Equal variances assumed | 3 163 | 076 | 1 331 | 707 | 184 | 11768 | 08839 | -.05587 | 29123 |
| | Equal variances not assumed | | | 1 296 | 460 364 | 196 | 11768 | 09083 | -.06081 | 29617 |
| Playing Army serious games does not scare me at all | Equal variances assumed | 263 | 608 | 730 | 707 | 466 | 05696 | 07805 | -.09627 | 21019 |
| | Equal variances not assumed | | | 716 | 470 756 | 474 | 05696 | 07956 | -.09937 | 21329 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes | Equal variances assumed | 277 | 599 | -.121 | 707 | 904 | -.00802 | 06631 | -.13822 | 12217 |
| | Equal variances not assumed | | | -.121 | 502 269 | 903 | -.00802 | 06605 | -.13779 | 12175 |
| Army serious games DO NOT make me feel uncomfortable in learning | Equal variances assumed | 535 | 465 | -.180 | 707 | 857 | -.01309 | 07279 | -.15600 | 12982 |
| | Equal variances not assumed | | | -.180 | 499 696 | 857 | -.01309 | 07263 | -.15579 | .12961 |
| Perceived Control Data Group | Equal variances assumed | 334 | 563 | 2 318 | 707 | 021 | 72169 | 31129 | 11052 | 1 33286 |
| | Equal variances not assumed | | | 2 328 | 502 793 | 020 | 72169 | 30996 | 11273 | 1 33066 |
| I could probably teach myself most things I need to know about Army serious games | Equal variances assumed | 039 | 844 | 1 352 | 707 | 177 | 09716 | 07186 | -.04391 | 23827 |
| | Equal variances not assumed | | | 1 342 | 486 085 | 180 | 09716 | 07242 | -.04512 | 23947 |
| I AM in complete control of my avatar when I train using Army serious games | Equal variances assumed | 091 | 763 | -.702 | 707 | 483 | -.05658 | 08059 | -.21480 | 10164 |
| | Equal variances not assumed | | | -.704 | 500 421 | 482 | -.05658 | 08038 | -.21450 | 10134 |
| I can make the computer do what I want it to do while playing an Army serious game | Equal variances assumed | 006 | 937 | 1 277 | 707 | 202 | 10314 | 08079 | -.05547 | 26175 |
| | Equal variances not assumed | | | 1 283 | 503 701 | 200 | 10314 | 08039 | -.05480 | 26108 |
| I DO NOT need an experienced person nearby when I am using an Army serious game | Equal variances assumed | 6 944 | 009 | 1 905 | 707 | 057 | .16780 | 08808 | -.00513 | 34072 |
| | Equal variances not assumed | | | 1 842 | 452 386 | 066 | 16780 | 09108 | -.01119 | 34678 |
| If I experience problems training on an Army serious game, I can usually solve them | Equal variances assumed | 294 | 588 | 1 948 | 707 | 052 | 14105 | 07240 | -.00109 | 28320 |
| | Equal variances not assumed | | | 1 967 | 510 086 | 050 | 14105 | 07172 | 00015 | 28195 |
| I do not need somebody to tell me the best way to use an Army serious game. | Equal variances assumed | 673 | 412 | 3 250 | 707 | 001 | 26911 | 08280 | 10653 | 43168 |
| | Equal variances not assumed | | | 3 245 | 494 546 | 001 | 26911 | 08293 | 10616 | 43206 |
