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Beliefs Of Graduate Students About Unstructured Computer Use In Face-to-face Classes With Internet Access And Its Influence On Student Recall

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BELIEFS OF GRADUATE STUDENTS ABOUT UNSTRUCTURED COMPUTER USE IN F2F CLASSES WITH INTERNET ACCESS AND ITS INFLUENCE ON STUDENT RECALL

by

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ABSTRACT

The use of computers equipped with Internet access by students during face-to-face (F2F) class sessions is perceived as academically beneficial by a growing number of students and faculty members in universities across the United States. Nevertheless, some researchers suggest unstructured computer use detached from the immediate class content may negatively influence student participation, increase distraction levels, minimize recall of recently presented information, and decrease student engagement. This study investigates graduate students' beliefs about computer use with Internet access during graduate face-to-face lecture classes in which computer use is neither mandated nor integrated in the class and the effect of such use on student recall. Methods include a 44-item questionnaire to investigate graduate students' beliefs about computers and two experiments to investigate the influence of computer use during a lecture on students' memory recall. One experimental group (*open laptop*) used computers during a lecture while the other (*closed laptop*) did not. Both groups were given the same memory recall test after the lectures, and the resulting scores were analyzed. Two weeks later, a second phase of the experiment was implemented in which laptop groups were reversed. Results from the first experiment indicated no statistically significant difference in recall scores between the *open laptop* group (M = 54.90, SD = 19.65) and the *closed laptop* group (M = 42.86, SD = 16.68); t (29) = -1.82, p = .08 (two tailed). Conversely, the second experiment revealed statistically significant differences in scores between the *open laptop* (M = 39.67, SD = 15.97) and the *closed laptop* group (M = 59.29, SD = 26.88); t (20.89) = 2.37, p = .03 (two tailed). The magnitude of the difference in mean scores (mean difference = 19.62, 95% CI: 2.39 to 36.85) was large (eta squared = 0.17). Multiple regression analysis suggests two factors accounted for 10% of the variance in recall scores: (1) students' beliefs about distractions from computer use, and (2) beliefs about the influence of computer use on memory recall. Based on survey findings, participants (N=116) viewed computers and Internet access in graduate classes as helpful academic tools, but distractions from computer use were major sources of concern for students who used computers in graduate classes and those who did not. Additionally, participants believed academic productivity would increase if instructors integrated computer use appropriately in the curricula. Results of the survey and experiments suggest unstructured computer use with Internet access in the graduate classroom is strongly correlated with increased student distractions and decreased memory recall. Thus, restricting unstructured computer use is likely to increase existing memory recall levels, and increasing unstructured computer use is likely to reduce memory recall. Recommendations include changes in the way students use computers, pedagogical shifts, computer integration strategies, modified seating arrangements, increased accountability, and improved interaction between instructors and students.

To my son,

Jermaine Jerome Johnson

Live godly; learn; trust but ask questions; work hard and love deeply; accept your faults; forgive yourself and others; judge wisely; show humility and respect to all.

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LIST OF ACRONYMS / ABBREVIATIONS

ANCOVA – Analysis of covariance

ANOVA – Analysis of variance

F2F – Face-to-face

LAN – Local area network

LTM – Long-term memory

MRA – Multiple regression analysis

PDA – Personal digital assistant

SPSS - Statistical package for the social sciences

STM – Short-term memory

TPC – Tablet personal computers

UCF – University of Central Florida

URL – Universal resource locator

WAP – Wireless access points

CHAPTER ONE: INTRODUCTION

Introduction

Neil Postman (1993) wrote of the surrender of the human race to the altar of technology despite the potential lethality of unregulated information epitomized by computers with Internet access. Postman's primary concerns about computers in the classroom are not related to their efficiency as teaching tools. Instead, he expresses apprehension about the unique ways in which computer use will transform established pedagogy and potentially undermine important aspects of traditional education. New technology is neither benign nor neutral; technology gives, takes, and most importantly, changes everything (Postman, 1993).

The introduction of computers in the classroom has changed the relationship between teacher and student in ways that are not always readily apparent (Breslow, 2007). Recent research data claims the change is both positive (instant access to information, flexible classrooms, improved note taking) and negative (increased distractions, decreased participation) (Caron & Gely, 2004; Maxwell, 2007; Yamamoto, 2008). Nevertheless, many universities are recommending and encouraging computer use with the expectation that their benefits outweigh the uncertainties surrounding their efficacy in the classroom (Cutshall, Changchit, & Elwood, 2006; Moran, Christoph, Puetz, & Walters, 2007).

Despite these trends, the data that explores the influence of computer use on class dynamics, student interaction, and instructional effectiveness remains subjective, anecdotal (Fried, 2008), under-investigated (Brubaker, 2006), and in some cases, contradictory (Grace-Martin & Gay, 2001; Schacter, 1999; Wurst, Smarkola, & Gaffney, 2008).

Consequently, the need for rigorous research probing the effects of computer use in the classroom on teaching and learning remains critical and necessary. Hence, this study explores the beliefs of graduate students towards unstructured computer use in face-to-face (F2F) graduate classes with Internet access and its influence on students' ability to recall recently presented information.

Background

Exponential growth of wireless computing began in the 1980s when the Federal Communications Commission (FCC) removed restrictions on wireless communications, and Bell Labs developed miniature wireless phones that became widespread communication devices for the masses (Baughman, 2001). At the same time, the development of the Transmission Control Protocol (TCP) and the Internet Protocol (IP) in the 1980s allowed different networks to be connected by a common protocol which led to the rapid deployment of wired and wireless networks (King, 2003). Institutions of higher learning benefited greatly from these innovations. In 2006, more than half of all colleges in the USA had a wireless campus; in 2007 that number surpassed 60%, and more than 75% of all college campuses surveyed had plans to implement wireless computing (K. C. Green, 2007). Despite the explosion of mobile technology, the debate over the benefits of computers in classrooms remains divisive (McCreary, 2009; Rockman, 2004).

Some researchers conclude the use of desktop computers, laptops, and wireless networks in classrooms positively influences active learning, promotes problem solving, strengthens connections between different academic disciplines, promotes academic achievement, and encourages student interaction, collaboration, motivation, and sharing (Barak, 2006; Barak, Lipson, & Lerman, 2006; Fried, 2008; Grace-Martin & Gay, 2001; Granberg & Witte, 2005; Sommerich, 2007). Students generally perceive access to the Internet as a necessary staple of college life, and most own laptops and use them frequently to manage emails, explore music, communicate with faculty, conduct research, complete class activities and assignments, play online games, pay bills, explore personal endeavors, and interact socially (Barak et al., 2006; Jaillet, 2004; Jones, 2002; Wolff, 2006).

Other researchers argue laptops in classrooms offer students a level of intimacy far superior to the options offered by desktops in computer labs, and their use confers significant flexibility to instructors who wish to rearrange their classrooms, promote collaborative learning, or encourage anytime learning environments (Efaw, Hampton, Martinez, & Smith, 2004; Penuel, 2006; Wolff, 2006).

Recent studies within the past ten years present a more complex picture (Penuel, 2006). Warschauer (2008) asserts few rigorous studies investigate test outcomes for classes that incorporate laptops. Of these studies, increases in writing scores and improvements in technical proficiency were the only substantive gains to student learning directly attributable to laptop use. Other researchers observed that computers in the classroom provide a tempting source of distraction and create additional difficulties for the student using the technology, the instructor managing the class, and students not using laptops (DeGagne & Wolk, 2007; Dunleavy, Dexter, & Heinecke, 2007; Jaillet, 2004; Mennenga & Hendrickx, 2008).

On the subject of academic performance, researchers found that having ubiquitous access to laptops did not increase test scores of college students (Wurst et al., 2008). The findings from Wurst, Smarkola, and Gaffney are consistent with the results of an earlier study by Grace-Martin & Gay (2001) who found that the academic performance of students who browsed the Internet during class sessions suffered significantly compared to students who did not use laptops regardless of course content. Consequently, Grace-Martin and Gay (2001) recommend limiting student access to the wireless network or directing student attention to specific computer content to improve student performance. These recommendations found additional support from a growing number of professors who have struggled with computer use in their classrooms (Brady, 2008; Yamamoto, 2008).

Other researchers observe a backlash against laptops (Caron & Gely, 2004; McCreary, 2009; Yamamoto, 2008), even as their use continues unabated in most college classrooms. A few frustrated professors are manually unplugging wireless transmitters in classes amidst student outrage (Young, 2006). Parents are expressing concerns about the glut of distracting activities made available to students via wireless laptops in classrooms, and online groups have been formed to discuss the benefits and threats posed by the technology (Adams, 2006; Maxwell, 2007). In fact, some universities have taken steps to limit, block, or ban laptop use in specific classes (Yamamoto, 2008). Other researchers contend banning laptops may eliminate the distractions they engender, but such restrictions also remove the potential benefits they offer (Brady, 2008; McCreary, 2009; Truman, 2005).

Carrie Fried (2008) observed that the developing feud between professors and students concerning unregulated laptop use is being reported by popular media outlets but is scarcely mentioned in academic journals. Consequently, reports of laptop disenchantment among faculty lack hard science and remain anecdotal. Some instructors prefer the hands-off approach, which empowers college students to be responsible for their own education, and allows graduate students the maturity to decide whether to listen to class instruction or turn their attention elsewhere (Maxwell, 2007).

Yet, the impact of inappropriate computer use may be more punitive than a possible decrease in the test scores of students using these devices. Maxwell (2007) found that students who were not using laptops had difficulty concentrating or listening to the instructor when laptop screens in their immediate radius were decorated with flashing websites, animations, colorful games, and other attention-arresting media. When used to explore content unrelated to classes for an extended period, computer use is likely to impact the entire class and has the potential to alter classroom dynamics significantly (Truman, 2005; Yamamoto, 2008). Other researchers complain that too much focus is being placed on the potency of the technology rather than the efficacy of the teaching activity (Selwyn, 2007), and the misplaced focus distracts from important changes occurring within the classroom (Kirkup & Kirkwood, 2005). Clearly, those who care about quality instruction cannot ignore the potential positive and negative influence of this technological phenomenon.

Problem Statement

The use of desktop and laptop computers with wireless Internet access by graduate students during face-to-face classroom lecture sessions is perceived as beneficial by many students, faculty, and academic institutions; however, a growing number of researchers assert unstructured computer use is distracting to both the student using it, and his or her peers (Fried, 2008).

Additional research findings reveal computer use that is not actively integrated in the curriculum may decrease students' participation in class discussions, negatively influence students' ability to recall recently presented information, and hinder the interactive exchange of ideas between instructor and student (Hembrooke & Gay, 2003; Wurst et al., 2008; Yamamoto, 2008). Consequently, more research is needed to determine the impact, efficacy, and implications of computer use in specific academic settings.

Purpose of Study

The purpose of this study is to investigate graduate students' beliefs about unstructured computer use with Internet access in face-to-face graduate classes and its effect on students' memory recall.

The need for research on this subject is critical. Penuel (2006) remarks that the collective knowledge of the educational community has not kept pace with the rapid expansion of computer technology, wireless networks, one-to-one computer initiatives in the classroom, and the impact and effectiveness of these programs. In his synthesis of the literature on computer technology in the classroom, Penuel

(2006) concludes that the majority of studies in this field focus on middle and high school students, and few may be considered rigorous.

Studies in the last ten years that examine computer use in the classroom provide arguments for and against their use (Brady, 2008). Some researchers observe benefits to be gained when computer technology is employed and used appropriately (Bielefeldt, 2006; Efaw et al., 2004; Fairman, 2004). Other studies report computers in the classroom can be very distracting (Brubaker, 2006; Foster, 2008; Young, 2006), and students (especially females) not using laptops were negatively affected by other students using them (DeGagne & Wolk, 2007; Fried, 2008).

Brain researchers who examined the relationship between memory and learning found that the presence of distractions in a learning environment significantly decreases the level of learning (Foerde, Knowlton, & Poldrack, 2006). These researchers made this conclusion after scanning participants using functional MRIs (fMRIs) as they performed single tasks without distractions and compared their performance and brain activity to another group of participants who performed the same tasks while distracted.

Since the effectiveness of computers in the classrooms is in dispute, especially in relation to unstructured computer use (Barak et al., 2006; Caron & Gely, 2004; Warschauer, 2008), there is a need for more research at all levels of academia and in various learning situations to inform all concerned about the most efficacious implementation of these technologies.

Operational Definitions of Key Terms

Key terms used in this study have the following operational meanings:

Computer - “an electronic device that accepts structured input, processes it according to prescribed rules and produces the result as output” (National Centre for Technology in Education, 2008a). For this study, a computer may refer to a desktop computer owned by the college or university and available for student use, or to a laptop computer owned by the student or academic institution and used during class sessions. Desktop or laptop configurations will be differentiated when necessary.

Laptop computer - a portable microcomputer having its main components (processor, keyboard, and display screen) integrated into a single unit capable of battery-powered operation (Merrian-Webster Online Dictionary, 2009).

Desktop computer - a personal computing machine usually larger in size and less portable than a laptop computer and generally has an attached keyboard rather than a built-in unit (Desktop computer, 2006).

Tablet PCs - similar to traditional laptops, but students may write directly on their screens using a stylus, and the technology provides multiple points of input including pen, voice, keyboard, and mouse. Consequently, students may draw, sketch, and write as they would with pencil on paper. Additionally, TPCs can translate ink-based input to editable text that can be used in a standard word processor (Moran et al., 2007).

Net book – very light, portable computers that are smaller than an average size laptop and weighs less than three pounds (Mossberg, 2009). Net books use ultra low voltage processors and are sometimes used interchangeably with notebook computers; however, the distinction between the two is often arbitrary (Ogg, 2009).

Structured computer use – academic F2F class session in which computer use by students is integrated in the teaching and learning process (Fried, 2008). For this study, *structured computer use* describes graduate students' computer use with Internet access that is required for class content or delivery and used for activities directly related to the ongoing class session. The instructor incorporates and requires computer use in the lesson, and personal, inappropriate, or off-task computer use is restricted, minimal, or strongly discouraged.

Unstructured computer use – class sessions in which computer use is optional and is neither integrated nor required for class content or discussion (Fried, 2008). For this study, unstructured computer use refers to a F2F graduate classroom environment in which the instructor allows students to use computers as they wish, but the class content is not tied to, nor integrated with their use during the class session to learn the content. Computer and Internet use is optional and is determined by and at the discretion of the student.

Graduate students - students pursuing an academic degree beyond a baccalaureate degree (Helland, 2002). Typically, graduate students refer to those pursuing a master's or a doctorate degree for a career in academia or government and are distinguished from students pursuing a professional education to work in law or medicine (Helland, 2002).

Internet - a network comprised of other networks linked together by a set of standards including the Transmission Internet Protocol (TCP) and the Internet

Protocol (IP) that allow sending and receiving of information in the form of digital packets in an orderly, reliable manner (Encyclopedia of Computer Science, 2003).

Wireless - communication technology that occurs when electromagnetic waves in the form of radio frequency waves are transmitted through the atmosphere (Wireless, 2006).

Wireless access point – a communication device that receives, routes, and sends signals from other devices that are also capable of sending and receiving wireless signals. The exchange and processing of signals allow the devices to communicate with each other, establish a network, and when configured appropriately, allows a user to connect to other networks such as the Internet (Wireless access point, 2006).

Wireless Internet access - a network configuration that allows users access to the Internet without a physical connection to the network (Wireless Internet access, 2001).

Lecture - a form of direct instruction that allows an instructor to transmit a large amount of information to students quickly with the expectation that students will remember the content. One problem with lecture as an instructional strategy is that it does not motivate critical thinking skills or promote social discussion when used alone (Arends & Castle, 2002). In this study, *lecture classes* will be defined as a classroom setting in which the instructor is physically present and communicates with students primarily through speech, and may supplement the instruction with PowerPoint notes, multimedia, question-and-answer segments, class discussions, and other activities. Students are expected to listen attentively to the instructor, make notes of class content they consider important, and respond with questions and commentary.

Memory recall - the retrieval of a memory trace (Thompson et al., 2002). In this study, the recall ability of graduate students will be tested using explicit tests, such as short answer questions that require students to actively remember facts from a class lecture or discussion (Thompson et al., 2002).

Beliefs - a person's inner state of mind that can be evaluated or assessed and are causally related to a person's behavior; however, behavior does not necessarily correspond neatly to a person's beliefs (Quinton, 2006). Beliefs commonly rise from knowledge a believer considers evidence, even if the evidence is inappropriately applied, fails to provide support for the belief, or is untrue (Quinton, 2006). In this study, beliefs represent graduate students' views of unstructured computer use in graduate classes, even when these beliefs do not correspond to students' actions and may not be supported by appropriate evidence.

Memory - the ability to recall past activities, thoughts, emotions, and information and may be categorized into episodic, procedural, and semantic memories (Moore, 2007). Memory involves three processes—encoding, storage, and retrieval (Swartz, 2003) and is divided into short term memory, also called working memory, and long term memory also known as permanent memory.

Episodic memory - specific experiences, events, or activities that become easier to store and remember when events are serious or significant.

Procedural memory - stored knowledge about performing an activity, completing a procedure, or performing a skill (Moore, 2007).

Semantic memory - facts and general knowledge and includes the knowledge humans store about meanings, definitions, and objects (Moore, 2007).

Memory encoding - a memory process of the human brain in which information or stimulus received from the environment is filtered for specific content or for information that is focused upon and then formatted in ways the brain can process and store (Moore, 2007).

Memory storage - the retention of encoded information in the human brain (Myers, 1996). Information may be stored for only a brief period in what is believed to working memory or short-term memory. Likewise, over time the information may be stored in a more permanent state called long-term memory (Bruning, Schraw, & Ronning, 1999; Myers, 1996).

Memory retrieval - a memory process that occurs in the human brain that refers to recalling, remembering, or accessing information previously stored and may be subdivided into recall and recollection (Swartz, 2003). *Recall* is the process of reproducing information, especially verbal information, previously stored, while *recollection* explores whether the individual encountered a stimuli before (Swartz, 2003).

Attention - may be divided in two parts—(1) arousal and (2) selection of information. Arousal refers to the state of being awake as opposed to being asleep. More precisely, arousal is the state of readiness or alertness that allows a living being to interact with the environment and surrounding stimuli (Posner & Rothbart, 2003). The second prong of attention is the selection of information which is the process that allows a living being to consciously focus the mind on an object, train of thought, or stimulus for immediate processing or for later storage in memory

(Posner & Rothbart, 2003). For this research study, *attention* refers to the second prong—the conscious selection of stimuli or information.