| Perceived Usefulness Data Group | Equal variances assumed | 887 | 347 | 2 863 | 707 | 004 | 1 05577 | 36872 | 33185 | 1 77970 |
| | Equal variances not assumed | | | 2 811 | 471 549 | 005 | 1 05577 | 37562 | 31767 | 1 79387 |
| Army serious games help me to train for my individual and collective tasks better | Equal variances assumed | 305 | 581 | 2 511 | 707 | 012 | 21678 | 08632 | 04731 | 38624 |
| | Equal variances not assumed | | | 2 500 | 490 398 | 013 | 21678 | 08671 | 04641 | 38714 |
| Army serious games can enhance training enough to justify possible extra effort. | Equal variances assumed | 4 004 | 046 | 1 103 | 707 | 271 | .09358 | 08487 | -.07305 | .26020 |
| | Equal variances not assumed | | | 1 069 | 455 130 | 286 | .09358 | 08757 | -.07851 | 26566 |
| Most tasks Army serious games train can NOT be trained better through other means | Equal variances assumed | 1 156 | 283 | 3 572 | 707 | 000 | .29969 | 08389 | 13498 | 46440 |
| | Equal variances not assumed | | | 3 586 | 501 740 | 000 | 29969 | 08359 | 13545 | 46393 |
| Army serious games provide a more useful way to train | Equal variances assumed | 1 638 | 201 | 2 786 | 707 | 005 | 24293 | 08721 | 07170 | .41415 |
| | Equal variances not assumed | | | 2 734 | 471 541 | 006 | .24293 | 08884 | .06836 | .41751 |
| Army serious games make it possible to train more productively | Equal variances assumed | 292 | 589 | 2 337 | 707 | 020 | 20280 | 08679 | 03240 | 37319 |
| | Equal variances not assumed | | | 2 310 | 481 183 | 021 | 20280 | 08778 | 03033 | 37527 |
| Behavioral Component Data Group | Equal variances assumed | 914 | 339 | 833 | 707 | 405 | 23481 | 28172 | -.31829 | 78791 |
| | Equal variances not assumed | | | 815 | 466 913 | 415 | 23481 | 28801 | -.33114 | 80076 |
| I would NOT avoid training on a topic if it involves training using Army serious games | Equal variances assumed | 328 | 567 | -.625 | 707 | 532 | -.05270 | 08431 | -.21822 | .11282 |
| | Equal variances not assumed | | | -.632 | 511 825 | 528 | -.05270 | 08341 | -.21657 | 11117 |
| I DO NOT only use Army serious games when I am told to. | Equal variances assumed | 4 740 | 030 | 1 058 | 707 | 291 | 09253 | 08748 | -.07921 | 26428 |
| | Equal variances not assumed | | | 1 036 | 468 462 | 301 | 09253 | 08932 | -.08299 | 26806 |
| I DO NOT avoid playing Army serious games. | Equal variances assumed | 1 202 | 273 | 514 | 707 | 607 | 04796 | 09327 | -.13617 | 23109 |
| | Equal variances not assumed | | | 504 | 470 086 | 614 | 04796 | 09513 | -.13896 | 23488 |
| I will use Army serious games regularly throughout my military career | Equal variances assumed | 046 | 832 | 1 648 | 707 | 100 | 14702 | 08923 | -.02816 | 32220 |
| | Equal variances not assumed | | | 1 631 | 482 617 | 104 | 14702 | 09015 | -.03011 | 32414 |