Divided attention - an experimental paradigm in which participants attempt to learn information while simultaneously engaged in a secondary task. This paradigm infers that the ability of participants to encode information being presented decreases tremendously if the secondary task is difficult or distracting (Kensinger, Clarke, & Corkin, 2003).

Distraction - “a condition or state of mind in which attention is diverted from an original focus or interest” (Distraction, 2007); distractions serve to divert or entertain and make concentration difficult (Distraction, 2000).

Research Questions: Descriptive

The questions to be addressed in this study focus on student beliefs about unstructured computer use in graduate F2F classes and include a main question and five sub-questions: (1) what are the beliefs of graduate students about the effects of unstructured computer use in F2F graduate classes equipped with Internet access on the following?

(a) Degree of classroom participation

(b) Degree of student distraction (computer users and non-users)

(c) Degree of influence distractions impose on memory recall

(d) Types of limits students are willing to accept on computer use

(e) Types of computer activities pursued in classes

Research Questions: Inferential

(2) Is there a statistically significant difference between recall test scores of graduate students who use computers equipped with Internet access in unstructured F2F graduate classes and those who do not, as measured by test scores on a recall test?

(3) Which student belief variables (general beliefs, participation, distractions, recall influence, limits, and computer activities as measured by a questionnaire) are most influential in predicting recall test scores of graduate students who use computers in unstructured F2F graduate classes with Internet access?

Null Hypothesis (Question 2)

There is no statistically significant difference in recall test scores of graduate students who use computers equipped with Internet access in unstructured F2F graduate classes and those who do not, as measured by test scores on a recall test.

Null Hypothesis (Question 3)

The independent variables (general beliefs, participation, distractions, recall influence, limits, or computer activity as measured by a questionnaire) are of no influence in predicting recall test scores of graduate students in F2F unstructured classes with Internet access.

Variables (Descriptive)

Independent variables for the descriptive portion of this study include questions and statements from the survey instrument classified into six groups to correspond to each descriptive research question. These include: (1) beliefs about the effects of computer use, (2) participation in classes when computers and Internet access are used, (3) distractions for computer users and non-users, (4) memory recall influence - the degree to which distractions influence student recall, (5) limits on computer use that students will accept, and (6) computer activities pursued in classes.

Likewise, the corresponding dependent variables include (1) general beliefs scores, (2) participation scores, (3) distraction scores, (4) memory recall scores, (5) limits scores, and (6) computer activities scores. Additionally, the instrument includes demographic questions as independent variables, and student responses as dependent variables.

Variables (Inferential)

Two questions are included in the inferential component of this study. The first was addressed using a short-answer, fill-in-the blank, recall test given to two groups of graduate students enrolled in the same research class that allowed unstructured computer use. The first group of students used computers during a lecture; the second group did not use computers during the same lecture (given later). Both groups were given a recall test after the lecture. The computer condition (computer use or non-use) during the lecture was the independent variable, and the recall test scores of students were the dependent variables.

The second inferential question explores the predictive influence of students' beliefs about computers (as measured by the questionnaire) on their recall test scores. The independent variables for this question are students' overall scores for their beliefs about computer use, participation, distractions, recall influence, limits, and computer activities. The dependent variables are recall scores.

Instrumentation

To address descriptive questions, this researcher developed a survey instrument composed of questions and statements to solicit responses from graduate students concerning their beliefs about unstructured computer use with Internet access in F2F graduate classrooms. The instrument has six sections, each of which corresponds to a descriptive research question. The six sections addressed students' general beliefs about computer use, degree of classroom participation, degree of student distraction for students who use computers and those who do not, degree of influence distractions impose on memory recall, types of limits students are willing to accept on computer use, and types of computer activities pursued in classes.

The questionnaire also requests demographic information including type of computer used, students' degree level, degree major, student status, gender, ethnicity, age, and first language.

To address inferential questions (2-3), this researcher employed a quasi-experimental research study during unstructured computer classes to assess graduate students' recall ability in two specific instances: (1) listening to a lecture while using a computer, and (2) listening to a lecture without a computer. Memory recall ability under both conditions was assessed using short-answer, fill-in-the-blank recall tests composed of questions taken from the lecture delivered during the class session. Additionally, students' overall beliefs scores on the questionnaire were compared to students' recall test scores to probe the level of influence the former has on the latter.

Significance of Study

While the effectiveness of unstructured computer use in the classroom remains divisive, this study is positioned to provide additional data on academic computing among graduate students in F2F lecture classrooms equipped with wireless Internet access. The findings from this study have implications for graduate students interested in optimizing their learning in multimedia classrooms, instructors developing teaching strategies for tech-savvy students, professors integrating technology in their courses, and university administrators deploying wireless technologies on their campuses.

Unstructured computer use in the classroom is an important topic; however, the research in this field remains limited. This data gap has been noted by some researchers who report academic research exploring the use of laptops and wireless Internet access in higher education is lacking (Kim, Mims, & Holmes, 2006).

On the question of unstructured computer use and academic achievement, Rockman (2004) asserts that studies showing increases in test scores are isolated and inconsistent and do not clearly tie positive results to computer use (Penuel, 2006). Other researchers (Campbell & Pargas, 2003, p. 101) note a dearth of resources that ". . . address how pedagogy can be enhanced with the presence of laptops in the classroom." Campbell and Pargas (2003) also insist laptop use in the classroom must become seamless and invisible and should be adapted to the lecture and the learning experiences of students. Consequently, these researchers encourage more experimentation with laptops in the classroom.

On the subject of experiments, some researchers (Moran et al., 2007) recommend research on student distractions when using tablet PCs (a laptop that allows direct input on its screen) in the classroom. They note the need for studies on faculty members who fail to incorporate the technology fully in their classrooms, and recommend research comparing student expectations of computer technology with faculty expectations. Fried (2008) offers two questions for research: (1) Why does laptop use interfere with learning—is it the distraction caused by the information viewed, or is it cognitive overload, and (2) do the disadvantages of using laptops outweigh their potential benefits?

Finally, Gay, Stefanone, Grace-Martin, & Hembrooke (2001) contend future research should explore how mobile computing affects particular learners and learning communities. Nevertheless, the rapidly changing advances in technology has not kept pace with the available literature and has challenged this researcher to investigate the impact of computers on one learning community—graduate students in classrooms equipped with wireless Internet access.

Existing research has focused on laptops in high schools (Sommerich, 2007), under-privileged schools (Mouza, 2008), undergraduate programs at colleges and universities (Barak et al., 2006; Fisher, Butler, & Keenan, 2004; Hembrooke & Gay, 2003), and law schools (Caron & Gely, 2004; Foster, 2008; Maxwell, 2007). Unfortunately, this researcher did not find published studies on the impact of unstructured computer use and wireless Internet access on graduate students in colleges of education in the USA. Most studies showing positive results of computers in the classroom focus on undergraduate and high school computer use that is integrated and part of the class content (Breslow, 2007; Crook & Barrowcliff, 2001; Fried, 2008; Mouza, 2008; Sommerich, 2007). The impact of unstructured or non-integrated computer use on graduate students remains open for investigation. Consequently, this study hopes to add to the available literature and begin filling that gap.

Institutions of higher learning are encouraging laptop use because of perceived benefits (Barak et al., 2006; Brubaker, 2006), but other researchers report their use are ". . . negatively associated with student learning and poses a distraction to fellow students" (Fried, 2008, p. 912). In some instances, researchers are recommending that faculty members ban laptop use that is not fully integrated in the course because their disadvantages outweigh their benefits (Hembrooke & Gay, 2003; Maxwell, 2007). These findings warrant further examination.

Organization of Study

This dissertation is organized in five chapters. Chapter 1 introduces the major issues surrounding computer use in the classroom. Chapter 2 reviews the available literature highlighting both structured and unstructured computer use in various academic settings. Chapter 3 explores research methods and instruments used in this study; chapter 4 presents the results of the study, and chapter 5 explores the ramifications and reasonable conclusions to be drawn from the results.

CHAPTER TWO: LITERATURE REVIEW

This chapter provides a review, summary, and analysis of research literature on computer use in classrooms and includes scholarly findings and recommendations. This review also explores laptop and desktop computers, wireless technology, computer activities in the classroom, differences between structured and unstructured use, theoretical framework of this research, and related findings on attention, distractions, memory, recall, and multitasking.

Overview of Related Technology

A computer is a complex, multifunction machine that accepts data, processes it according to stored instructions or programs, and returns a response (Microsoft Corporation, 2002). Any device that processes information and returns a desired result may also be classified as a computer (Microsoft Corporation, 2002). Computers are produced in various sizes and shapes, but this research study will focus on desktop and laptop computers as typically used in graduate classes.

Desktop Computers

Desktop computers are useful in educational settings to explore information on the Internet, access stored data, view multimedia (including video, audio, images, text, simulation, and animation designed to instruct or support learning), explore software programs, and provide entertainment. Responses from a computer are generally viewed on a computer screen that displays the result to the user, from audio speakers that play sounds or music, or from printers that provide printed output (National Centre for Technology in Education, 2008b).

Desktop computers vary in size but are personal computers intended to be used in a single location and are small enough to fit on or near a desk. Desktops generally have a separate screen, mouse, and keyboard and may be mounted in different configurations to fit the user's need. Some desktop computers are designed with the all-in-one form factor in which the computer, display screen, speakers, and other peripherals are packaged as one unit rather than separate hardware components (National Centre for Technology in Education, 2008b).

Many colleges and universities in the USA make desktop computers available in their labs, libraries, and open access areas for student use. Some institutions of higher learning even require students to own a computer (Cutshall et al., 2006; Fisher et al., 2004; Mennenga & Hendrickx, 2008), and in some instances where no ownership mandate exists, most students already own an adequate laptop or desktop computer (Truman, 2005).

Laptop Computers

Laptops are among the most widely used wireless technology in higher education for academic purposes (Barak, 2006; Kim et al., 2006). They have all the capabilities of a desktop computer but contain a battery that powers them for hours without electrical outlets (National Centre for Technology in Education, 2007). Laptops generally weigh between two and ten pounds, making them portable and powerful. The inherent mobility and ability to handle similar computing tasks as desktop computers make laptops compelling tools for teaching, learning, creating, and sharing (National Centre for Technology in Education, 2007).

Wireless Networks

During the early development of computer networks, schools and students used Ethernet cables to connect computers to local area networks (LAN) (Kim et al., 2006). In recent years, the trend has migrated to wireless networks that transmit data packets (text, voice, video, or pictures) through the airwaves (Kim et al., 2006). Zhang (2004) describes wireless computing as hardware and software components that connect computers to a network using low-power radio frequencies, infrared, microwave links, and similar technologies. To create a wireless network, each computing device is equipped with a wireless adapter that sends and receives data transmissions to and from access points (small devices mounted in various locations in the networked area that contain components and circuits to receive and transmit data, and serve as a bridge connecting the wireless components to a wired network). When in use, wireless technology transforms the college lecture hall into a collaborative, interactive lab setting; it's network range promotes flexible environments that give laptop users access to the Internet, printers, and servers (Barak, 2006; Zhang, 2004).

In recent years, the potential for laptop use in classrooms increased significantly for three reasons: (1) the cost of wireless deployment on campuses fell, (2) laptops became faster, more powerful, portable, and affordable, and (3) the potential for increased communication and pedagogy became apparent (Barak, 2006; Cutshall et al., 2006; Rockman, 2004). As wireless infrastructure on school campuses improved, students were able to access the Internet and other networks anytime, anywhere on campus (Granberg & Witte, 2005). A recent report from The Campus Computing Project 2008 concludes almost 70% of higher educational classrooms had access to wireless networks, and private universities led the growth with 76% of their classrooms having a wireless reach (K.C. Green, 2008). Researchers claim that this technological evolution is poised to become an integral part of classroom pedagogy with the potential to change class communication and information exchange (Barak et al., 2006). Others claim the transformation is already in progress (Hiltz & Turoff, 2005).

Computer Use Trends

The exponential growth of computers on school campuses have led to the coining of the term *ubiquitous computing* to describe their pervasiveness (Crook & Barrowcliff, 2001; Finn & Inman, 2004). Most colleges and universities are wired for Internet access, and more than two-thirds of all campuses in the USA provide wireless access (K.C. Green, 2008). As computing technology increases in speed and capability, student computing will continue to migrate from desktop computers in the classroom to laptop computers and small, smart devices. Nick Wingfield (2009) observes that mobile workers prefer laptops over desktops because of the former's mobility, and smart phones with large screens and credible keyboards are now replicating many important functions of the laptop. While the number of computing machines has increased, their effectiveness and appropriate use is still being debated. Likewise, research on computer use and their impact on pedagogy in higher educational settings remains lacking (Kim et al., 2006).

Structured and Unstructured Computer Use

When reviewing literature on computer use in the classroom, it is important to note whether the research study evaluated *structured* computer use in which computer technology is actively integrated in the curriculum or *unstructured* use in which computer use is minimally regulated (Fried, 2008). Instead of *structured* and *unstructured* use, one researcher uses the terms *restricted* and *unrestricted* computer use, but essentially, the meanings are similar (Truman, 2005).

This researcher views *structured* computer use as the integration of computers, software, hardware, and related technologies in a manner that tightly supports and improves the instructional process (Barak et al., 2006; Granberg & Witte, 2005). The instructor and students work in tandem to integrate computers so that the use of the technology is relegated to and is part of the current class content and structure (Breslow, 2007; DeGagne & Wolk, 2007; Truman, 2005).

On the other hand, *unstructured* computer use in this study describes classroom computer use minimally regulated by the instructor and is neither integrated nor required for class content or discussion (Maxwell, 2007). Unstructured use is characteristic of graduate classes with a high degree of student autonomy in which instructors allow students to use their computers, presumably for note-taking or research, but class content is not tied to, and does not require students to access data or applications to complete requirements for the class session (McCreary, 2009; Yamamoto, 2008).

Fried (2008) observes that much of the emerging research on the influence of mobile technology in the classroom focus on structured computer use. Researchers often promote the positive results from these studies, but Fried and others note the lack of objective measures of learning and a missing non-laptop control group in most of these studies (Fried, 2008; Wurst et al., 2008; Yamamoto, 2008).

Structured computer use is prevalent in all areas of academia (Imhof, Vollmeyer, & Beierlein, 2007). Instructors often integrate specific technology in their classrooms and will monitor students' use to ensure they stay on task (Barak et al., 2006; Sommerich, 2007). Depending on the course objectives and teaching strategies, some instructors will also use a computer application or specific technology as the main teaching tool (Efaw et al., 2004; Moran et al., 2007). This form of instruction may include displaying an image of the instructor's computer on a large projection screen and using the display as a tool to help students learn a spreadsheet application, a database program, or an image editing program (Efaw et al., 2004; Weaver & Nilson, 2005). In these instances, and others like them, student's use of the technology is highly structured and provides few opportunities for students to engage in off-task activities without missing important details (Barak et al., 2006; Liu, Macmillan, & Timmons, 1998). Many studies have been conducted under structured computer use conditions resulting in both positive and negative results about the efficacy of computers and Internet access in the classroom (Breslow, 2007; Campbell & Pargas, 2003).

Nevertheless, at the graduate and professional levels, adult students have an expectation of autonomy that grants them less oversight and minimal regulations to guide their access to computers for most class sessions (Sorensen, 2005; Yamamoto, 2008). These unrestricted graduate classroom conditions that allow unstructured computer use are rarely addressed in the literature even though they provide the best opportunities to study real-world computer use in the classroom (Fried, 2008).

Structured Computer Use in the Classroom

Early studies of computers in the classroom between 1993 and 1999 found an increase in student motivation, academic achievement, and collaboration in classrooms that integrated laptops in the core curriculum (Grace-Martin & Gay, 2001). Reviews of these studies give rise to two major concerns. First, laptops used in these observations were attached to hardwired Ethernet cables; hence, the results gained do not reflect today's ubiquitous wireless connectivity on many campuses across America. Second, the operating systems used on these laptops were primarily DOS-based (Windows 98) and do not reflect advances and improved usability in current operating systems.

In another K-12 study, Sommerich (2007) used questionnaires and a recording program at the secondary level to monitor high school seniors' use of tablet PCs (TPCs) and to assess their attitudes towards the technology. Each student was given a tablet PC to use in classes for note-taking, homework assignments, communication with other students, communication with faculty members, and for other purposes. Seventy-seven students completed and returned the questionnaire resulting in a 73% response rate. Two thirds of respondents were 11th graders and 75% of all participants were female. Researchers also installed monitoring software on the computers of 13 students for 16 days.

After analyzing their findings, researchers report students had a positive attitude towards TPC use in classes, but less than 30% of students felt their grades improved with the use of TPCs. Most participants (76%) felt their interaction with other students improved with TPC usage, but only 42% agreed the same was true of their communication with faculty members. Researchers did not find differences in attitude towards TPCs based on gender, but students in grade 12 were more likely than 11th graders to view TPCs in the classroom as a distraction.

Several concerns emerge from this study. First, 77 students completed the questionnaire, but 75% of them were females which may reflect a sample that over-represented the perspective of the female population. Second, the monitoring software recorded only 13 students—only three of whom were males—for 16 consecutive days. A sample size this small may not be optimal for the results sought and may not be broadly reflective of students' general attitude towards laptop technology. Third, researchers failed to provide important information about the validity of the survey instrument, so reviewers lack an objective foundation upon which to judge its worth (Nieswiadomy, 2008). Fourth, monitoring software installed on some computers functioned as an objective tool to measure student use, but no information was provided about the effect of this surveillance on student use. Students may have adjusted their computing behavior for the 16 days the monitoring tool was in use. If this behavioral change occurred, the results of the monitoring may be incomplete. Finally, the results of this study are important, but the highly structured environment of a high school classroom may not extrapolate well to a graduate school setting geared towards independent thought and creative learning.

Nevertheless, a growing number of recent studies have provided results that are more pertinent by investigating specific implementations of technology in the classroom (Barak et al., 2006; DeGagne & Wolk, 2007; Kim et al., 2006; Penuel, 2006; Warschauer, 2008; Wurst et al., 2008).

At the undergraduate level, researchers (Efaw et al., 2004) at West Point Military academy conducted a quasi-experimental study with 10 instructors and 527 freshmen college students in a General Psychology class taught in 30 sections. Twenty-two sections and four instructors were designated the control group where traditional teaching and learning methods were employed, and laptops were not used. The experimental group consisted of eight sections and four instructors who infused technology heavily in their classes and encouraged each student to do the same.

The purpose of this experiment was to examine the influence of laptop computers in the classroom on teaching strategies, student attitudes, and learning outcomes. Student learning was assessed using their scores on six multiple choice and short-answer tests and a final multiple-choice exam of 100 questions.

Researchers found that students who used laptops in their classrooms and whose use was directed by the instructor scored 3.3 points higher, on average, for all seven examinations than students in similar classes being taught the same content but prevented from using laptops. Student attitudes improved significantly for those who were allowed laptop access, and students were excited about their improved note-taking, quick access to relevant materials for class discussions, impromptu research activities, virtual library access, organized notes, and class presentations that required laptop use (Efaw et al., 2004).

Three observations arise from this study. First, the increased test scores noted in this study may be indicative of the teaching prowess of the self-selected instructors in the experimental classes and may not be directly linked to student gains from laptop use (Efaw et al., 2004). Second, West Point Military Academy is predominantly male—85% of its students (National Center for Education Statistics, 2008)—so test results and student attitudes reflect a male perspective. A third point of contention is the culture of West Point that encourages rigor and discipline (United States Military Academy West Point, 2009). Presumably, students in these settings are less likely to use laptops during class sessions for significant off-task activities. Consequently, the findings here represent a highly structured classroom environment that tightly integrates laptop use; however, this setting is not typical of graduate schools.

Another undergraduate study by Weaver and Nilson (2005) produced similar results. At Clemson University's College of Engineering and Sciences, researchers surveyed 616 students enrolled in 19 courses who were required to use laptops in their freshman classes. Both students and faculty reported high satisfaction from their laptop classes; 61% percent confirmed increased engagement, and 48% reported increased learning with laptops.

Two notable observations arise from this study. First, the participants were first-year students. Their perceptions of laptop use may not be indicative of other students who have used laptops in classes for four or more years. Second, reports of increased learning were attributed to half the total number of participants, yet, the study did not provide or include a quantifiable method to judge the improvements. Consequently, a genuine assessment is difficult, but the positive views of students surrounding the initial introduction of laptops in a classroom is consistent with many other studies (Truman, 2005).

At the Massachusetts Institute of Technology (MIT), Barak, Lipson, & Lerman (2006) used questionnaires, video recorders, and neutral observers to monitor students' use of laptops, assess student attitudes towards studio classes that incorporated wireless laptops, and investigate the impact of this technology on active learning in large lecture halls. Researchers reported the results of an online survey with an 85% response rate (318 students). Each student either owned a laptop and used it during classes or was given a loaner laptop for this study. All laptops had wireless access to the Internet.

Researchers described positive responses from students who were asked about their use of wireless laptops in classes. Students strongly preferred laptops to the tethered desktop models and benefited greatly from the hands-on experience of computer programming after each lecture session. Students also found laptops helpful in preparing homework, completing class activities, and note taking during meetings with instructors. Nevertheless, 15% of students reported unrestricted laptop use distracted them during classes, and 12% browsed the web, wrote emails, and visited websites unrelated to class content (Barak et al., 2006).

Thus, for learning outcomes, laptops (1) encouraged the learning of procedural understanding of computer programming, (2) provided numerous opportunities for immediate feedback between students and instructors, (3) made abstract ideas concrete, and (4) encouraged student interaction and collaborative work between student and instructor. While acknowledging the benefits of wireless laptops, these researchers concluded that their use pose significant challenges to learning and are best deployed only when necessary to further specific instructional goals. Consequently, some classrooms might see improvements in student productivity when computer use is restricted (Barak et al., 2006).

While the research outcomes support prevailing findings of both positive and negative computer use, the sample used in this study were beginning computer and engineering students at the undergraduate level. Consequently, results may not reflect computer usage at higher levels of academia. Furthermore, researchers did not define the ratio between sexes, so responses may reflect a predominant gender. Additionally, students were aware they were being observed, and this supervision may have curbed their computer usage habits so that positive outcomes may be artificially inflated by reflecting the results of a tightly controlled classroom rather than students' genuine attitudes or usage patterns.

At Dakota State University, where all incoming students are required to lease or own tablet PCs (TPCs), researchers (Moran et al., 2007) compared the responses of 302 first year students with 75 upper class students concerning their attitude towards TPCs in the classroom using a 23-item questionnaire. After reviewing results, researchers concluded new students were very receptive of TPCs and had high expectations concerning their efficacy, but upper class students, who had been using TPCs for many years, were significantly less enthusiastic. Senior students reported a substantial decrease in the instructional effectiveness of laptops, an unfavorable verdict on their use in classrooms, and increased distractions. Moreover, students who used TPCs for more than one academic year were more likely to find them increasingly distracting in the classroom than students who were just introduced to them (Moran et al., 2007). Consequently, researchers recommended more study to compare both faculty and student expectations of mobile technology in the classroom and cautioned that the practice of placing expensive technology in the hands of students was no guarantee these devices would improve academic excellence.

Three potential weaknesses from this study include (1) the scarcity of details on the actual use of computers in the classroom, (2) the dearth of information concerning the validity of the survey instrument (Nieswiadomy, 2008), and (3) the abbreviated length of time freshman students used TPCs before responding to the questionnaire. Despite these concerns, the conclusions of this study reflect the growing body of evidence suggesting mobile technology in the classroom may not be the most effective academic option and are best used when integrated.

Unstructured Computer Use in the Classroom

The studies presented thus far reflect integrated computer use. The subsequent studies examine unstructured computer use in the classroom that is minimally regulated by the instructor and not required for class content.

Researchers at a major research university were interested in learning whether there was a correlation between the amount of time students spent browsing the web and their individual academic performance (Grace-Martin & Gay, 2001). Consequently, they gave laptop computers with wireless connectivity to 82 students enrolled in a Communication and a Computer Science course and allowed them to use laptops with minimal regulations. Researchers recorded the browsing habits of students for one semester using a proxy server and obtained permission to track students individually.

After collecting and analyzing 1.7 million web addresses, they found that academic performance of students who browsed the Internet during class sessions suffered significantly, and this finding remained true regardless of course content. They also found that extensive web browsing was related to poor academic performance. Specifically, extensive web browsing during class lectures resulted in lower final grades. Students in the Communications course benefited from the presence of laptops in their classes but fared considerably worse when they engaged in extensive computer browsing outside the classroom. Computer Science students, which were primarily male, benefited from home use (Grace-Martin & Gay, 2001).

Grace-Martin and Gay posit that the benefits of pervasive wireless access in classes hinged on the characteristics of students, class structure, and the computing infrastructure available to students on campus. They concede there might be benefits to be gained for some students in specific educational settings but recommended limiting student access to the wireless network, or directing student attention to specific computer content to improve student performance. They warn that the presence or absence of wireless networks has considerable influence on the ways in which students use their laptops, so instructors should consider increasing student productivity and success by limiting student access to wireless networks in settings where this restriction may be viable and advisable (Grace-Martin & Gay, 2001).

Several potential concerns arise from this research. First, the laptops used in this study were not owned by students but were given to them to use for one semester. It is conceivable students may use university-owned equipment in ways that are significantly different from the ways in which they use their own computing devices. Second, 53 of the 82 students sampled for this study were computer science majors. Of that number, only two students were female. Accordingly, the results reflect a male-dominated perspective and are less revealing of the female attitude. Third, the operating systems used on the laptops for this study was Windows 98—a dated operating system. Hence, extrapolations from these findings should be considered carefully.

Another researcher (Hembrooke & Gay, 2003) investigated whether laptop use had a negative impact on student recall and conducted a study with 44 students majoring in Communication, Computer Science and Design. Half the student body was allowed to use laptops without restrictions in one lecture session, while the other half, in a separate classroom listening to the same lecture, were not allowed laptop access. At the end of both lectures, both sets of students were given a surprise test that assessed their recall and recognition of the lecture content. The researchers found that students who used their laptops in classes performed significantly worse for recall questions than those who did not use their laptops (Hembrooke & Gay, 2003). This result demonstrates that the active use of laptops for content unrelated to an ongoing lecture may not be conducive to successful multitasking in a classroom setting.

Truman (2005) designed a cross-sectional quasi-experimental field study in which undergraduate students were assigned to one of two groups—an *unrestricted access* group in which students used their laptops with minimal interference or to the *restricted access* group in which access to the Internet, chat, and email functions were prohibited unless their use was necessary for instruction.

Researchers also installed stealth-monitoring software on each computer and recorded students' computing activities three times weekly. Additionally, Truman measured student performance, student satisfaction, participation and involvement, and students' cognitive engagement using pre-validated measures.

Findings of this study reveal that in computer-restricted classes, students had an average on-task keystroke count of 14,153, while the unrestricted class averaged 6,397 keystrokes. Moreover, students in the restricted classes spent an average of 10.5 hours using their laptops for class-related content while the unrestricted laptop group reported less than five hours on class-related content. Truman also found that students who used their laptops in classes to engage in activities not directly related to class content performed poorly on the IT examination (Truman, 2005).

These findings led Truman and his team to conclude restricting student access to the Internet is associated with higher levels of class-related use, and laptop use contributed significantly to lower grades, less time spent on class activities, and student distraction. He states that his research lends support to banning laptop use in certain classes, but this recommendation would be over-reactive. Instead, he proposes that faculty find ways to discourage inappropriate laptop use and promote applicable integration. He recommends faculty members and administrators to consider revising their courses to incorporate laptops as critical teaching tools and remind students regularly of the appropriate use of computers in the classroom (Truman, 2005).

Two potential criticisms emerge from this study. First, students were aware their computing activities were being recorded, and this knowledge may have influenced their behavior for the better. Second, the process of deciding which items in the log files related to class content and which items were not is a subjective approach. Notwithstanding, the authors of this study counter that appropriate measures were taken to minimize subjectivity.

Wurst, Smarkola, and Gaffney (2008) designed a study at a large urban university in the United States with three groups of undergraduate honors students majoring in business. The first group of students participated in honors classes without laptop computers. The second and third groups of students and their 10 instructors were given IBM laptops. Researchers developed four questions that explored (1) the degree of constructivism in honors classes compared to traditional classes, (2) the effect of ubiquitous computing on constructivism in honors classes, (3) changes to student GPA attributable to laptop computers, and (4) student satisfaction levels after using computers in classes.

Data was collected over a three-year period during fall and spring semesters using surveys and a constructivist inventory to measure student satisfaction, constructivist activity, and student assessment. Findings from this study reveal that students perceive their honors class to be more constructivist that non-honors programs, but laptop use did not play a role in increasing the level of constructivism that occurred in the classroom. Moreover, the addition of laptops did not lead to statistically significant improvements in tests grades as measured by students' GPA, and honor students who used laptops were less satisfied with their education overall compared to honor students in the same program who did not use laptops (Wurst et al., 2008). While many students enjoyed the benefits of laptop use and were able to take notes and find relevant class information on the Internet quickly, more than 77% of participants conceded laptops were a source of much distraction, and most found the temptation to explore the Internet too great to resist. Consequently, many students were inattentive to the lectures from their instructors. Despite these issues, the overall program was very successful primarily because the students in the honors program were high-achieving motivated learners (Wurst et al., 2008).

In another recent study at Winona State University, Carrie Fried (2008) analyzed responses of 137 students with laptops in two psychology classes that allowed unrestricted access to the campus wireless network. Eighty-one percent (81%) of students managed their emails, 68% communicated via instant messaging, 43% browsed websites unrelated to class content, and 25% played games during each 75-minute class session. Students who used their laptops extensively in classes consistently scored lower on examinations, and students who complained of distractions identified other students' laptop use as the single greatest interference with their ability to pay attention. Fried concluded that unstructured laptop use posed significant challenges to student performance and effective teaching, and she encouraged faculty members to design their classes to accommodate and integrate laptops or limit their use (Fried, 2008). One contention with this study stems from the self-reported nature of students' laptop use which does not always represent accurately the amount of time spent on a particular activity (Homan & Armstrong, 2003). It is generally assumed students are likely to spend more time browsing the Internet for content unrelated to the class than they are willing to report (Fried, 2008). Still, the findings of this study are consistent with the emerging body of research on computer technology in the classroom.

Computer Use in Law Schools

Nancy Maxwell, professor of Law at Washburn University, offers helpful insights about the problems she faced in her classroom when wireless Internet access became available to her law students (Maxwell, 2007). The implementation of wireless access led her to adopt a no-laptop policy in her classes as she observed the changes that occurred. Her insights reveal some of the major complaints instructors have regarding laptops and wireless networks in the classroom. She reported feeling disconnected from her students when laptops were introduced, and she observed a decrease in student engagement as more laptops appeared. After reviewing student notes, she concluded that students using laptops for class purposes failed to summarize the lecture but instead, transcribed her lecture word for word. Moreover, their engagement with laptops lessened their interaction with other students (Maxwell, 2007).

Similar findings were reported by Yamamoto (2008), a professor of law at South Texas College of Law. He ultimately banned laptop use in his federal taxation class citing four reasons: (1) laptop use was distracting to users and non-users; (2) computer use created mental and physical barriers between teacher and student; (3) computer use promoted poor note-taking skills by encouraging students to type the lecture rather than summarize important points, and (4) laptop use had a deleterious effect on students and class discussions (Yamamoto, 2008).

Jana McCreary (2009), assistant professor at Florida Coastal School of Law, did not mandate an outright ban on all laptop use, but created a laptop-free zone in which laptop users were not allowed in the first few rows of her classroom. This arrangement limited the potential distraction on students in the front rows who did not use computers, and the arrangement was flexible enough to accommodate various learning styles. This arrangement was based on a desire to improve classroom interaction, minimize student distraction, promote various learning styles, and accommodate students who prefer to use laptops (McCreary, 2009).

Distractions in the Classroom

A review of the literature for both structured and unstructured computer use at K-12, undergraduate, and graduate institutions provides evidence of benefits to be gained from specific collaboration between technology and class content. Conversely, the unrestricted, unstructured use of computers in classrooms is potentially detrimental to students' academic achievement because web-based entertainment can be distracting to the student viewing it and for neighboring students distracted by it (Efaw et al., 2004; Fried, 2008; Yamamoto, 2008).

Distractions from Computer Use

With rare exceptions, every study that has examined computer use in an unstructured classroom setting in which computer use is neither tightly regulated nor integrated into the course reports student distraction as a source of concern (Caron & Gely, 2004; Maxwell, 2007; McCreary, 2009; Yamamoto, 2008; Young, 2006). Distractions in the classroom are not new; they have always been part of academic life and is manifested in various forms—note-taking , conversations with classmates, daydreaming, deciphering crossword puzzles, completing homework assignments for unrelated classes etc., (Brady, 2008; Hembrooke & Gay, 2003; Maxwell, 2007). Similarly, powerful laptops combined with wireless Internet access offer a compelling temptation to explore entertainment options offered by today's Internet portals (Brady, 2008; Bugeja, 2007).

At West Point Military Academy, researchers who introduced laptops in 22 class sections and integrated the technology in the curriculum found that students persisted in using their Internet access to browse the web for content unrelated to classes and to communicate via instant messaging during the lecture (Efaw et al., 2004). This finding provides some indication that the problem of distraction from computers in the classroom is a compelling concern even in class settings that integrate their use or institutions with students who pride themselves with strict discipline, rigor, honor, and achievement (United States Military Academy West Point, 2009).

Students often assert their ability to multitask—perform two or more tasks simultaneously (Crawford, 2004; Wallis, 2006), and claim they can give the requisite attention to the instructor while viewing websites that bear no relationship to class content (Freedman, 2007; Maxwell, 2007). Nevertheless, Brady (2008) concluded multitasking hampers students' ability to learn. Barkhuus (2005) found laptop use in classrooms requires significant student attention. Other researchers concur—students must pay attention before they can actively perceive a phenomenon (Chun & Wolfe, 2001; Nicholson, Parboteeah, Nicholson, & Valacich, 2005).

Some researchers clarify that the activities students often label as multitasking are better described as sequential processing. When performing tasks sequentially, a person performs one activity, then switches quickly to another, and then another in sequence. This rapid sequential processing is necessary because the human ability to multitask is very limited and has great potential for errors, even among young people (Wallis, 2006).

Simons and Levins (1998) found that human beings have a decreased ability to notice changes occurring around them while distracted, even when the changes occur instantly or are part of an ongoing, natural event. If this finding is applied to computer use in the classroom, it might indicate students are less aware of activities occurring in their immediate vicinity, including details from a lecture or class activities, when they are in a distracted state. In classic experiments where subjects performed one main activity while simultaneously monitoring a secondary activity for changes, their performance on one or both tasks invariably suffered (Hembrooke & Gay, 2003). These findings support the perception that students in an active classroom engaged in multiple unrelated class activities, or students distracted from their primary activities, decrease their potential for effective learning.

Resistance to Laptop Use

A growing number of instructors in academic institutions including Harvard, Georgetown, Florida International, University of Wisconsin and others are restricting, and in some cases, banning laptops not specifically required for class content, citing significant interference with traditional class dynamics (Associated Press, 2006b; Foster, 2008). Some law professors express frustrations with the widening chasm between teacher and student when laptops are used in their classrooms (Associated Press, 2006a; Caron & Gely, 2004). They note the inherent difficulty of making eye contact with students hidden behind laptops, and even students without laptops are sometimes concealed from view by the oversized computing screens of neighboring colleagues (Young, 2006). These developments are among the many reasons some instructions resist computers in the classroom.

Characteristics of Graduate Students

This research study investigates the belief of graduate students towards unstructured computer use with Internet access and the effect on their memory recall. This researcher chose not to focus on undergraduate students because numerous studies have examined the influence of computers on this group of students. One important study was done by Hembrooke and Gay (2003) who investigated the effects of computer use on the recall ability of students and found that undergraduates who were using a computer while listening to a lecture did not score well on immediate recall memory tests. Additionally, important differences in the pedagogy of graduate students and their computer use in the classroom (compared to undergraduates) make them the preferred target population for this study (Gonzalez, 2001).

Researchers have theorized that the best undergraduate education revolves around full-time students who live on campus, attend small classes where faculty members emphasize teaching and student development, promote general education options, provide frequent interaction between students, peers, and faculty in and outside the classroom, and emphasize a curriculum that incorporates group-based intellectual experiences (Pascarella & Terenzini, 1998). Traditionally, undergraduate education helps students become carriers of information by delivering to them great quantities of preexisting knowledge (Brown, 2001).

In contrast, graduate education helps students create new knowledge by immersing them in communities of practice (Brown, 2001). Graduate education is broadly comprised of a master's degree and a doctoral degree and is distinguished from a professional graduate education—post-baccalaureate education that focuses on professional fields such as law and medicine (Helland, 2002). Students who pursue graduate education generally do so immediately after completing an undergraduate study, but increasingly, many graduate students are mature adults returning to college after spending a few years in the workplace (Helland, 2002). These graduate students are generally academically independent, self-motivated, and inquiring (Ben-Jacob, Levin, & Ben-Jacob, 2000).