# APPENDIX E

## Military Class Groups

**Multiple Comparisons**

Tukey HSD

| Dependent Variable | (I) Class Groups | (J) Class Groups | Mean Difference (I-J) | Std. Error | Sig | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| General Attitude Towards Army Serious Gaming Data Group | Enlisted | NCO | 1 60852 | 1 59398 | 571 | -2 1352 | 5.3522 |
| | | Officer | 3.39118 | 1.77069 | 135 | -.7676 | 7.5499 |
| | NCO | Enlisted | -1 60852 | 1 59398 | .571 | -5 3522 | 2 1352 |
| | | Officer | 1 78267 | 1.19728 | .297 | -1.0293 | 4.5947 |
| | Officer | Enlisted | -3 39118 | 1 77069 | .135 | -7 5499 | 7676 |
| | | NCO | -1 78267 | 1 19728 | 297 | -4 5947 | 1.0293 |
| Affective Component Data Group | Enlisted | NCO | - 25280 | 47389 | 855 | -1 3658 | 8602 |
| | | Officer | -.22180 | .52642 | 907 | -1 4582 | 1.0146 |
| | NCO | Enlisted | .25280 | 47389 | .855 | -.8602 | 1.3658 |
| | | Officer | .03099 | 35595 | 996 | -.8050 | .8670 |
| | Officer | Enlisted | 22180 | 52642 | 907 | -1 0146 | 1.4582 |
| | | NCO | -.03099 | 35595 | .996 | -.8670 | .8050 |
| Given the chance to train using an Army serious game such as Virtual BattleSpace2 or Tactical Iraqi, I am NOT afraid that I might have trouble learning in navigating through it. | Enlisted | NCO | .00930 | 12297 | .997 | -.2795 | 2981 |
| | | Officer | 10850 | 13660 | .707 | -.2123 | .4293 |
| | NCO | Enlisted | -.00930 | .12297 | 997 | -.2981 | .2795 |
| | | Officer | .09920 | .09236 | 531 | -.1177 | .3161 |
| | Officer | Enlisted | -.10850 | 13660 | 707 | -.4293 | .2123 |
| | | NCO | -.09920 | 09236 | .531 | -.3161 | 1177 |
| I DO NOT hesitate to train using an Army serious game in case I might look stupid. | Enlisted | NCO | -.05447 | 10794 | .869 | - 3080 | 1990 |
| | | Officer | -.06783 | 11991 | .838 | -.3494 | .2138 |
| | NCO | Enlisted | .05447 | 10794 | 869 | - 1990 | 3080 |
| | | Officer | -.01336 | 08106 | .985 | -.2038 | .1771 |
| | Officer | Enlisted | .06783 | 11991 | .838 | -.2138 | .3494 |
| | | NCO | .01336 | .08106 | .985 | -.1771 | .2038 |
| I do not feel uneasy about learning using a Army serious game | Enlisted | NCO | .04987 | .13157 | .924 | -.2592 | .3589 |
| | | Officer | .04345 | 14616 | .952 | -.2998 | 3867 |
| | NCO | Enlisted | -.04987 | .13157 | .924 | -.3589 | 2592 |
| | | Officer | -.00642 | 09883 | .998 | -.2385 | 2257 |
| | Officer | Enlisted | -.04345 | .14616 | .952 | - 3867 | 2998 |
| | | NCO | .00642 | .09883 | .998 | -.2257 | .2385 |
| Playing Army serious games does not scare me at all. | Enlisted | NCO | -.10875 | 11601 | .617 | -.3812 | 1637 |
| | | Officer | -.09979 | 12887 | .719 | -.4025 | 2029 |
| | NCO | Enlisted | 10875 | 11601 | 617 | - 1637 | .3812 |
| | | Officer | .00897 | 08714 | .994 | -.1957 | .2136 |
| | Officer | Enlisted | .09979 | 12867 | 719 | -.2029 | 4025 |
| | | NCO | -.00897 | 08714 | .994 | - 2136 | .1957 |
| I DO NOT hesitate to play Army serious games because I am afraid of making learning mistakes. | Enlisted | NCO | -.01719 | 09656 | .983 | -.2487 | .2143 |
| | | Officer | -.05880 | .10949 | .853 | -.3160 | .1984 |
| | NCO | Enlisted | .01719 | .09656 | .983 | -.2143 | .2487 |
| | | Officer | -.04161 | .07403 | .840 | -.2155 | 1323 |
| | Officer | Enlisted | .05880 | 10949 | .853 | -.1984 | 3160 |
| | | NCO | .04161 | 07403 | .840 | -.1323 | 2155 |
| Army serious games DO NOT make me feel uncomfortable in learning. | Enlisted | NCO | -.13156 | 10809 | .443 | -.3854 | .1223 |
| | | Officer | -.14734 | .12007 | .438 | -.4294 | 1347 |
| | NCO | Enlisted | .13156 | 10809 | .443 | -.1223 | 3854 |
| | | Officer | -.01578 | 08119 | 979 | -.2065 | .1749 |