Students who pursue master's degrees generally do so to advance their careers, while graduate students who pursue doctorate degrees enter the professoriate or other careers outside academia (Helland, 2002). Graduate students are taught using an academic apprenticeship model that focuses on research, discovery, knowledge creation, and mentoring, especially at the doctoral level (Brown & Duguid, 2000; Gonzalez, 2001). Additionally, graduate students are allowed much autonomy, unlike their undergraduate counterparts whose education is intertwined with guidance, supervision, and personal interactions with faculty in and outside the classroom (Gonzalez, 2001).

The growth of technology in higher education has changed the way faculty and students interact, and opened the door to "anytime, anywhere" delivery of instruction and pedagogy that responds to diverse student populations and learning styles, and promotes active, self-directed learning (Pascarella & Terenzini, 1998). Technology has helped foster change towards personal, self-directed learning that situates the needs of students at the center of education while providing them with tools to promote their own erudition (Beldarrain, 2006). This paradigm shift aligns well with the needs of graduate students who view themselves as adult learners and expect to be treated accordingly. They want control of their own learning, and many approach the classroom with a rich set of experiences and personal resources they intend to share with their peers during class discussions (McCreary, 2009). This interactive sharing of ideas may be helped or hindered by the way in which computer use in the classroom is implemented.

Reviewing the literature on computers in the classroom indicates their benefits are in dispute (Fried, 2008), and any perceived value from their use is heavily dependent on the degree of integration in the curriculum, the characteristics of the students, and the learning situation (Wurst et al., 2008). Not every learning environment or student benefits from computer use in the classroom (Gay et al., 2001; Warschauer, 2008). Furthermore, graduate classes that rely on student discussions, sharing of experiences, and social interactions are especially vulnerable to the adverse results of computer use including student distractions, reduced class participation, and frequent web browsing unrelated to class activities (Maxwell, 2007; McCreary, 2009; Yamamoto, 2008).

Thus, effects of computer technology in the classroom is particularly acute for graduate students who are qualitatively different in their learning goals and personal circumstances than younger undergraduate students (Ben-Jacob et al., 2000). Consequently, this research study is well positioned to provide helpful data on computer use among graduate students.

Digital Learners

In 2001, Marc Prensky referred to students from kindergarten through college who have known computers, video games, camcorders, cell phones, instant messaging, and digital entertainment all their lives as *digital natives*. He states, without offering credible evidence other than anecdotes and personal observations, these students "think and process information fundamentally different from their predecessors" and are distinct from their parents whom he refers to as *digital immigrants* (Prensky, 2001). Marc observes that digital immigrants speak a foreign language to their digital children and do not fully appreciate their learning talents and technological gifts, which include the ability to multitask, process information rapidly, engage in electronic interactions, discriminate against text-based learning, and have an affinity for games and entertainment. Prensky (2001) claims the teaching and learning methods that worked for previous generations are not compatible with today's digital learners and instructors must quickly adapt.

Prensky also found support from others who refer to this new generation of learners as *Millenials* and described as confident, driven to success, sheltered, and team-oriented (Howe & Strauss, 2003). Unfortunately, authors of these claims failed to provide empirically rigorous data to substantiate their pronouncements (Bennett, Maton, & Kervin, 2008).

Emerging research on computer use by current generations of young learners is complex and evolutionary, and evidence from research data is still in its infancy (Bennett et al., 2008). Some researchers observe that the current generation of students often expect to be rewarded with excellent grades without the concomitant effort, prefer comfort and convenience rather than rigorous education, expect immediate attention, dismiss social norms and respect for authority, advance a personally gratifying, selfish agenda, and prefer personal views above reasoned discussions and civil interactions (Taylor, 2006). These observations are in direct contrast to the optimistic outlook advanced by others (Howe & Strauss, 2003; Prensky, 2001). There is enough data to infer that *Millenials* are generally more comfortable with emerging technology, but their embrace is more revolutionary than catastrophic and is not uniform across all ethnic and cultural groups. Consequently, more disinterested research is necessary to verify claims about digital learners that will allow researchers to isolate empirical features that can be examined methodologically (Bennett et al., 2008).

Conceptual Framework

This research study is grounded in *divided attention paradigm* research, also called *dual task paradigm* (M. Naveh-Benjamin, Craik, Gavrilescu, & Anderson, 2000; Moshe Naveh-Benjamin, Craik, Guez, & Dori, 1998). Divided attention paradigm provides extensive research data to demonstrate that participants whose attention is divided between encoding information being presented while simultaneously performing a secondary task results in a negative and detrimental effect on memory performance when compared to other participants who provide undivided attention during a single task (Anderson et al., 2000; Baddeley, Lewis, Eldridge, & Thomson, 1984; Fernandes & Moscovitch, 2000; Herath, Klingberg, Young, Amunts, & Roland, 2001; Jiang, 2004; Kensinger et al., 2003; Mulligan & Hartman, 1996; Moshe Naveh-Benjamin et al., 1998).

Divided attention research draws a clear distinction between the effects of distractions on encoding recently presented information and retrieving stored information (M. Naveh-Benjamin et al., 2000). Performing two or more independent but demanding tasks concurrently while attempting to encode information has a deleterious influence on recall of information being encoded, but minimal impact on retrieval of stored information (Baddeley et al., 1984; Rohrer & Pashler, 2003). Equally important, divided attention reduces performance on secondary tasks (M. Naveh-Benjamin et al., 2000).

Experiments also revealed that divided attention affects not only encoding, but the quality of encoding that occurs (Foerde et al., 2006; M. Naveh-Benjamin et al., 2000). When a student provides full attention to a primary task, encoding and rehearsing of important information occur with deep, elaborate processing. On the other hand, when the same information is presented to the student while his or her attention is divided between two or more tasks, the encoding that occurs is shallow, less flexible, and less effective (Foerde et al., 2006; M. Naveh-Benjamin et al., 2000).

Consequently, any secondary task that distracts a student during a learning activity will reduce the amount of learning that occurs (Baddeley et al., 1984). Likewise, students are expected to give their full attention to the instructor in a class setting, however, their attention is likely to be disrupted if they engage in a secondary demanding or distracting task (Herath et al., 2001). If this disruption occurs while students are encoding new information, it may lead to difficulty encoding and processing the information being presented (Kensinger et al., 2003; Moshe Naveh-Benjamin et al., 1998).

Findings from multiple research studies reveal computer use with Internet access for activities detached from the class content provide significant distraction opportunities (Caron & Gely, 2004; Fried, 2008; Maxwell, 2007; Moran et al., 2007). Moreover, students who used their computers during lecture sessions performed significantly worse on recall tests than students who did not use a computer while encoding recently presented information (Hembrooke & Gay, 2003). These findings on computer use support theories of dual task or divided attention paradigm research.

Giving attention is a necessary ingredient for consciously perceiving and reporting visual events and for encoding information to working memory (Chun & Wolfe, 2001; Kensinger et al., 2003). Consequently, students who use computers with Internet access in classes and spend most of their time engaged in multitasking activities (in which they divide their attention between the instructor's lecture and their own unrelated pursuits on the computer) pose a significant distraction to their own learning and that of fellow students (Crawford, 2004; Fried, 2008; Wallis, 2006). If the distraction to students occur while they are encoding new information, their ability to recall information will suffer dramatically, and learning will decrease (Anderson et al., 2000; Baddeley et al., 1984; Fernandes & Moscovitch, 2000; Foerde et al., 2006).

Figure 1 depicts a visual representation of the effect a distraction or a secondary activity has on a person's attention and encoding of new information. If this disruption is significant, the information or stimulus received may be significantly eroded resulting in permanent loss or corruption in short-term memory and rehearsal. Under these circumstances, the information received is unlikely to reach long-term memory, and if it does, it will be incomplete, inaccurate, or corrupted (Foerde et al., 2006; Moshe Naveh-Benjamin et al., 1998).

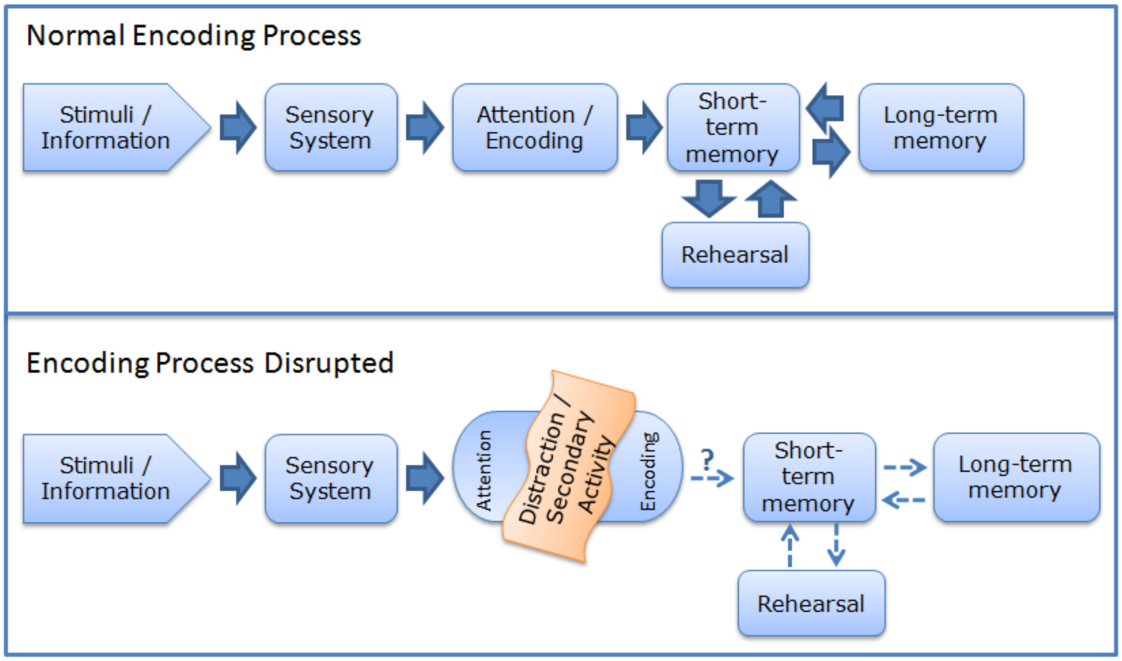


Figure 1. Effects of distraction or secondary activity on encoding and memory.[1]

[1] As per the divided attention paradigm, a person who engages in multiple activities simultaneously, or is distracted from a primary task reduces the likelihood that information received during the distracted state will be properly encoded or stored.

Memory, Attention, and Multitasking

This research study examined the impact of computers on student recall. Consequently, a discussion on memory and attention is necessary.

Memory

Memory promotes learning by allowing information gained across different points in time to be recalled and used. Additionally, memory allows past experiences to exist and is a necessary ingredient for mental continuity over time (Swartz, 2003). Human beings rely on the ability to remember events that occurred in the last few seconds, or several years earlier. Consequently, memory is often divided into long and short-term memories (Myers, 1996). Short-term memory (STM) is active memory that retains information for a brief duration and is enhanced when a person rehearses or actively pays attention to information being processed (Myers, 1996). Long term memory (LTM) stores information for longer durations including days, months, or years and is sometimes called permanent memory (Elsevier's Dictionary of Psychological Theories, 2006). The capacity of long-term memory is thought to be unlimited, while short term memory last for half a second to two seconds unless rehearsed (Myers, 1996).

The memory process has three components—encoding, storage, and retrieval (Bruning et al., 1999). *Encoding* refers to the way in which information or stimuli is registered or placed in memory; *storage* is concerned with how information is kept in memory and includes the location and length of a memory; *retrieval* focuses on the mental act of recalling previously stored memories (Bruning et al., 1999; Swartz, 2003).

Memories may also be categorized into episodic, procedural, and semantic memories (Moore, 2007). *Episodic memory* refers to specific experiences, events, or activities and becomes easier to store and remember when events to be remembered are serious or significant. *Procedural memory* refers to stored knowledge about performing an activity, completing a procedure, or performing a skill. *Semantic memory* focuses on facts and general knowledge and includes the knowledge humans store about meanings, definitions, and objects (Moore, 2007).

John Sutton (2006) reports memories are constructed for specific use and are not held firmly once stored. In other words, memory has a certain amount of plasticity and may incorporate false or misleading information when the memory is recalled and constructed.

Attention

With the exception of knowledge, attention is probably the most important resource of the mind. It is defined as the amount of cognitive resources a person gives to a task or stimulus (Bruning et al., 1999, pp. 23-24). The human being encounters countless amounts of stimuli each day, more than any being can process; therefore, a person must choose what he or she decides to focus on and filter out everything else so as not to be overwhelmed (Nicholson et al., 2005; Tombu & Seiffert, 2008). This process of filtering occurs automatically, therefore, it is important for a person to give attention to that which he or she considers important (Bruning et al., 1999; Roda & Thomas, 2006). This selective process is the crux of attention.

Attention is a limited resource and is the first step in learning; students who wish to learn must give their focus to the important elements of the learning situation (Woolfolk, 2001, p. 246). If a student's attention is disrupted during learning, his ability to encode, store, or remember the information being presented will diminish (Fernandes & Moscovitch, 2000). If the disruption is significant, information being presented may be lost (Kensinger et al., 2003). Hence, distractions interfere with a primary task and may result in increased error or decreases in performance of one or both tasks (Herath et al., 2001).

Multitasking

Human beings have always had the ability to multitask or perform two or more activities at once (Salvucci & Taatgen, 2008). In fact, most working environments and daily life require multitasking. The principal aim of multitasking is to improve efficiency and includes the driver who answers a mobile phone while driving or the secretary who performs many operations simultaneously (Freedman, 2007; Wickens, 2005). Some multitasking operations are relatively easy to perform (walking while talking with a friend), but other concurrent operations are more difficult (listening to two distinct conversations while reading) (Salvucci & Taatgen, 2008).

Students are increasingly claiming they can multitask well (Adams, 2006; Crawford, 2004; Wallis, 2006), but researchers have found even seemingly simple operations such as driving while speaking on a cell phone is not conducive to optimal multitasking (Strayer & Johnston, 2001).

On the other hand, the findings of researchers lend some support to students' claim. For instance, Posner (1982) provide clear evidence that certain activities can be performed simultaneously almost as well as a single task, however, this ability was modulated by several factors including the amount of practice the person had, the uncertainty of the incoming signals, the complexity of the tasks involved, and the degree of similarity between the tasks to be performed.

Nevertheless, complex tasks requiring significant cognitive processing, although possible, did not fare as well for multitasking operations (Posner, 1982). Other researchers theorize multitasking is a myth; human beings engage in a series of quick, changing tasks performed sequentially that are often mistaken for multitasking (Wallis, 2006). Some argue that younger people have brains better suited to multitasking than the older generation who have not been trained in the same way (Adams, 2006). Still, the human capacity to multitask is very limited to highly practiced, autonomous skills. Multitasking with two or more tasks that are new, unpracticed, or require similar amounts of cognitive resources increases errors, doubles the time of completion, and creates slowdowns when compared to doing each task in sequence with full attention (Wallis, 2006).

Notwithstanding, the question from this discussion remains: is computer use in the classroom during lectures one of those tasks optimized for multitasking? Specifically, can graduate students in a classroom listen attentively to the instructor, encode, and store information from the lecture effectively, while at the same time, use their computers for activities related and unrelated to the ongoing class lecture or discussion? This study aims to shed light on elements of this question.

Literature Review Summary

There are benefits to be gained from computer use in colleges and universities, but it must be integrated well in the curriculum (Barak et al., 2006; Wurst et al., 2008). Otherwise, unstructured computer use becomes a major source of distractions (Yamamoto, 2008). Moreover, few well-designed studies tie computer use with increases in test scores (Penuel, 2006; Warschauer, 2008). Some instructors found ways to limit the use of laptops in their classrooms (McCreary, 2009), while others explored more creative ways to teach while incorporating the technology (Brady, 2008).

The ways in which computers are used in a classroom may influence student attention and recall. Information received in short-term memory must be kept active or rehearsed to gain permanence, otherwise it will be lost (Woolfolk, 2001). When students shift their attention to another task or are distracted while receiving or encoding new information, they increase the rate at which the information in short-term memory fades or is completely lost (Jiang, 2004; Mulligan & Hartman, 1996).

Unstructured computer use in classrooms with Internet access significantly increases the likelihood for student distraction (Crawford, 2004; Maxwell, 2007) and potentially interferes with the encoding process for students trying to give attention to the instructor (Foerde et al., 2006). Hence, interference from inappropriate computer use has the potential to negatively affect students' ability to recall information presented while they are in a distracted state (Yamamoto, 2008).

CHAPTER THREE: METHODOLOGY

Research Design

The purpose of this study is to investigate graduate students' beliefs about unstructured computer use in classes with Internet access and the effect on the recall performance of students in a face-to-face (F2F) lecture setting. This chapter describes the research design, variables, instruments, procedures, data analysis, description of participants, and data collection techniques.

The research design is quasi-experimental in nature and uses quantitative methods with triangulation; it includes descriptive and inferential components. The descriptive component was investigated using a survey instrument to assess graduate students' beliefs about computer use in F2F classrooms. This instrument was critically evaluated, revised, pilot tested, revised again, and then implemented to graduate students in fall 2009 at the University of Central Florida. The inferential component was investigated using a short-answer, fill-in-the-blank recall test to explore the impact of computer use on students' memory recall.

Additionally, this researcher analyzed students' responses to the questionnaire and triangulated these responses with students' recall test scores to gain insights into the predictive interaction between student beliefs about computers and recall performance in a graduate classroom that allows unstructured computer use that is neither required for nor integrated in the class content.

Research Design: Background

The impetus for the inferential section of this research design was influenced by a study from Hembrooke & Gay (2003) in which researchers divided a class of 44 undergraduate students into two groups and tested their recall after a lecture. One group of students used laptops during the lecture and was subsequently tested for memory recall ability. The second group did not use laptops during the lecture and students in this group were also tested after the lecture presentation.

Later in the study, Hembrooke and Gay reversed laptop groups so that the group using laptops in the first experiment became the non-laptop group in the second iteration, and the non-laptop group in the first iteration became the laptop-using group for the second experiment. After much analysis, these researchers reported that in both experiments students using laptops during the lecture scored consistently lower for recall tests than the students who did not use laptops during the lecture (Hembrooke & Gay, 2003).

Some areas of this present research study follows a similar research design as Hembrooke & Gay but incorporates graduate students instead of undergraduates for the sample. The decision to focus on graduate students is necessitated by the differences in perspective, objectives, pedagogy, and circumstances of graduate students when compared to undergraduates. Graduate students are academically independent, self-motivated and inquiring (Ben-Jacob et al., 2000; Rose, 2005). They pursue advanced degrees to enhance their careers or to target the professoriate, and they enter graduate education with a wealth of experiences, especially those students who spent time in the workplace before continuing graduate study (Helland, 2002; Rose, 2005).

The effects of computer use in classrooms with graduate students present an interesting difference in population between undergraduate students and graduates that makes the latter worthy of further study for two reasons. First, the academic autonomy of graduate students in the classroom, and the ways in which this autonomy may influence their computer use (Gonzalez, 2001). Second, the scarcity of data on graduate students showing an increase in test scores that are directly attributable to computer use in the classroom—with the exception of writing and technical proficiency (Fried, 2008; Warschauer, 2008).

Research Questions: Descriptive

The questions used to guide this study are as follows:

(1) What are the beliefs of graduate students about the effects of unstructured computer use in F2F graduate classes equipped with Internet access on the following?

(a) Degree of classroom participation

(b) Degree of student distraction (computer users and non-users)

(c) Degree of influence distractions impose on memory recall

(d) Types of limits students are willing to accept on computer use

(e) Types of computer activities pursued in classes

Research Questions: Inferential

(2) Is there a statistically significant difference between recall test scores of graduate students who use computers equipped with Internet access in

unstructured F2F graduate classes and those who do not, as measured by test scores on a recall test?

(3) Which student belief variables (general beliefs, participation, distractions, recall influence, limits, and computer activities as measured by a questionnaire) are most influential in predicting recall test scores of graduate students who use computers in unstructured F2F graduate classes with Internet access?

Null Hypotheses

The inferential portion of this research study includes two null hypotheses. The first states there is no statistically significant difference in recall test scores of graduate students who use computers equipped with Internet access in unstructured F2F graduate classes and those who do not, as measured by test scores on a recall test. Likewise, the second states that the independent variables (general beliefs, participation, distractions, recall influence, limits, or computer activity as measured by a questionnaire) are of no influence in predicting recall test scores of graduate students in F2F unstructured classes with Internet access.

Variables

The independent variables from the descriptive portion of this research study were classified in six groups to correspond with each research question:

Independent Variables (Descriptive)

1. Beliefs (general beliefs about of computer use)
2. Participation (in classes when computers and Internet access are used)

3. Distractions (for both computer users & non-users)
4. Memory recall (degree to which computer use influence student recall)
5. Limits (types of computer limits students will accept)
6. Computer activities (types of computer activities pursued in classes)

Dependent Variables (Descriptive)

Likewise, the corresponding dependent variables include:

1. Scores on the beliefs section of the instrument scale
2. Scores on the participation section of the instrument scale
3. Scores on the distraction section of the instrument scale
4. Scores on the memory recall influence section of the instrument scale
5. Scores on the limits section of the instrument scale
6. Scores on the computer activities section of the instrument scale

Additionally, the survey instrument includes demographic questions as independent variables. The dependent variables are student response categories.

Variables (Inferential)

Two questions are included in the inferential component of this study. Both are addressed using a short answer, fill-in-the blank, recall test given to two groups of graduate students. The first group (*open* laptop) used a computer during a lecture; the second group (*closed* laptop) did not. The computer condition (computer use or non-use) during the lecture was the independent variable and the recall test scores of students were the dependent variables.

The second inferential question examined the relationship of student beliefs (as measured by belief scores on a questionnaire) and their predictive relationship with students' recall test scores. The independent variables for this question are students' scores for beliefs, participation, distractions, memory recall, limits, and computer activities. The dependent variables are recall scores of students. Table 1 depicts the relationship between research questions and variables.

Table 1

Association between Research Questions and Variables

Research Questions	Independent Variables	Dependent Variables
1	General beliefs	Belief scores
1a	Participation	Participation scores
1b	Distractions	Distraction scores
1c	Memory recall influence	Recall influence scores
1d	Limits	Limits scores
1e	Computer activities	Computer activities scores
2	Computer use or non-use	Recall test scores
3	Beliefs, participation, distractions, recall influence, limits, and activity scores	Recall test scores

Population and Sample

The targeted population for this study are graduate students at the University of Central Florida—a major, public, multi-campus, metropolitan, research university in southern United States (University of Central Florida, 2008). The sample for the survey includes 116 graduate students (both master's and doctoral students in the College of Education) who consented to voluntary participation.

The sample for the inferential portion was purposive and consisted of 31 doctoral students (enrolled in a graduate research course taught at the College of Education at the University of Central Florida) for the first experiment and 29 of the same group of doctoral students in the second experiment. The course was taught as a F2F class in two sections (section 0001 and section 0002) in which the instructor used lecture as the main instructional mode to introduce students to research philosophy, data gathering, analysis, and interpretation.

Students in both experiments were chosen for participation because they met five requirements. First, the course in which they were students was taught in two sections with homogenous students; second, all students were pursuing doctoral degrees; third, both class sections met weekly in face-to-face classes (as opposed to online or mixed-mode classes); fourth, all students had access to computers, and finally, lecture was the principal method for content delivery.

Instrumentation

To assess graduate students beliefs and use of computers in a F2F graduate classroom, this researcher reviewed numerous dissertations, articles, and academic databases for a suitable instrument with high reliability. While various instruments were available that addressed students' attitudes towards computer, this researcher was unable to find a suitable instrument that addressed unstructured computer use in F2F graduate classes or an existing instrument that could be easily adapted for this study. Consequently, this researcher constructed a survey instrument in the form of a questionnaire based on data available in the literature on this subject.

The survey instrument contained 43 questions divided in three sections. The first section addressed graduate students' beliefs about unstructured computer use in the graduate classroom and its influence on their learning, participation, peers, distraction levels, and classroom dynamics. The second section examined specific ways in which students used computers during graduate F2F classes for both class-related activities, and for activities unrelated to the current class session. The third section demographic information including graduate students' gender, age, program of study, student status, ethnic group, type of computer most often used in classes, and whether English was their first language.

The first twenty questions contained statements requiring participants to select Likert scale items (1-5) ranging from *strongly disagree*, *disagree*, *neither agree nor disagree*, *agree*, and *strongly agree*. Questions 21-33 used a modified Likert scale (1-4) ranging from *never*, *rarely*, *sometimes*, and *frequently*. Both sets of questions had an option for *N/A* or *not applicable*. Question 34 allowed open numerical responses to gauge the percentage of time students spent on computer activities in classes, and question 35 allowed for open-ended comments about computer use. Questions 36-43 addressed demographic variables; participants were asked to select the appropriate responses from the list provided. Table 2 provides a blueprint of the relationship between questions and statements on the instrument and the descriptive research questions.

Table 2

Blueprint for Survey Instrument Used in Pilot Study

Research Questions	Survey Instrument
What are the beliefs of graduate students about the effects of unstructured computer use in F2F graduate classes equipped with Internet access on the following?	Questions 1-4, 35
Classroom participation	Questions 5-8
Student distraction	Questions 9-13
Influence on recall	Questions 14-17
Limits on computer use	Questions 18-20
Computer activities	Questions 21-33, 34
Demographic data*	Questions 36-43

Note. Questions 34 and 35 were analyzed separately and were not included in the overall scale or total score during the pilot study.

*Demographic data not included in the research questions but listed to complete blueprint.

The development of the survey instrument used in this study occurred in three phases: (1) initial evaluation and revision, (2) pilot study, analysis, and revision to improve reliability, (3) final instrument. Each phase is discussed consecutively.

Initial Evaluation and Revision of Instrument

The survey instrument was developed by this researcher after carefully analyzing the literature and designing questions and statements that would provide data to address the descriptive research questions. Reliability scores are presented later in this section.

The instrument was divided into three general sections that addressed:

1. Graduate students' beliefs about unstructured computer use in the graduate classroom and its influence on their learning, participation, peers, distraction levels, and classroom dynamics
2. Specific ways in which students used computers during graduate F2F classes for both class-related and unrelated activities
3. Demographic information including graduate students' gender, age, program of study, student status, ethnic group, type of computer used most often in classes, and English usage.

Four Associate Professors at UCF—two of whom had specialization in instrument design—reviewed the initial questionnaire and provided substantial feedback that was used to revise the instrument and improve its reliability. Changes made to the initial questionnaire included:

- Changing the section of the survey that asked specific questions about students' computer use including sending instant messages, managing emails, visiting social sites etc., during classes. This section was changed from Yes / No check boxes to a Likert scale ranging from 1-4 of *never*, *rarely*, *sometimes*, and *frequently*.
- Changing the response options on one demographic question that asked about English speaking ability from "Native speaker" and "Non-native speaker" to "Yes" or "No"
- Rearranging ethnic and racial groups
- Removing response options from a demographic question about students' program of study and providing an open response option instead

Pilot Study, Revisions, and Reliability

For the second phase of instrument development, a pilot study was conducted during the summer of 2009 at the University of Central Florida to ensure all the pieces of the instrument were reliable and to conduct a practice-run prior to implementation (Dillman, 2007). The pilot study was necessary to contribute to an assessment of the validity, rigor, and reliability of the instrument (Lancaster, Dodd, & Williamson, 2004) and to expose any potential problems prior to a large scale utilization. Lancaster et al., (2004, p. 309) notes that a pilot study for a survey helps to ensure questions and formatting are appropriate and comprehensible, instructions are clearly defined, and questions are consistent throughout the document, and easily understood.

An online version of the survey was also developed to mirror the paper version and was used where participants had access to a computer with Internet access. Both versions differed only in formatting, navigation, and instructions as appropriate, but questions were identical.

The responses gained from this pilot were analyzed and used to revise, rewrite, and validate the instrument before it was implemented for large-scale application. The selected sample for the pilot study were 37 doctoral students from the College of Education at the University of Central Florida, but only 32 participants completed the questions on the instrument resulting in a response rate of 86%. From the 32 responses, one case was discarded from analysis because it contained test responses, and another case had missing data from the demographic section of the questionnaire. This case was also discarded. The final number of respondents totaled 30 doctoral students including 25 females and 5 males. The questionnaire, study description, and consent documents were hosted on a server available at SurveyGizmo, and all students who participated in the pilot study completed the questionnaire online using a link provided by the researcher.

Pilot Study Demographic Data

The instrument was administered online. Results of the demographic responses indicate 30 doctoral students (25 females and 5 males) from the College of Education at the University of Central Florida participated. For student status, 11 respondents stated they were in their 4^{th} year of doctoral study, 18 participants selected third year, and one participant indicated second year. Twenty students identified *laptop* as the computer used most often in graduate classes; 10 identified a desktop computer.

Ten students majored in Instructional Technology, six in Counselor Education, five in General Education, three in Exceptional Education, three in Special Education, two in Mathematics Education, and one in Instructional Systems Design. Most students (29 of 30) selected Ph.D. for their degree level; one selected Ed.D. Twelve students identified themselves as African American / Black; 10 students selected Caucasian / White; five selected Asian American / Asian; two selected *Other*, and one selected Latin American / Hispanic.

Most participants were between ages 29-32; six were between 33 and 36; five were 37-40, and four were 41 and older. Twenty-four participants selected English as their first language, and six indicated otherwise.

Analysis of the demographic data revealed an uneven gender distribution. Females accounted for 87% of the sample; males were 13%. Seventy percent of participants were pursuing a Ph.D. in Instructional Technology, Counselor Education, or General Education. The remaining participants were enrolled in Exceptional Education, Instructional Systems Design, Mathematics Education, and Special Education. Sixty percent of all respondents were third year doctoral students. Sixty-seven percent of participants were between the ages of 29 and 36, 80% spoke English as a first language and 73% identified themselves as African American / Black or Caucasian / White. Sixty-seven percent used a laptop predominantly in classes, while 33% used a desktop computer.

Pilot Instrument Reliability

Instrument reliability denotes the degree to which items on an instrument measure the same variable or whether selected items on an instrument measure the same underlying element (Leech, Barrett, & Morgan, 2005). The results of the initial analysis on the pilot were used to establish instrument reliability and a baseline for item revisions.

To assess whether the Likert items (questions 1-30 on the questionnaire) formed a reliable scale, a correlation coefficient was conducted using SPSS. The analysis produced a Cronbach's Alpha of .82 indicating very good internal consistency. Statistical researchers note that Cronbach's Alpha values above .7 are acceptable, and values exceeding .8 were desirable. Similarly, values exceeding .9 may signify the presence of items on the scale that are unnecessarily repeated or may not be required for a consistent measure (Leech et al., 2005; Pallant, 2007).

An item analysis of the questions revealed that the *Corrected Item-Total Correlation* column included 12 problematic items below .3 which suggests these items may be measuring different variables than the overall scale (Pallant, 2007). Additionally, negative results in the *Inter-Item Correlation Matrix* implied some items on the instrument needed to be reverse-scored, and an analysis of *Cronbach's Alpha if Item Deleted* column showed an improved correlation coefficient if certain items were deleted.

Consequently, items 5 and 13 were reverse scored because they were designed to be negative statements, and items 6, 8, 9, 11, and 18 were deleted. Questions 30, 31, and 32 were not part of the overall scale calculation because of their unique response options, and questions 33-40 were demographic. A second

Cronbach's Alpha was performed on the remaining 24 scaled items resulting in a correlation coefficient of .856 reflecting very good internal consistency.

Final Instrument Used for Research Study

After completing the pilot study, conducting reliability analyses, evaluating feedback from more than 12 doctoral students via emails and telephone conversations, and aggregating suggestions from two professors, a number of changes were incorporated into the evolving instrument to create the final measuring tool for the descriptive portion of this research study. These changes include:

- The total number of questions was increased to 44 from 43. Questions 6, 8, 9, and 11 that were removed from analysis during the pilot were replaced with new questions (6, 9, 14, and 10) respectively, on the final instrument.
- Question items used to create total scores were rearranged. Eight questions for demography were considered separately.
- Graduate classes were changed to "F2F graduate classes" throughout the instrument to differentiate between online, mixed mode, and face-to-face classes. (Mixed mode classes incorporate elements of face-to-face and online only classes.)
- Several questions were reworded to create more neutrality, clarity, and precision throughout the instrument.
- Question 30 on the pilot was deleted due to the limited number of responses received.

- Question 31 (requested the participant to express each item listed as a percentage of class duration) was reduced from four options on the pilot to two options. This action was necessary due to feedback from participants who affirmed “class notes” could be incorporated into “activities directly related to class.”
- Two other age options were added to age range (49-52, and 53-55).

Methodology: Survey

Appendix A provides the questionnaire used for the descriptive portion of this study after all changes and suggestions from the pilot study were incorporated. The final instrument garnered 159 online responses from students at the University of Central Florida, of which 116 were usable. The survey was necessary to provide data for the six descriptive questions investigated in this research study to assess graduate students’ beliefs about computer use including their general beliefs about computers, participation, distraction levels, influence on memory recall, computer-use limits, and computer activities pursued in classes.

The questionnaire also requested demographic information including the type of computer used, students’ degree level, degree major, student status, gender, ethnicity, age, and first language.

Methodology: Recall Test

To address the effect of computer use on student recall, this researcher assessed graduate students’ recall ability in two specific instances: (1) listening to a lecture while using a computer, and (2) listening to a lecture without a computer.

Recall ability was assessed using a short answer, fill-in-the-blank test composed of questions derived from a lecture delivered during the class session. This research met with the instructor prior to the recall experiments to review the lesson content and to extract items that were used to create the recall fill-in-the-blank test instrument. Students were not given specific warning of an impending test prior to the lecture and had no reason to expect one. This precaution was taken to limit the influence of an impending test on changes to students' normal computing behavior and learning patterns. Nevertheless, students were informed before the experiments that their recall test results would be used only for research purposes and would not be part of their academic grade.

On the day of the first phase of experiments, the instructor entered the classroom in the afternoon and taught classes normally, taking care to follow her notes carefully to ensure she presented the same content to both student groups. The afternoon class was designated *open laptop* group and was composed of 17 doctoral students. Students did not know, and were not told, they would be tested after the lecture presentation. They had unrestricted access to their laptops and desktop computers to use them normally (as they would during regular class sessions).

At the end of the lecture (which last 35 minutes) this researcher entered the classroom for the first time, explained the experiment in general terms and gave students the option to participate based on informed consent. The instructor left the room and was not present during the assessed memory recall test. All 17 students agreed to participate and were given a 15-item, short answer, fill-in-the-blank recall test to assess their recollection of critical concepts discussed in the lecture. Their answers were collected and scored.

Several hours later, a second group (designated *closed laptop*) and composed of 14 doctoral students, met during the evening in the same classroom as before and participated in the same lecture discussion with the same instructor as the first group, except, this second group of students were not permitted access to computers during the lecture. At the end of the lecture (which lasted 30 minutes), the instructor left the classroom temporarily and this researcher entered and explained the experiment to students in general terms. Students who consented were given the same 15-item, short answer, fill-in-the-blank recall test as the *open laptop* group.

The recall test consisted of short-answer questions requiring students to write-in responses manually using a pen or pencil. Open laptops, desktop computers, active phones, class notes, or assistance from colleagues were prohibited during the tests. When each test was complete, this researcher collected and scored the results and evaluated differences between scores for the *open* and *closed laptop* sessions.

Two weeks later using the same groups of students as the previous experiment, this researcher reversed the *open laptop* and the *closed laptop* groups. Students who were allowed to use computers during the first experiment were not allowed computer use during the second experiment, and students who were not allowed to use computers during the first lecture were free to use them during the second iteration. At the end of both class sessions, this researcher administered a new short answer, fill-in-the-blank test with questions taken from the lecture presented during that class session. The experiment followed the same rules as the previous experiment two weeks earlier. Student responses were collected, scored, and analyzed to identify whether the use of computers with Internet access played a statistically significant role in the observed changes in scores between the *open* and *closed laptop* groups.

Data Collection: Survey

Data was collected using the survey instrument developed for the descriptive component of this study. One hundred fifty-nine students at the University of Central Florida chose to participate. Students in the sample were given a packet containing a description of the study, a consent form, and the questionnaire. Reading the study description, reviewing the consent form, and completing the questionnaire took 15 minutes.

Alternatively, students had the option of completing the questionnaire online using SurveyGizmo—an online survey tool. For those who choose this option, students were able to access the questionnaire online from their computers. Students were also presented with a description of the study and consent form and were encouraged to print a copy of the consent documents for their records. Completing the questionnaire indicated informed, voluntary consent.