**Multiple Comparisons**

Tukey HSD

| Dependent Variable | (I) Class Groups | (J) Class Groups | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| | Officer | Enlisted | .14734 | .12007 | .438 | -.1347 | .4294 |
| | | NCO | .01578 | .08119 | .979 | -.1749 | .2065 |
| Perceived Control Data Group | Enlisted | NCO | .50664 | .46281 | .518 | -.5804 | 1.5936 |
| | | Officer | 1.11797 | .51412 | .076 | -.0895 | 2.3255 |
| | NCO | Enlisted | -.50664 | .46281 | .518 | -1.5936 | .5804 |
| | | Officer | .61134 | .34763 | .184 | -.2051 | 1.4278 |
| | Officer | Enlisted | -1.11797 | .51412 | .076 | -2.3255 | .0895 |
| | | NCO | -.61134 | .34763 | .184 | -1.4278 | .2051 |
| I could probably teach myself most things I need to know about Army serious games. | Enlisted | NCO | .00000 | .10696 | 1.000 | -.2512 | .2512 |
| | | Officer | .03846 | .11882 | .944 | -.2406 | .3175 |
| | NCO | Enlisted | .00000 | .10696 | 1.000 | -.2512 | .2512 |
| | | Officer | .03846 | .08034 | .881 | -.1502 | .2272 |
| | Officer | Enlisted | -.03846 | .11882 | .944 | -.3175 | .2406 |
| | | NCO | -.03846 | .08034 | .881 | -.2272 | .1502 |
| I AM in complete control of my avatar when I train using Army serious games. | Enlisted | NCO | .14054 | .11972 | .469 | -.1406 | .4217 |
| | | Officer | .07661 | .13300 | .833 | -.2368 | .3890 |
| | NCO | Enlisted | -.14054 | .11972 | .469 | -.4217 | .1406 |
| | | Officer | -.06394 | .08993 | .757 | -.2751 | .1473 |
| | Officer | Enlisted | -.07661 | .13300 | .833 | -.3890 | .2358 |
| | | NCO | .06394 | .08993 | .757 | -.1473 | .2751 |
| I can make the computer do what I want it to do while playing an Army serious game. | Enlisted | NCO | .07414 | .12013 | .811 | -.2080 | .3563 |
| | | Officer | .15271 | .13345 | .487 | -.1607 | .4661 |
| | NCO | Enlisted | -.07414 | .12013 | .811 | -.3563 | .2080 |
| | | Officer | .07857 | .09023 | .659 | -.1334 | .2905 |
| | Officer | Enlisted | -.15271 | .13345 | .487 | -.4661 | .1607 |
| | | NCO | -.07857 | .09023 | .659 | -.2905 | .1334 |
| I DO NOT need an experienced person nearby when I am using an Army serious game. | Enlisted | NCO | .20110 | .13073 | .274 | -.1059 | .5081 |
| | | Officer | .35260* | .14522 | .041 | .0115 | .6937 |
| | NCO | Enlisted | -.20110 | .13073 | .274 | -.5081 | .1059 |
| | | Officer | .15150 | .09819 | .272 | -.0791 | .3821 |
| | Officer | Enlisted | -.35260* | .14522 | .041 | -.6937 | -.0116 |
| | | NCO | -.15150 | .09819 | .272 | -.3821 | .0791 |
| If I experience problems training on an Army serious game, I can usually solve them. | Enlisted | NCO | .21298 | .10734 | .117 | -.0391 | .4651 |
| | | Officer | .33264* | .11924 | .015 | .0526 | .6127 |
| | NCO | Enlisted | -.21298 | .10734 | .117 | -.4651 | .0391 |
| | | Officer | .11966 | .08062 | .299 | -.0697 | .3090 |
| | Officer | Enlisted | -.33264* | .11924 | .015 | -.6127 | -.0526 |
| | | NCO | -.11966 | .08062 | .299 | -.3090 | .0697 |
| I do not need somebody to tell me the best way to use an Army serious game. | Enlisted | NCO | -.12213 | .12318 | .583 | -.4114 | .1672 |
| | | Officer | .16496 | .13684 | .450 | -.1564 | .4864 |
| | NCO | Enlisted | .12213 | .12318 | .583 | -.1672 | .4114 |
| | | Officer | .28709* | .09253 | .006 | .0698 | .5044 |
| | Officer | Enlisted | -.16496 | .13684 | .450 | -.4864 | .1564 |
| | | NCO | -.28709* | .09253 | .006 | -.5044 | -.0698 |
| Perceived Usefulness Data Group | Enlisted | NCO | .62301 | .54769 | .491 | -.6633 | 1.9094 |
| | | Officer | 1.67254* | .60841 | .017 | .2436 | 3.1015 |