Data Collection: Recall Test

Data collection for the recall test occurred in two phases to accommodate the presence of laptops for the first experiment and the absence of laptops during the second. All students who consented to the experiment also completed the questionnaire. The first iteration of the recall test experiment was administered to 31 doctoral students enrolled in a research class taught in two sections. This researcher designated students in section 001 as the *open laptop* group and students in section 002 as the *closed laptop* group. Seventeen *open laptop* students listened to a typical class lecture while using a computer, while fourteen *closed laptop* students listened to the same lecture without using computers.

Students were not told about the recall test that would occur at the end of the lecture, and no discernable changes were made to the class structure or content delivery (except the restriction on laptop use for the *closed laptop* group). The instructor also took specific steps that included the use of a detailed outline to deliver the same content in a qualitatively similar manner to both classes. At the end of each lecture, students (based on voluntary, informed consent) were given a recall test. Their responses were collected, secured, and scored.

Two weeks later, using the same groups of students as the previous iteration, this researcher reversed the *open* and *closed laptop* classes so that students who were allowed computer use in the first test did not use computers during this iteration. Similarly, the students whose computer use was restricted during the first lecture were free to use them during this phase of the study.

At the end of each class lecture session, this researcher administered another recall test using the same rules as the previous experiment. Students were not told of the impending recall test prior to the lecture and had no reason to change their normal computing behavior (other than the restrictions on computer use for the *closed laptop* group).

Responses were collected, scored, and analyzed to identify whether the use of computers with Internet access played a statistically significant role in the observed changes in scores between the *open laptop* and *closed laptop* groups. Participants' voluntary informed consent was necessary at all phases of this study.

Data Analysis

Student responses to the questionnaire and recall test scores were analyzed using Statistical Package for the Social Sciences (SPSS) version 16. For survey questions, descriptive statistics were used to analyze the means of scaled items on the questionnaire, and frequencies were performed on the categorical variables. Likert scale items were evaluated to create total scores using SPSS. Written responses or comments were evaluated in summary to identify themes that accurately reflect students' beliefs, concerns, and perceptions. Microsoft Word and Excel were used to aggregate and sort responses not suitable for SPSS.

For inferential questions, descriptive statistics were used to analyze student recall scores. Then mean differences between recall test scores of students who used computers during the lecture and students who did not were analyzed using an independent samples *t* test (two-tailed). A *t* test is a parametric statistical test that allows a researcher to compare differences between the mean scores of two groups or sets of values (Nieswiadomy, 2008). Next, this researcher used an ANCOVA (Analysis of Covariance) to control for the effect of the first recall test on the performance of students on the second recall test. This step was necessary to mitigate the effects of possible improved student performance on the second test after experiencing the first test. The ANCOVA is a robust test that a researcher may use to control for a variable that may affect the dependent variable (Nieswiadomy, 2008) i.e., the test scores.

Finally, this researcher used multiple regression analysis (MRA) to correlate the recall tests scores of students with their overall belief scores from the survey instrument (beliefs, participation, distractions, recall influence, limits, and computer activity scores). This analysis was necessary to assess the predictive influence of students' overall belief scores on recall scores. Multiple regression analysis is a statistical method used to study the relationship between a dependent variable and two or more independent variables, and is appropriately used for prediction (Shavelson, 1996). An alpha level of .05 and confidence interval of 95% were used for all statistical tests.

Methodology Summary

This research study contains two sets of questions—descriptive and inferential. A survey instrument containing 44 items to assess students' overall belief scores about computer use was used to provide data to investigate the descriptive questions. Inferential questions were assessed using two fill-in-the-blank recall tests. Parametric tests including independent *t* tests, ANCOVA, and multiple regression analyses were performed using SPSS to analyze the resulting data.

CHAPTER FOUR: RESULTS

Overview

This chapter describes the results of a research study that employed an online questionnaire and two experiments. The questionnaire was used to investigate graduate students beliefs about unstructured computer use, and the experiments were conducted in two phases to examine the influence of computer use on student recall.

The research study was conducted at the University of Central Florida in Orlando, Florida. Invitations to complete the survey were sent to more than 12 instructors in the College of Education who taught classes with graduate students who met the requirements for this study. Additionally, this researcher visited several classrooms over the course of one month (after gaining permission from instructors) and encouraged students to participate in the study.

The online questionnaire received 159 student responses. After removing incomplete responses and repeat entries, the final sample size was decreased to 116 graduate students enrolled in masters, specialists, and doctoral programs of study at the College of Education at the University of Central Florida. The adjusted response rate was 49 percent. Of the 116 graduate students who participated in the survey, 31 doctoral students also participated in two recall experiments. The results of the experiments are presented later in this chapter.

Analyses of the questionnaire and experiments were conducted to provide data for descriptive and inferential research questions. The questionnaire assessed descriptive questions concerning graduate students' beliefs about unstructured computer use in face-to-face (F2F) classes with Internet access on classroom participation, student distraction, influence on memory recall, computer use limits, and computer activities pursued in classes. Inferential questions were measured using two memory recall experiments.

Analyses of the experiments were conducted using independent samples *t*-tests to examine differences in recall scores between students who used laptops during a lecture and those who did not. Additionally, analysis of covariance (ANCOVA) was performed to control for the effects of the first recall experiment on the scores of the second experiment, and multiple regression analysis was employed to assess the predictive influence of students' beliefs about computers on their recall scores.

Analysis of Descriptive Questions

The survey instrument was implemented as an online questionnaire with six sections to align with the main descriptive research question and its five sub-questions. What are the beliefs of graduate students about the effects of unstructured computer use in F2F graduate classes with Internet access on the following?

(a) Degree of classroom participation

(b) Degree of student distraction (computer users and non-users)

(c) Degree of influence distractions impose on memory recall

(d) Types of limits students are willing to accept on computer use

(e) Types of computer activities pursued in classes

Additionally, the questionnaire contained demographic questions that asked participants about the type of computers they used most frequently, the academic degree they were pursuing, their current student status, gender, ethnicity, age, and the primacy of the English language.

The questionnaire consisted of 44 items. Twenty items were measured on a Likert scale 1–5 representing *strongly disagree* to *strongly agree* respectively. Fourteen items were measured on a 1-4 scale in which 1 represented *never*, 2 *rarely*, 3 *sometimes*, and 4 *frequently*. Two items (35 and 36) on the questionnaire were analyzed separately because of their unique response requirements, and the remaining eight items were demographic variables that were analyzed accordingly.

Frequency distributions were compiled for the scaled items (1-34) to provide data on individual responses to each survey item. Additionally, individual items on the questionnaire were added to create total scores or subscales for students' overall beliefs, participation, distraction levels, memory recall influence, computer use limits, and computer activities. Analysis of each total score variable will be presented later in this chapter.

Gender, Age, and Computer Type

The data provided in Table 3 includes frequency and percentage scores for participants' gender, age, and type of computer used in graduate classes. Analysis indicates more students used laptop computers (66%) rather than desktops (27%) by a significant margin. Female participants (75%) outnumbered males (24%) by a 3:1 ratio, and sixty-six percent of participants were between 20 and 32 years, while 34% were between 33 and 52 years.

Table 3

Demographic Data: Gender, Age, and Computer Type

Demography	Categories	#	%
Gender*	Males	28	24
	Females	87	75
Age of participants	20–24	30	26
	25-32	46	40
	33-52	39	34
Computer used	None	6	5
	Laptops	77	66
	Desktops	31	27
	Both	2	2

Note. Values denoted * may not equal 100% of the sample due to rounding or missing values.

The data presented in Table 4 shows students pursuing Ph.D. and Ed.D. degrees represented 51% of respondents; 47% were enrolled in master's programs, and one student was enrolled in a specialist program. Forty-four percent of students were in their first year of studies, and 45% were either second (34%) or third (11%) year students. The remaining 8% were in their fourth or fifth year, and 3% did not specify.

Table 4

Demographic Data: Degree Type and Student Status

Demography	Categories	#	%
Degree type*	Master's degree	55	47
	Specialist degree	1	1
	Ed.D.	13	11
	Ph.D.	46	40
Student status	First year student	51	44
	Second year student	39	34
	Third year student	13	11
	Fourth year or more	9	8

Note. Values denoted * may not equal 100% of the sample due to rounding.

The data for Table 5 reveals that most participants, by a significant margin, (71%) reported their ethnicities as Caucasian American / White, 10% listed Latin American or Hispanic, 7% selected African American / Black, and 7% listed Asian American / Asian. The remaining 4% chose Native American / Indian or *Other* for ethnicity.

Table 5

Demographic Data: Ethnicity

Demography	Categories	#	%
Ethnicity	African American / Black	8	7
	Asian American / Asian	8	7
	Caucasian American / White	82	71
	Latin American / Hispanic	11	10
	Native American / Indian	1	1
	Other	5	4

The most common degree majors among respondents as shown in Table 6 were Counselor Education (17%), Instructional Technology (17%), Mental Health (11%), and Educational Leadership (11%). Ten percent of respondents chose not to specify their degree majors.

Table 6

Demographic Data: Degree Major

Demography	Categories	#	%
Major*	Communications Science	3	3
	Counselor Education	20	17
	Curriculum and Instruction	2	2
	Education	7	6
	Educational Leadership	13	11
	Educational Technology	5	4
	Exceptional Education	8	7
	Hospitality Education	5	4
	Instructional Technology	20	17
	Marriage / Family Therapy	5	4
	Mental Health	13	11
	Other education majors	4	3
	Unspecified	11	10

Note. Values denoted * may not equal 100% of the sample due to rounding.

Analysis of Beliefs Scale

Table 7 presents frequency data of survey items 1–3 noting the number of responses to each Likert-scale choice. Fifty percent of respondents disagreed with the statement (item 1) suggesting computers with Internet access were essential to their learning even in classes that do not require their use. Ten percent were uncertain, and the remaining 40% agreed. On the question of whether in-class computer use increases academic productivity (item 2), 53% agreed or strongly agreed, 10% were ambivalent, and 37% disagreed. Item 3 asked if students believed computer use with Internet access improves grades. Twenty-six percent of participants were unsure, 39% disagreed, and 35% agreed.

Table 7

Frequency Table for Survey Items 1–3 (General Beliefs Scale)

#	Keywords	SD	D	N	A	SA
1	Essential	17	40	12	24	22
2	Productivity	7	35	12	32	29
3	Grades improvement	7	38	30	26	15

Note. SD = strongly agree; D = disagree; N = neither agree nor disagree; A = agree; SA = strongly agree. Number of respondents = 116; Missing responses not listed; # refers to question number on survey; Keywords are the main subject of the survey item.

Analysis of Participation Scale

Frequency data for survey items 4–8 shown in Table 8 presents the number of responses to each Likert-scale choice. The majority of respondents (74%) agreed that instructors should integrate computer use in the classroom to improve productivity; 7% disagreed, and 19% neither agreed nor disagreed. On the subject of increased participation (item 5) in the graduate classroom when computers and Internet access are used, 56% of respondents disagreed. Only 21% agreed with this statement, and the rest (23%) were indecisive.

Table 8

Frequency Table for Survey Items 4–8 (Participation Scale)

#	Keywords	SD	D	N	A	SA
4	Integrate for productivity	2	6	22	47	39
5	Increase participation	20	44	27	12	12
6	Increase volunteering	17	47	28	15	9
7	On-task web access	11	31	7	40	27
8	Listen attentively	15	45	16	26	14

Note. SD = strongly agree; D = disagree; N = neither agree nor disagree; A = agree; SA = strongly agree. Number of respondents = 116; Missing responses not listed; # refers to question number on survey; Keywords are the main subject of the survey item.

On the subject of increased volunteerism (item 6) in graduate classes when computers and Internet access are used, 55% disagreed, and 22% agreed; the rest

(24%) were uncommitted. Responses to item 7 (frequent Internet access for class-related activities) were very positive. Fifty-eight percent of participants agreed they accessed the Internet regularly while 36% disagreed; 7% neither agreed nor disagreed. More than half of all respondents (52%) confirmed they were less attentive to the instructor when they used computers with Internet access in graduate classes; 35% felt their attentiveness increased; 13% were ambivalent.

Analysis of Distraction Scale

Frequency data of survey items 9–13 shown in Table 9 presents the number of responses to each Likert-scale choice. Item 9 stated that participants were not distracted from class activities when they used computers with Internet access.

Table 9

Frequency Table for Survey Items 9–13 (Distraction Scale)

#	Keywords	SD	D	N	A	SA
9	Distraction levels	11	59	13	22	11
10	Student distractions	17	46	5	28	20
11	Proximity distractions	13	19	6	53	25
12	Multitasking	5	14	11	52	31
13	Improved multitasking	6	40	16	33	20

Note. SD = strongly agree; D = disagree; N = neither agree nor disagree; A = agree; SA = strongly agree. Number of respondents = 116; Missing responses not listed; # refers to question number on survey; Keywords are the main subject of the survey item.

The majority of respondents (61%) disagreed with this statement, 11% were undecided and 28% agreed. Item 10 referenced distractions created by computer activities of other students. Fifty-four percent of respondents conceded they were distracted by off-task browsing habits of other students; 41% were not distracted, and 5% neither agreed nor disagreed. Distractions that arise when one student sits close to or in the line of sight of other students using their computers for off-task activities was the focus of item 11 on the questionnaire. Sixty-seven percent of participants agreed they were sometimes distracted in this setting; 28% disagreed, and 5% were uncommitted. On the subject of multitasking (item 12), 73% of students indicated they frequently multitasked when using their computers during graduate classes, 17% disagreed, and 10% were uncertain. Forty-six percent felt they multitasked well (item 13), 40% disagreed, and 14% were undecided.

Analysis of Recall Influence Scale

Frequency data for survey items 14–17 (representing the distraction scale and presented in Table 10) notes the number of responses to each Likert-scale choice. Item 14 indicated computer use with Internet access did not affect respondents' ability to concentrate. Response scores were divided on this statement; 43% disagreed, and 42% agreed. The remaining 15% were equivocal. On the question of whether computer use helps with memory recall, participants were evenly divided. Thirty-seven percent agreed, and 37% disagreed; 26% neither agreed nor disagreed. The next item (16) referenced difficulty remembering class discussions after using a computer with Internet access during the class. Responses did not reflect an overwhelming view; 38% agreed with this statement, 46% disagreed, and 16% were unsure. The final item included in this scale (item 17) stated students may inadvertently “tune-out” the instructor while using a computer with Internet access. Seventy-four percent of participants agreed with this statement, and 10% were ambivalent. The remaining 16% disagreed.

Table 10

Frequency Table for Survey Items 14–17 (Recall Influence Scale)

#	Keywords	SD	D	N	A	SA
14	Concentration	7	43	18	30	18
15	Increased recall	6	37	30	22	20
16	Recall difficulties	9	42	18	38	5
17	Instructor tune-out	4	15	11	66	19

Note. SD = strongly agree; D = disagree; N = neither agree nor disagree; A = agree; SA = strongly agree. Number of respondents = 116; Missing responses not listed; # refers to question number on survey; Keywords are the main subject of the survey item.

Analysis of Limits Scale

The data in Table 11 presents frequency data of survey items 18–20 noting the number of responses to each Likert-scale choice. Item 18 stated students would be unhappy if they were not allowed computer and Internet access during graduate classes. Students’ responses were divided between those who agreed (46%) and those who disagreed (44%); 10% neither agreed nor disagreed. On the issue of student dissatisfaction if Internet access capability was removed or disallowed, 49%

disagreed, 36% agreed, and 15% were undecided. Item 20 explored whether students would be dissatisfied if instructors imposed limitations on computer and Internet use in classes. Forty-eight percent of respondents disagreed, 37% agreed, and 15% were uncertain.

Table 11

Frequency Table for Survey Items 18–20 (Limits Scale)

#	Keywords	SD	D	N	A	SA
18	No Computer	15	36	12	26	27
19	No Internet	16	41	17	21	21
20	Limits on use	16	40	17	22	21

Note. SD = strongly agree; D = disagree; N = neither agree nor disagree; A = agree; SA = strongly agree. Number of respondents = 116; Missing responses not listed; # refers to question number on survey; Keywords are the main subject of the survey item.

Analysis of Computer Activities Scale

The data presented in Table 12 displays frequency data of survey items 21–34 noting the number of responses to each Likert-scale choice for computer activities. Item 20 asked participants about their computer use for note taking during graduate F2F classes with Internet access. Sixty-seven percent of respondents selected *sometimes* or *frequently*; 20% chose *rarely*, and 13% did not use computers for notes. On the other hand, 70% of respondents used computers to conduct online research that was directly related to ongoing classes, but most (64%) did not use computer in one class to complete assignments for another.

Table 12

Frequency Table for Survey Items 21–34 (Computer Activities Scale)

#	Keywords	N	R	S	F
21	Notes	15	23	42	36
22	Online research	14	21	48	33
23	Assignments other class	38	36	35	7
24	Instant messaging	59	30	22	5
25	Social sites	54	24	30	8
26	Jobs	86	17	9	3
27	Videos	98	14	3	1
28	Web browsing (off-task)	25	37	45	9
29	Email	19	19	46	32
30	News	38	33	40	5
31	Play games	82	19	11	4
32	Calendar	48	30	29	9
33	Engaged	20	28	28	38
34	Disengaged	54	35	19	6

Note. SD = strongly agree; D = disagree; N = neither agree nor disagree; A = agree; SA = strongly agree. Number of respondents = 116; Missing responses not listed; # refers to question number on survey; Keywords are the main subject of the survey item.

Although communicating using instant messaging (IM) is available to students, most (77%) stated they did not use IM in classes (*never* 51%; *rarely* 26%). The majority (68%) did not visit social sites such as Facebook (*never* 47%; *rarely* 21%). Respondents also answered *never* or *rarely* for computer use in F2F classes for job-hunting (90%), watching videos unrelated to classes (97%), and playing online games (87%). Thirty-nine percent used computers with Internet access in F2F unstructured classes to read news, maintain their calendars (33%), check email (68%), and browse the Internet (47%). At least 58% agreed they spent most of their class duration engaged in activities directly related to current class activities, while 22% noted they *frequently* or *sometimes* spent more than half their class time engaged in off-task computer activities.

Instrument Reliability and Scores

To assess whether questions and statements in the survey instrument formed a reliable scale, Cronbach's alpha was computed for the overall instrument and for the summed items in each of the six sections of the questionnaire. The overall alpha for the instrument was .93 indicating excellent internal consistency.

Similarly, the alpha for overall beliefs score was .88 and overall participation score was .84 indicating good internal consistency for both sections. Additionally, the alpha for distraction scores (.79) and recall scores (.82) indicated the items had good internal consistency, and alpha scores of .92 for limits scores and .93 for computer activity scores showed very reliable internal consistency.

Equally important, Pearson's correlation was computed to assess test-retest reliability of the scaled items (1–34) on the survey instrument by comparing the means of response scores in the first instance with the means of response scores by the same group of students in the second instance. The results of this test are presented in Table 13 and reveal excellent test-retest reliability (*r*=.97; *p* < .001) with high correlation scores.

Table 13

Pearson Correlations for Test / Retest Reliability of Scaled Items (N = 34)

Scores	Initial	Retest	Mean	*SD*
Initial mean scores		.973*	2.75	.75
Retest mean scores	.973*		2.64	.72

Note. SD = standard deviation.

* *p* < .001

Total Scores for Beliefs Scale

Items 1–3 on the survey instrument were added to create a total score for students' beliefs about the importance of having access to computers and Internet access in the graduate classroom. Three Likert-scaled items ranged from *strongly disagree* (scored as 1) to *strongly agree* (scored as 5) formed the general beliefs scale. The mean score for students' beliefs was 9.31 and a 3.45 standard deviation.

An examination of the trimmed mean of 9.31 suggests extreme scores were insignificant. Skewness implies the degree to which a set of scores departs from perfect symmetry (Lomax, 2001), and a perfectly normal distribution has a skewness of 0 (Leech et al., 2005). Skewness for students' total belief score was .12, which characterizes a distribution that is approximately normal with low scores clustered to the left. A kurtosis of -1.15 indicates the distribution is relatively flat. Figure 2 illustrates the overall score distribution for the beliefs scale.

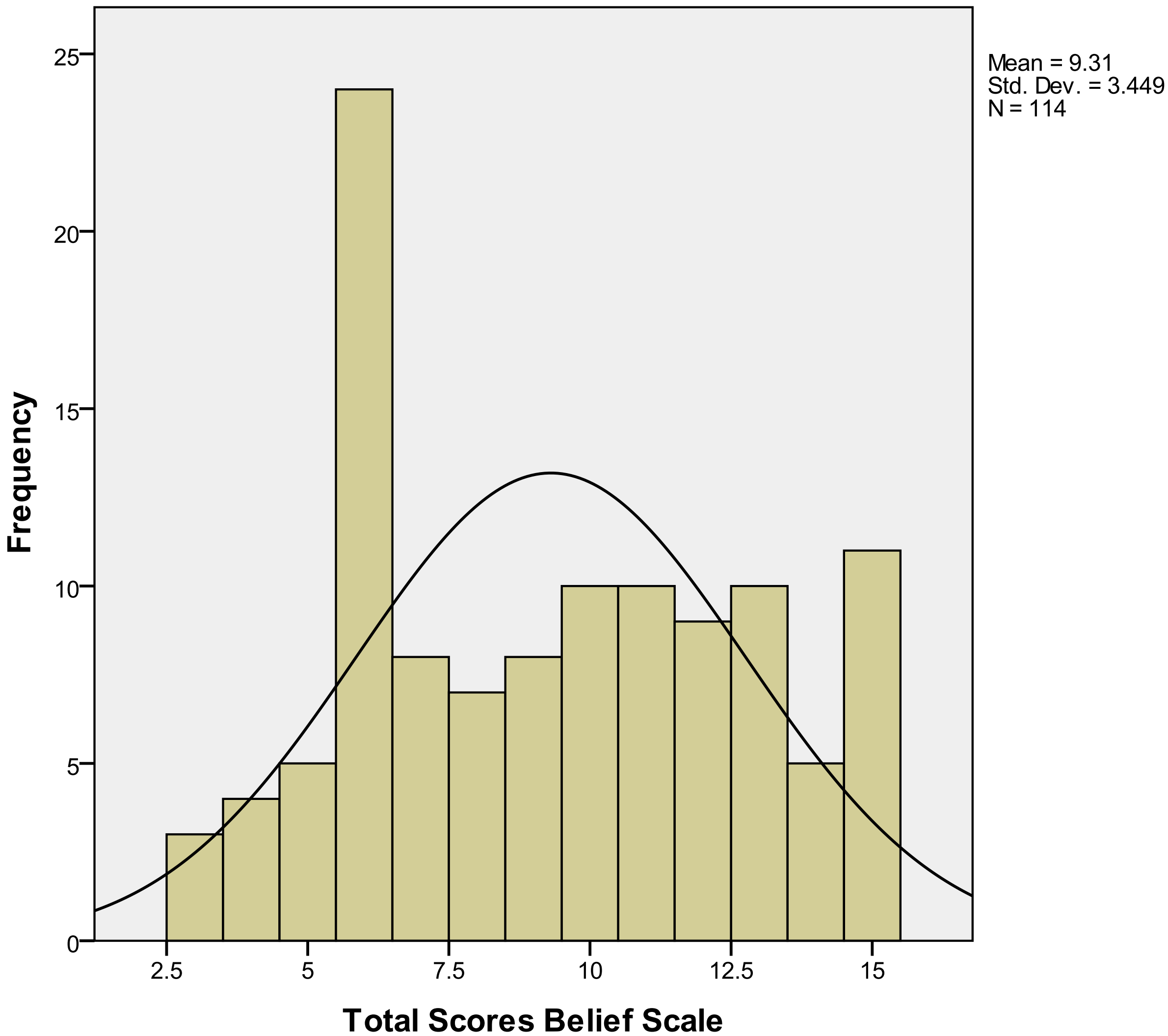


Figure 2. Distribution of scores for total beliefs scale.

Total Scores for Participation Scale

Items 4–8 on the survey instrument were added to create a total score for students' beliefs about their participation in graduate classes when computers and Internet access were used. Four Likert-scaled items ranging from *strongly disagree* (scored as 1) to *strongly agree* (scored as 5) formed this scale. The mean score for participation was 15.31 with a 4.47 standard deviation. Skewness of .15 represents a distribution that is approximately normal with most scores clustering near the high end, and kurtosis of -.53 shows a somewhat peaked distribution. Figure 3 illustrates the overall score distribution of the participation scale.

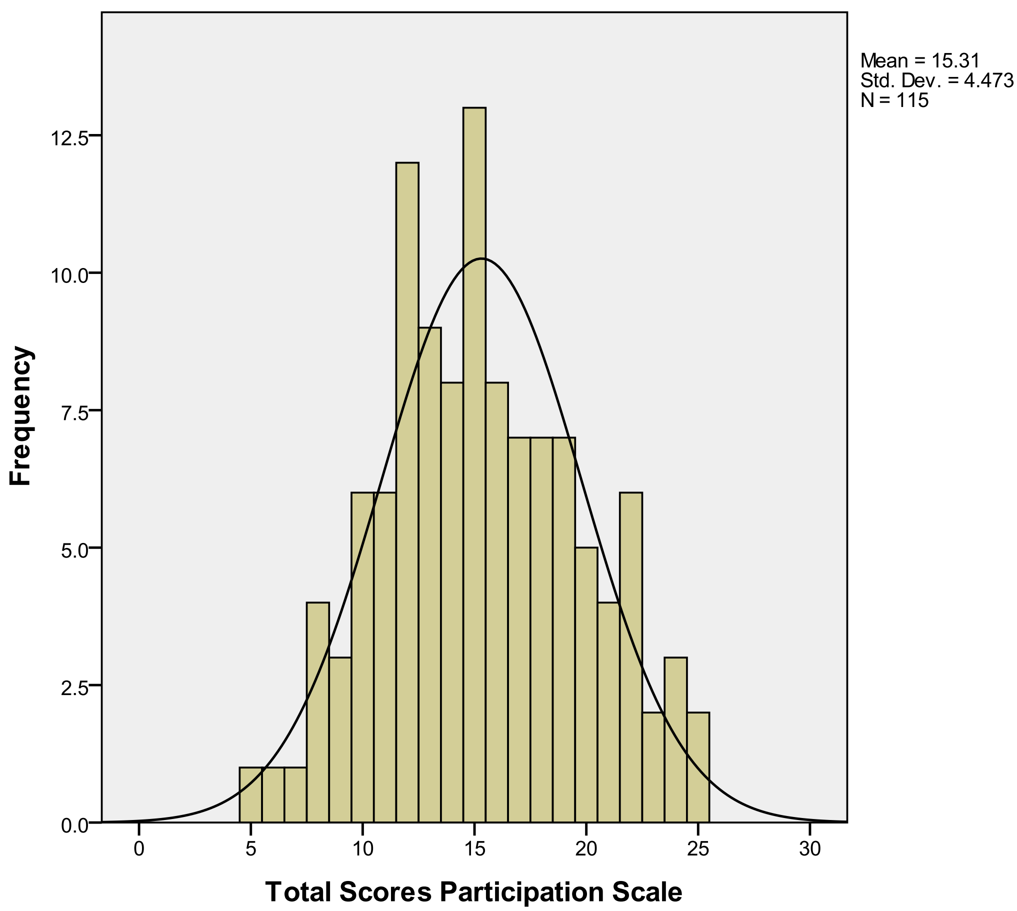


Figure 3. Distribution of scores for participation scale.

Total Scores for Distraction Scale

The total score for student distraction scale was created by adding survey items 9–13 to assess students' beliefs about the degree to which they are able to avoid distractions from computer use with Internet access in classes. Five Likert-scale items ranging from 1–5 (*strongly disagree* to *strongly agree*) created this measure, but item 11 was reverse coded to ensure all items used the same scale. The mean score for distraction was 15.07 and 4.44 for standard deviation. Skewness of .41 reflected a distribution that was approximately normal with most scores clustering near the low end. Kurtosis of -.51 denoted a flat distribution. Figure 4 illustrates the overall score distribution of the distraction scale.

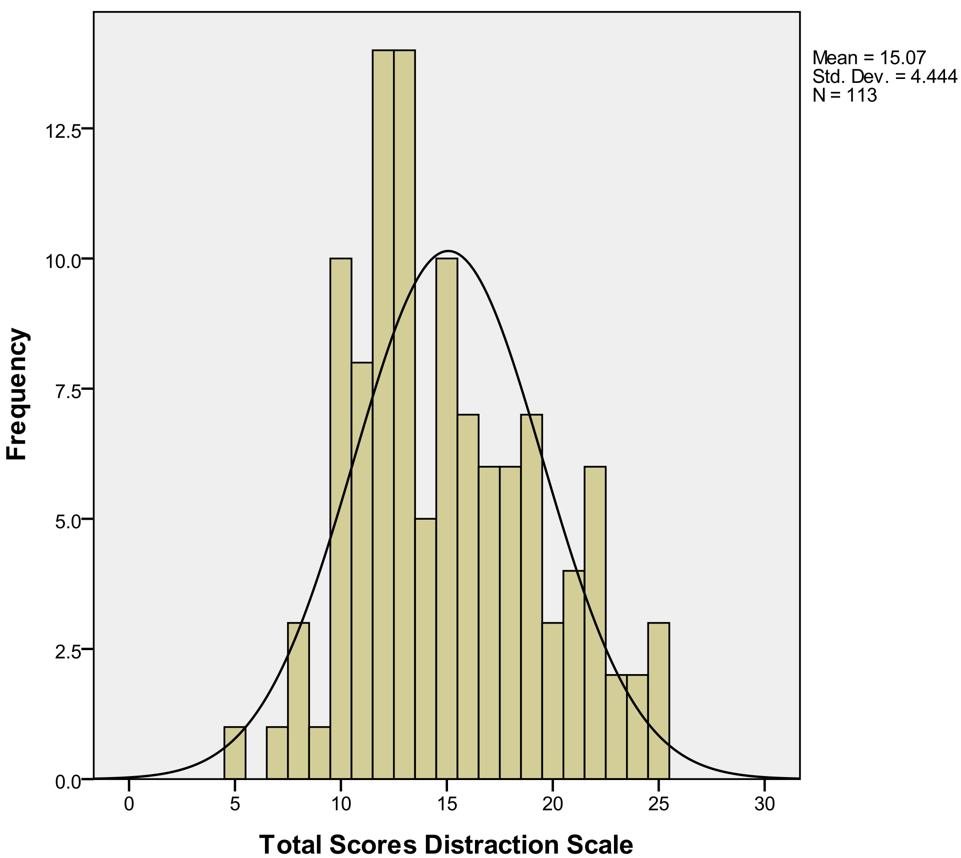


Figure 4. Distribution of scores for distraction scale.

Total Scores for Influence on Recall Scale

Total score for students' beliefs about the influence of computers on recall was calculated by adding survey items 14–17 with Likert-scale ranging 1–5 (*strongly disagree* to *strongly agree*). Items 16 and 17 were reverse scored to ensure all associated items used the same scale. The mean score for recall influence scale was 11.55 with a 3.65 standard deviation. Trimmed mean of 11.48 confirmed extreme scores were not influencing the mean. Skewness of .24 implied the distribution was approximately normal with most of the scores clustering near the low end, and kurtosis of -.83 indicated a relatively flat distribution. Figure 5 illustrates the overall score distribution of the influence on recall scale.

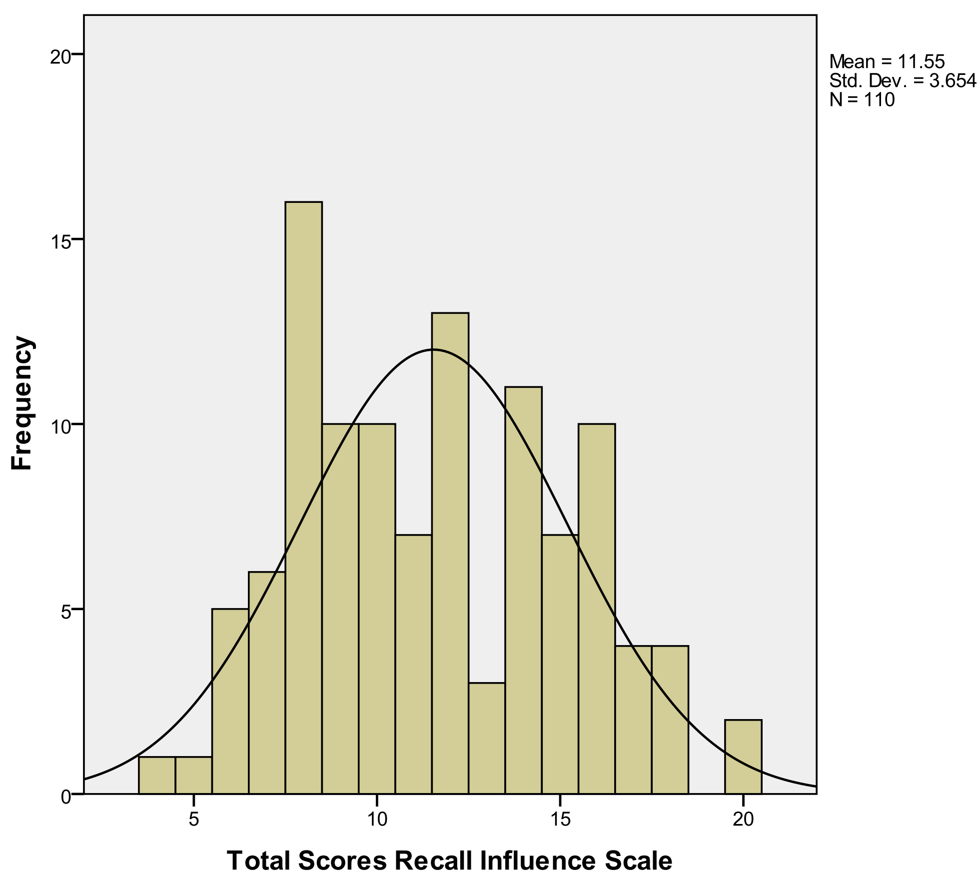


Figure 5. Distribution of scores for influence on recall scale.

Total Scores for Computer Limits Scale

Total score for computer use limits scale was generated by adding survey items 18–20, which were Likert-scaled items scored 1–5 ranging from *strongly disagree* to *strongly agree*. Computer limits total score measures the degree to which graduate students would be dissatisfied if their computer and Internet use were restricted in classes. The mean score was 8.97 with a 3.77 standard deviation. Skewness of .13 reflects a distribution that is approximately normal with most scores clustering near the low end, and kurtosis of -1.1 reflects a flat distribution. Figure 6 illustrates the overall score distribution of the limits on computer use scale.

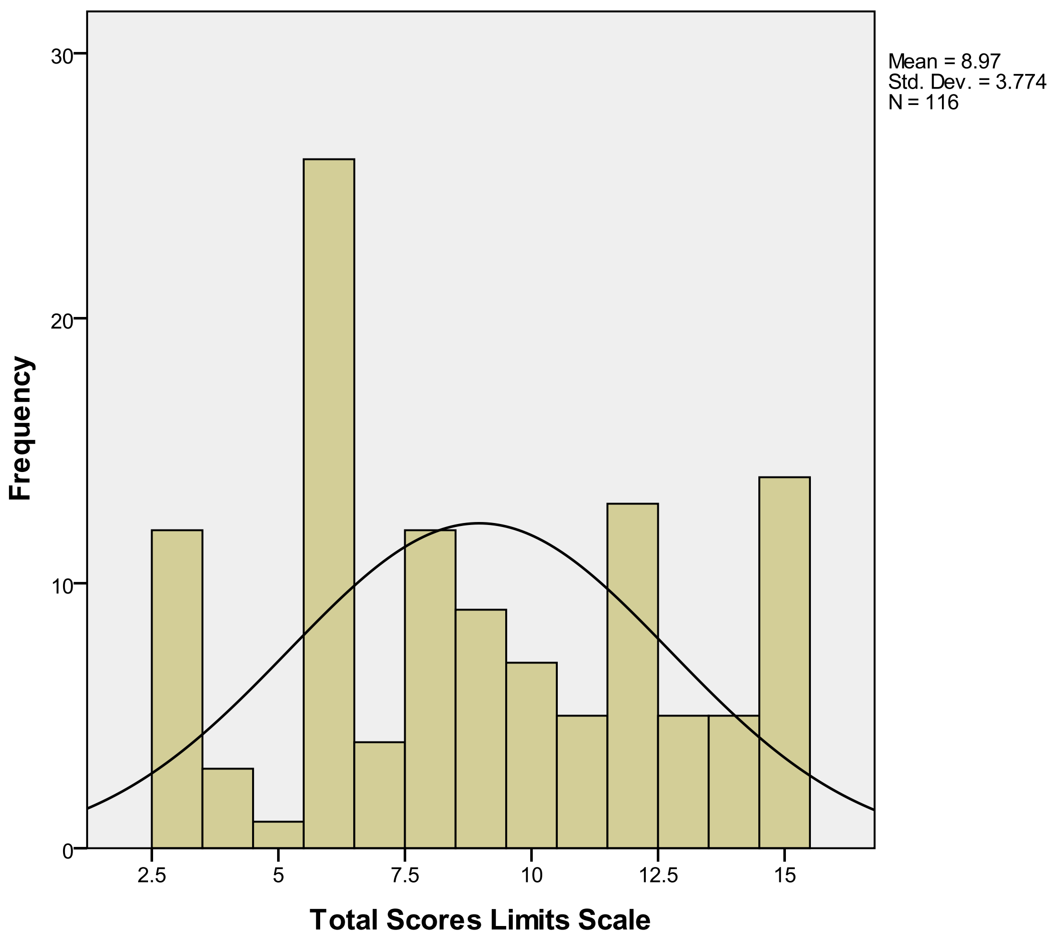


Figure 6. Distribution of scores for limits on computer use scale.