**Multiple Comparisons**

Tukey HSD

| Dependent Variable | (I) Class Groups | (J) Class Groups | Mean Difference (I-J) | Std Error | Sig | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| | NCO | Enlisted | -.62301 | 54769 | 491 | -1 9094 | 6633 |
| | | Officer | 1.04953 | 41139 | 029 | .0833 | 2.0157 |
| | Officer | Enlisted | -1 67254* | 60841 | 017 | -3 1015 | -.2436 |
| | | NCO | -1.04953* | 41139 | 029 | -2.0157 | -.0833 |
| Army serious games help me to train for my individual and collective tasks better. | Enlisted | NCO | .03817 | 12829 | .952 | -.2631 | 3395 |
| | | Officer | .27510 | 14251 | .131 | -.0596 | 6098 |
| | NCO | Enlisted | -.03817 | 12829 | 952 | -.3395 | 2631 |
| | | Officer | 23694* | .09636 | .038 | .0106 | .4633 |
| | Officer | Enlisted | -.27510 | .14251 | .131 | -.6098 | 0596 |
| | | NCO | -.23694* | 09636 | .038 | -.4633 | -.0106 |
| Army serious games can enhance training enough to justify possible extra effort. | Enlisted | NCO | .10149 | 12600 | 700 | -.1944 | 3974 |
| | | Officer | .23323 | 13997 | 219 | -.0955 | 5620 |
| | NCO | Enlisted | -.10149 | 12600 | .700 | -.3974 | 1944 |
| | | Officer | 13174 | .09464 | .346 | -.0905 | 3540 |
| | Officer | Enlisted | -.23323 | .13997 | .219 | -.5620 | 0955 |
| | | NCO | -.13174 | 09464 | .346 | -.3540 | 0905 |
| Most tasks Army serious games train can NOT be trained better through other means. | Enlisted | NCO | .12670 | .12484 | .568 | -.1665 | 4199 |
| | | Officer | .40217* | 13868 | 011 | 0765 | 7279 |
| | NCO | Enlisted | -.12670 | 12484 | .568 | -.4199 | 1665 |
| | | Officer | 27547* | 09377 | 010 | 0552 | 4957 |
| | Officer | Enlisted | -.40217 | 13868 | 011 | -.7279 | -.0765 |
| | | NCO | -.27547 | .09377 | .010 | -.4957 | -.0552 |
| Army serious games provide a more useful way to train | Enlisted | NCO | .21382 | 12945 | .225 | -.0902 | 5178 |
| | | Officer | 43697 | .14380 | .007 | .0992 | 7747 |
| | NCO | Enlisted | -.21382 | .12945 | 225 | -.5178 | 0902 |
| | | Officer | .22315 | .09723 | .057 | -.0052 | 4515 |
| | Officer | Enlisted | -.43697* | .14380 | .007 | -.7747 | -.0992 |
| | | NCO | -.22315 | 09723 | 057 | -.4515 | 0052 |
| Army serious games make it possible to train more productively | Enlisted | NCO | .14284 | .12899 | .510 | -.1601 | 4458 |
| | | Officer | .32506 | 14329 | .061 | -.0115 | .6616 |
| | NCO | Enlisted | -.14284 | .12899 | .510 | -.4458 | 1601 |
| | | Officer | .18222 | 09689 | 145 | -.0453 | 4098 |
| | Officer | Enlisted | -.32506 | 14329 | .061 | -.6616 | 0115 |
| | | NCO | -.18222 | 09689 | 145 | -.4098 | .0453 |
| Behavioral Component Data Group | Enlisted | NCO | .73166 | 41801 | 187 | -.2501 | 1.7134 |
| | | Officer | .82247 | .46435 | 180 | -.2681 | 1.9131 |
| | NCO | Enlisted | -.73166 | 41801 | .187 | -1.7134 | .2501 |
| | | Officer | .09081 | .31398 | 955 | -.6466 | 8282 |
| | Officer | Enlisted | -.82247 | 46435 | 180 | -1.9131 | 2681 |
| | | NCO | -.09081 | 31398 | .955 | -.8282 | 6466 |
| I would NOT avoid training on a topic if it involves training using Army serious games | Enlisted | NCO | -.00162 | 12538 | 1 000 | -.2961 | .2928 |
| | | Officer | -.01945 | 13927 | 989 | -.3466 | 3077 |
| | NCO | Enlisted | .00162 | 12538 | 1.000 | -.2928 | 2961 |
| | | Officer | -.01783 | 09417 | 980 | -.2390 | .2033 |
| | Officer | Enlisted | .01945 | 13927 | 989 | -.3077 | .3466 |
| | | NCO | .01783 | 09417 | 980 | -.2033 | 2390 |

**Multiple Comparisons**

Tukey HSD

| Dependent Variable | (I) Class Groups | (J) Class Groups | Mean Difference (I-J) | Std. Error | Sig | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| I DO NOT only use Army serious games when I am told to | Enlisted | NCO | .21993 | .12984 | 208 | -.0850 | 5249 |
| | | Officer | .26172 | 14423 | 166 | -.0770 | .6005 |
| | NCO | Enlisted | -.21993 | 12984 | 208 | -.5249 | 0850 |
| | | Officer | .04178 | 09752 | .904 | -.1873 | .2708 |
| | Officer | Enlisted | -.26172 | 14423 | 166 | -.6005 | 0770 |
| | | NCO | -.04178 | 09752 | 904 | -.2708 | 1873 |
| I DO NOT avoid playing Army serious games | Enlisted | NCO | .26324 | 13833 | 139 | -.0616 | 5881 |
| | | Officer | .26772 | 15366 | 190 | -.0932 | .6286 |
| | NCO | Enlisted | -.26324 | 13833 | .139 | -.5881 | 0616 |
| | | Officer | .00447 | .10390 | .999 | -.2396 | .2485 |
| | Officer | Enlisted | -.26772 | 15366 | 190 | -.6286 | 0932 |
| | | NCO | -.00447 | 10390 | 999 | -.2485 | 2396 |
| I will use Army serious games regularly throughout my military career. | Enlisted | NCO | .25010 | 13247 | .143 | -.0610 | 5612 |
| | | Officer | .31249 | 14716 | .086 | -.0331 | 6581 |
| | NCO | Enlisted | -.25010 | .13247 | 143 | -.5612 | 0610 |
| | | Officer | .06239 | 09950 | 805 | -.1713 | .2961 |
| | Officer | Enlisted | -.31249 | 14716 | .086 | -.6581 | .0331 |
| | | NCO | -.06239 | .09950 | .805 | -.2961 | 1713 |

* The mean difference is significant at the 0 05 level

# APPENDIX F

## Perceived Gaming Confidence Groups

**Multiple Comparisons**

[illegible]

| Dependent Variable | (I) Perceived Gaming Competence Groups | (J) Perceived Gaming Competence Groups | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| General Attitude Towards Army Serious Gaming Data Group | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | -8.0880 |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | 2.8601 |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | -1.8924 |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Affective Component Data Group | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | .000 | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | 1.4699 |
| Given the chance to train using an Army serious game [illegible] I would [illegible] NOT [illegible] | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | .000 | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I DO NOT hesitate to train using an Army serious game [illegible] | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] as [illegible] Army serious game | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Playing Army serious games does not scare me at all | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I DO NOT hesitate to play Army serious games because I am afraid of making gaming mistakes | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Army serious games DO NOT make me feel uncomfortable in learning | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Perceived Control Data Group | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | 2.6817 |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | 4.0380 |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I would probably teach myself most things I need to know about Army serious games | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

**Multiple Comparisons**

Tukey HSD

| Dependent Variable | (I) Perceived Gaming Competence Groups | (J) Perceived Gaming Competence Groups | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| | More | Less | 47454* | 09733 | 000 | 2459 | 7032 |
| | | Average | 17829* | 07418 | 047 | 0021 | 3505 |
| I AM in complete control of my avatar when i train using Army serious games | Less | Average | -.30804* | 11407 | 018 | -.5759 | -.0401 |
| | | More | -.44136* | 10967 | 000 | -.6989 | -.1838 |
| | Average | Less | 30804* | 11407 | 018 | 0401 | 5759 |
| | | More | -.13332 | 08357 | 248 | -.3236 | 0630 |
| | More | Less | 44136* | 10967 | 000 | 1838 | 6989 |
| | | Average | 13332 | 08357 | 248 | -.0630 | 3286 |
| I can make the computer do what I want it to do while playing an Army serious game | Less | Average | -.39826* | 11246 | 001 | -.6624 | -.1341 |
| | | More | -.68166* | 10812 | 000 | -.9358 | -.4279 |
| | Average | Less | 39826* | 11246 | 001 | 1341 | 6624 |
| | | More | -.28359* | 09240 | 002 | -.4771 | -.0901 |
| | More | Less | .68166* | 10812 | 000 | 4279 | 9358 |
| | | Average | .28359* | 09240 | 002 | 0901 | 4771 |
| I DO NOT need an experienced person nearby when I am using an Army serious game | Less | Average | -.25356 | 12443 | 104 | -.5458 | 0387 |
| | | More | -.52842* | 11983 | 000 | -.8094 | -.2475 |
| | Average | Less | .25356 | 12443 | 104 | -.0387 | 5458 |
| | | More | -.27486* | 09117 | 007 | -.4890 | -.0607 |
| | More | Less | 52842* | 11983 | 000 | 2475 | 8094 |
| | | Average | 27486* | 09117 | 007 | .0607 | 4890 |
| If I experience problems training on an Army serious game, I can usually solve them | Less | Average | -.40743* | 10039 | 000 | -.6432 | -.1716 |
| | | More | -.66983* | 09652 | 000 | -.8965 | -.4431 |
| | Average | Less | 40743* | 10039 | 000 | 1716 | 6432 |
| | | More | -.26241* | 07355 | 001 | -.4352 | -.0897 |
| | More | Less | 66983* | 09652 | 000 | 4431 | 8965 |
| | | Average | 26241* | 07355 | 001 | .0897 | 4352 |
| I do not need somebody to tell me the best way to use an Army serious game | Less | Average | -.01362 | 11845 | 993 | -.2918 | 2646 |
| | | More | -.27309* | 11389 | 044 | -.5406 | -.0058 |
| | Average | Less | .01362 | 11845 | .993 | -.2646 | 2918 |
| | | More | -.25947* | 08679 | 008 | -.4833 | -.0556 |
| | More | Less | .27309* | 11389 | 044 | .0056 | 5406 |
| | | Average | .25947* | 08679 | 008 | .0556 | 4833 |
| Perceived Usefulness Data Group | Less | Average | -2.96640* | 50346 | 000 | -4.1489 | -1.7839 |
| | | More | -4.27798* | 48404 | 000 | -5.4148 | -3.1411 |
| | Average | Less | 2.96640* | 50346 | 000 | 1.7839 | 4.1489 |
| | | More | -1.31158* | .36687 | 001 | -2.1779 | -.4452 |
| | More | Less | 4.27798* | 48404 | 000 | 3.1411 | 5.4148 |
| | | Average | 1.31158* | 36687 | 001 | .4452 | 2.1779 |
| Army serious games help me to train for my individual and collective tasks better | Less | Average | -.73382* | 11823 | .000 | -1.0115 | -.4582 |
| | | More | -.98195* | .11367 | 000 | -1.2289 | -.6950 |
| | Average | Less | 73382* | 11823 | 000 | 4582 | 1.0115 |
| | | More | -.22812* | 08682 | 023 | -.4316 | -.0247 |
| | More | Less | 98195* | 11367 | 000 | 6950 | 1.2289 |
| | | Average | 22812* | 08682 | 023 | 0247 | 4316 |
| Army serious games can enhance training enough to justify possible extra effort | Less | Average | -.70344* | 11570 | 000 | -.9752 | -.4317 |
| | | More | -.95265* | 11124 | 000 | -1.2139 | -.6914 |
| | Average | Less | 70344* | 11570 | 000 | 4317 | 9752 |
| | | More | -.24922* | 08477 | 009 | -.4483 | -.0501 |
| | More | Less | 95265* | 11124 | 000 | .8914 | 1.2139 |
| | | Average | 24922* | 08477 | 009 | 0501 | 4483 |
| Most tasks Army serious games train can NOT be trained better through other means | Less | Average | -.24955 | 11935 | 092 | -.5299 | 0308 |
| | | More | -.50107* | .11474 | 000 | -.7708 | -.2316 |
| | Average | Less | 24955 | 11935 | 092 | -.0308 | 5299 |
| | | More | -.25152* | 08744 | 012 | -.4569 | -.0461 |
| | More | Less | 50107* | 11474 | 000 | 2316 | .7708 |
| | | Average | 25152* | .08744 | 012 | 0461 | .4569 |
| Army serious games provide a more useful way to train | Less | Average | -.68560* | 11934 | 000 | -.9659 | -.4053 |
| | | More | -.98868* | 11473 | .000 | -1.2582 | -.7192 |

**Multiple Comparisons**

Tukey HSD

| Dependent Variable | (I) [illegible] Groups | (J) [illegible] Groups | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Army serious games [illegible] | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Behavioral Control [illegible] Group | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I would NOT [illegible] training [illegible] Army serious games | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I DO NOT [illegible] Army serious games [illegible] | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I DO NOT [illegible] playing [illegible] serious games | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| I will [illegible] serious games [illegible] military career | Less | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | Average | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | More | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | More | Less | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | | Average | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

*. The mean difference is significant at the .05 level.

# VITA

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## EDUCATION

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M.S. in Education. University of Louisville. May 1994

B.S. in Computer Information Systems. McKendree College. December 2002

B.S. in Education. University of Louisville. August 1992

## PROFESSIONAL EXPERIENCE

| | |
|---|---|
| 2012 - Now | Chief, Capabilities and Implementation Office, TRADOC Capability Manager for The Army Distributed Learning Program, Fort Eustis, VA |
| 2011 - 2012 | Supervisory Training Strategy and Plans Analyst, TRADOC Operations Management Activity, Fort Eustis, VA |
| 2006 - 2011 | Future Force Training Analyst, TRADOC G7 Advanced Concepts Directorate, Fort Eustis, VA |
| 2004 - 2006 | Knowledge Manager, Unit of Action Maneuver Battle Laboratory, Fort Knox, KY |
| 2002 - 2004 | Knowledge Manager, Armor and University of Mounted Warfare, Fort Knox, KY |
| 1995 - 2002 | Lead Software Architect, Lead Engineer and Formative Evaluator, IITRI/Northrup Grumman/Litton PRC/TRW/BDM, Fort Knox, KY |
| 1992 - 1995 | Senior Training Developer, Directorate of Training Development, Fort Knox, KY |

## PROFESSIONAL ASSOCIATIONS

| | |
|---|---|
| 1998 - Now | Institute of Electrical and Electronics Engineers (IEEE) |
| 1998 - Now | IEEE Computer Society (CS) |
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