Total Scores for Computer Activities Scale

Total score for computer activities scale was generated by adding survey items 21–34, which were 14 Likert-scale items scored 1–5 ranging from *strongly disagree* to *strongly agree*. The mean score for computer activities scale was 29.37 with a standard deviation of 7.79. Skewness of .07 reveals a distribution that is approximately normal with most of the scores clustering near the low end (left side of the graph), and kurtosis of .52 signifies a peaked distribution with scores clustered in the center. Figure 7 illustrates the overall score distribution of the computer activities scale showing most scores near the low area of the graph.

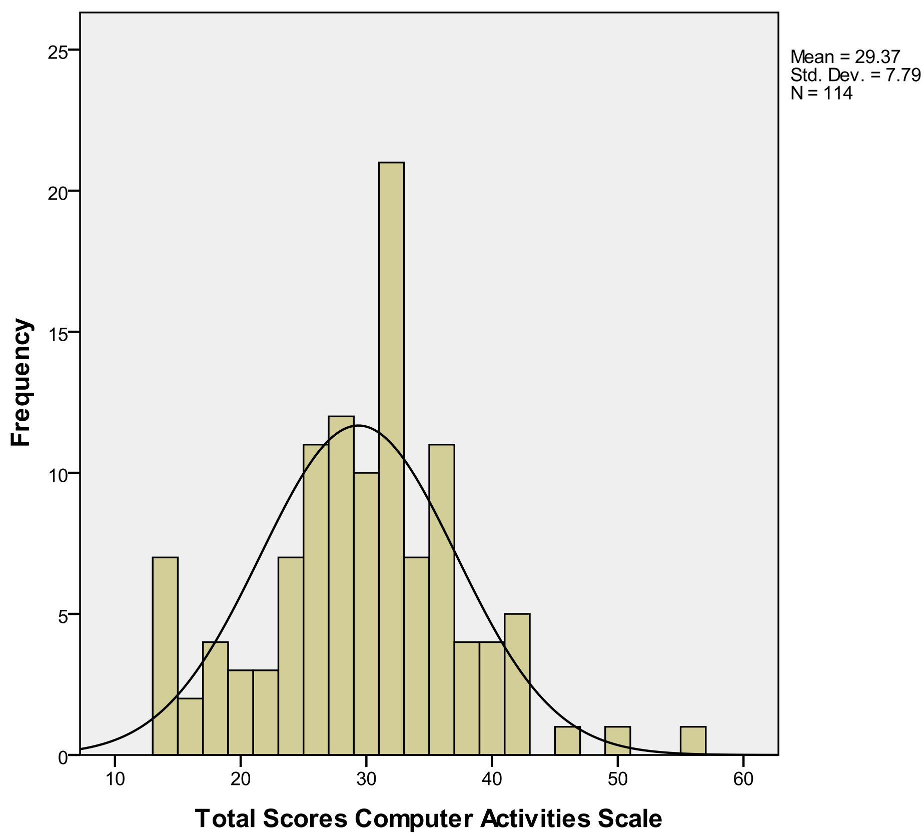


Figure 7. Distribution of scores for computer activities scale.

The data provided in Table 14 summarizes the mean, standard deviation, and skewness of the overall scores of the six scales used in this instrument.

Table 14

Mean, Standard Deviation, and Skewness of Scales

Scales	Mean	*SD*	Skewness
Beliefs scale	9.31	3.45	.12
Participation scale	15.31	4.47	.15
Distraction scale	15.07	4.44	.41
Recall influence scale	11.55	3.65	.24
Computer use limits scale	8.97	3.77	.13
Computer activities scale	29.37	7.79	.07

Note. SD = standard deviation.

Computer Activity as Percentage of Class Duration (Item 35)

Item 35 on the survey instrument asked participants to state the amount of time (in percentage) they spent using computers during F2F classes for related and unrelated class activities. Participants could enter any number between zero and 100 to represent their computer usage. The mean score for computer usage directly related to class activities was 74.68. Participants also confirmed they spent 25% of their class time on activities unrelated to classes. Standard deviation was 25.69 for both. Skewness was -1.12 for scores for computer activities directly related to classes, which refers to a clustering of scores at the high end of the graph. A kurtosis of .31 reflects a peaked distribution. Conversely, scores for computer activities unrelated to classes had a skewness of 1.12 indicating a clustering of scores on the lower end of the graph. Figure 8 illustrates the score distribution for class-related computer activities.

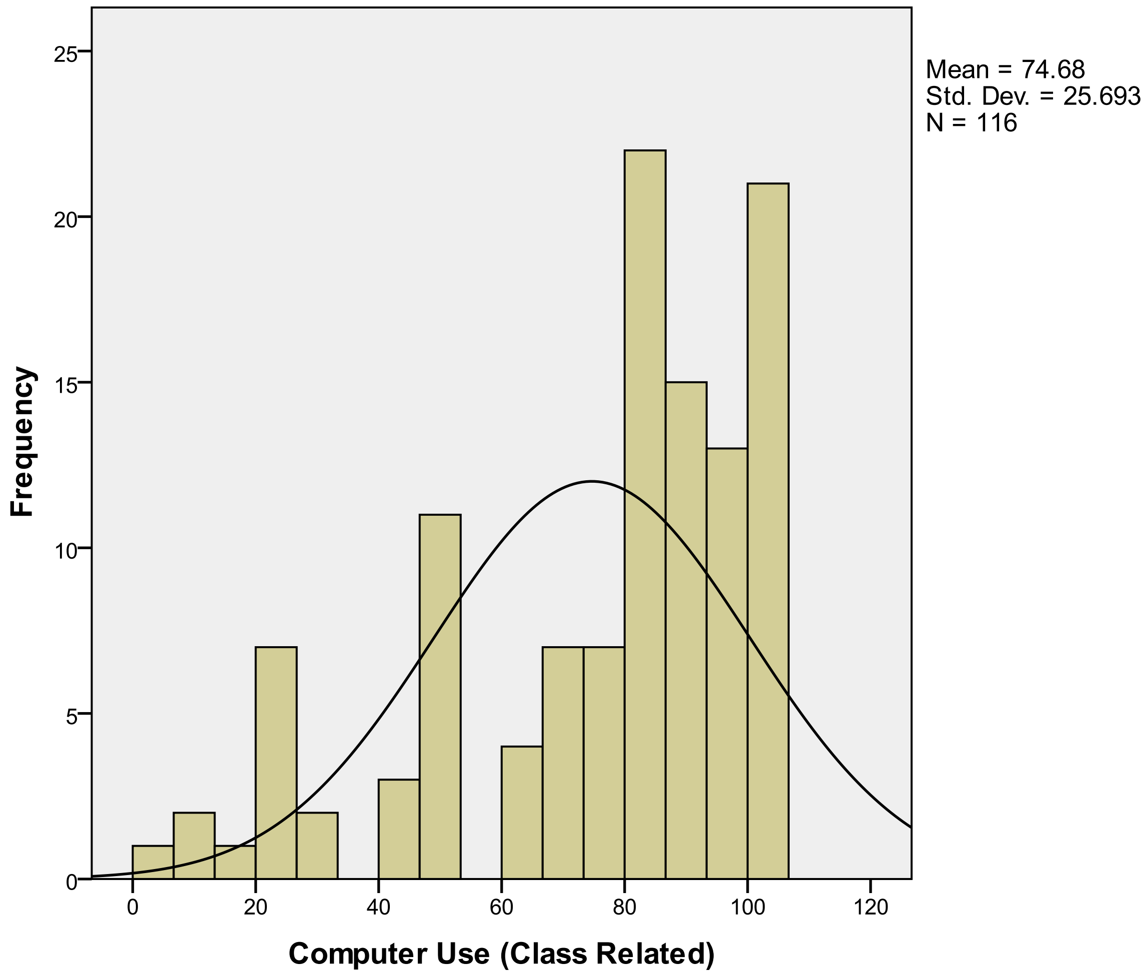


Figure 8. Scores for computer use directly related to class activities.

Analysis of Open-ended Comments (Item 36)

Finally, item 36 on the survey instrument provided participants with an optional open-ended response area that allowed participants to enter additional comments about computer use in classrooms. Of the 116 total participants, 68 students or 59% of respondents added comments that were later aggregated in Microsoft Word and Excel to organize responses in loosely related groups and themes.

More than half the comments received (51%) highlighted distractions from computer use as a source of much concern. Typical comments included:

- I use the computer to take notes even though this often distracts from what is being said. I may write the words down, but lack and [*sic*] understanding of their meaning or context.
- It is hard to discipline myself to listen fully to the instructor and not check email or work on other projects.
- Whenever I have brought my laptop to class (not in graduate school, but undergrad), I would get distracted and go on Facebook, personal email, etc when I was bored with class material. To use a computer in class can really hinder my learning experience because I don't have that kind of discipline.
- Computer use in class can be useful to learning. However, it is really annoying and distracting to sit behind grad [*sic*] students using computers to play games, go on facebook [*sic*], etc.

- I never use a computer in class because I find it distracting. I've been in classes with computers and from my experience, the students where [*sic*] spending most of their time on sites not related to the class.
- I am sorry to see so many students on unrelated sites during class. Shame, shame.
- I have never found that bringing laptops to class was helpful. All the student is supposed to be doing is typing their [*sic*] notes and that can easily be done by hand. When the professor asks people who are using laptops to stay on topic and not surf the web, the students NEVER obey them. I always see people on Facebook or checking their e-mail. It's more of a distraction than a benefit. My answer to #35 wouldn't let me put 2 zeros in the boxes so I put 50 so I could finish the survey. I don't use computers in the classroom.
- The current graduate program I am in does not put much emphasis on using computers in class. In the courses for the first Master's I received (which I graduated from in May of this year), having and using our computers was required for every class. Therefore, I feel as though I can make a good comparison between both experiences. Having the laptop with internet access was definitely a distraction. I would find myself checking my email, doing work for other classes and for my job, checking social networking sites, etc. I believe that distraction did affect my performance in class discussions and my ability to actively listen during lectures. My classmates were distracting as well because they would be involved in similar activities. The professors struggled to keep the

attention of the class. Comparatively, I feel more engaged and retain more information because I don't have the laptop with me in my current courses. In my opinion, the use of laptops is effective if it is a structured activity.

Student comments also highlighted many of the benefits from computer use. In fact, 43% of comments included ways in which computer use with Internet access was advantageous to students. Typical comments included:

- I have a learning disability so using the computer helps to facilitate and guide my learning. The recall of language is very difficult for me to manage, so I browse for multiple resources to support the language that the graduate work brings.
- When I actually use the computer, it is usually to look up terms I dont [*sic*] know so if I am asked to respond I dont [*sic*] sound stupid. I really try not to do other things while the teacher is teaching. I really like having the internet [*sic*] in class.
- Using computers during class, helps the student explore what was learned in the engaged moment and demonstrate learning took place.
- In graduate school, it's necessary to multitask. I'm glad we have access to the internet [*sic*] because we need to find lots of information fast, and we also need to schedule ourselves frequently. Therefore, I would be unhappy if they took this opportunity away.

Some students (38%) also highlighted the need for computer integration and improved pedagogy that incorporate the benefits of computer technology in their comments. Responses such as “Computers in F2F classroom are only beneficial if they are tools for the lecture,” or “I like the use of internet [*sic*] searches to research what my professor is lecturing about. I wish the professors would sometimes direct us to website [*sic*] with visuals or additional info while they are lecturing” were typical. One student summarized her views carefully:

> The current graduate program I am in does not put much emphasis on using computers in class. In the courses for the first Master's I received (which I graduated from in May of this year), having and using our computers was required for every class. Therefore, I feel as though I can make a good comparison between both experiences. Having the laptop with internet [*sic*] access was definitely a distraction. I would find myself checking my email, doing work for other classes and for my job, checking social networking sites, etc. I believe that distraction did affect my performance in class discussions and my ability to actively listen during lectures. My classmates were distracting as well because they would be involved in similar activities. The professors struggled to keep the attention of the class. Comparatively, I feel more engaged and retain more information because I don't have the laptop with me in my current courses. In my opinion, the use of laptops is effective if it is a structured activity.

Nevertheless, a few comments (<4%) highlighted concerns about distractions, but emphasized personal responsibility. Typical comments included, "I think at this level is it up to the students to determine what is appropriate use of the computer. Honestly teachers should incorporate more hands-on learning with the computer." Another student added, "computers with internet access are just too tempting for all of us, however, it is up to us to get the most out of the class, we are the owners of our own education!"

Students' comments affirm computers are used in unstructured graduate classrooms as academic aids, but their use would be more productive if they were integrated. Comments also highlighted students' struggles with computer-based distractions, although a few participants suggested students must be personally responsible for their own learning. A summary of response themes is provided in Table 15 with one representative example of student comments (Appendix F provides the complete list of comments). The data in this table shows students perceived computers as an academic aid, a source of distraction, a tool that needs integration and improved pedagogy in the classroom, and a tool that requires students to take ownership of their education.

Table 15

Summary of Student Responses to Item 36

Category	Example	#
Academic aid	Frequently use laptop for notes, locating course content when professor uses web ct [*sic*], look up a definition that's not clear, etc.	29
Distraction source	Computers with internet [*sic*] access are just too tempting for all of us.	35
Requires integration	I would be distracted by the use of computers in the classroom unless the professor specifically used them as part of the curriculum.	16
Requires better pedagogy	Computers are not used effectively in the graduate courses I have taken. Instructors are uncertain how to use them as an effective teaching tool, thereby decreasing my ability to use them as an effective learning tool.	10
Personal responsibility	I know some student [*sic*] miss use [*sic*] their computers, but really it's our learning and our responsibility.	3

Note. Response counts exceed 100% because responses often fit multiple categories.

Inferential Findings

In addition to the descriptive research questions, this research study also included two inferential questions for consideration. Parametric tests including *t*-tests, ANCOVA, and regression analyses were used to assess these items.

Independent Samples T-Test (Experiment 1)

An independent samples *t*-test was used to analyze one of the two inferential questions in this study: is there a statistically significant difference between recall test scores of graduate students who use computers with Internet access in unstructured F2F graduate classes and those who do not, as measured by test scores on a recall test? The independent variable was the laptop condition (open or closed), and the dependent variables were student scores on the recall test. An alpha level of .05 was used.

The experiment to investigate this question was done in two phases. The first experiment included 31 doctoral students in a research class that met in two class sections. Seventeen students in the first class-section who were designated *open laptop* group listened to an afternoon lecture while using their laptops and were given a fill-in-the-blank recall test consisting of 15 test items at the end of the lecture. Prior to the experiment, students did not know they would be tested after the lecture, and they were not allowed to consult their notes or laptops during the test.

The second class-section met later that evening and listened to the same lecture given by the same professor as the previous group. The 14 students in this second group were designated *closed laptop* group and were asked to close all laptop and desktop computers for the duration of the experiment. At the end of the lecture, which was delivered qualitatively and stylistically similar to the earlier lecture, students were given the same fill-in-the-blank recall test as the first group. Completed tests were collected, scored, and analyzed in SPSS.

Results of the first *t*-test indicated no statistically significant differences in scores between the *open laptop* group (*M* = 54.90, *SD* = 19.65) and the *closed laptop* group (*M* = 42.86, *SD* = 16.68); *t* (29) = -1.82, *p* = .08 (two tailed). The magnitude of the differences in mean scores (mean difference = 12.04, 95% CI: -1.52 to 25.61) was large (eta squared = 0.11). Accordingly, *p* > .05, and this researcher failed to reject the null hypothesis, which states, there are no differences in scores between the *open* and *closed laptop* groups. Table 16 summarizes the means and standard deviations for both groups. Levene's test of homogeneity and variances was not significant (*p* = .19), which indicates the variances for the two groups are equal, and the assumptions for equality were not violated.

Table 16

Scores for Open and Closed Laptop Groups (Experiment 1)

Groups	#	Means	*SD*
Open laptop	17	54.90	19.65
Closed laptop	14	42.86	16.68

Note. SD= standard deviation.

Independent Samples T-Test (Experiment 2)

Two weeks after the first recall experiment, a second experiment was conducted using the same methods and procedures as the first experiment with one exception—the laptop groups were reversed so that the *open laptop* group from the first experiment became the *closed laptop* group for the second experiment. Participants closed their laptops and turned off their computer screens during the lecture. Similarly, the *closed laptop* group from the first experiment was designated the *open laptop* group for the second experiment. Participants listened to the lecture while using their computers as they would for regular classes.

At the end of the lectures, both the *open* and *closed laptop* groups were given the same 20-item recall test. Student responses were collected and scored. Twenty-nine doctoral students from the first experiment participated in the second experiment—14 students in *closed laptop* condition, and 15 in the *open laptop* group.

An independent samples *t*-test was used to analyze the results. The research question under consideration asked whether there was a statistically significant difference between recall test scores of graduate students who use computers with Internet access in unstructured F2F graduate classes and those who did not, as measured by test scores on a recall test?

The independent variable was the laptop condition (open or closed), and the independent variables were the scores on the recall test. An alpha level of .05 was used.

The results of the second *t*-test showed statistically significant differences in scores between the *open laptop* (M = 39.67, SD = 15.97) and the *closed laptop* group (*M* = 59.29, *SD* = 26.88); *t* (20.89) = 2.37, *p* = .03 (two tailed). The magnitude of the differences in mean scores (mean difference = 19.62, 95% CI: 2.39 to 36.85) was large (eta squared = 0.17). Accordingly, $p < .05$, therefore, this researcher rejects the null hypothesis, which states, there are no differences in scores between the *open* and *closed laptop* groups. The data provided in Table 17 summarizes the means and standard deviations for both groups. Levene's test of homogeneity and variances was significant (*p* = .03) which implied the variances for both groups were not equal, and the assumptions for equality were violated. Nevertheless, the group sizes were fairly even (14 and 15), consequently, the violation was not significant.

Table 17

Scores for Open and Closed Laptop Groups (Experiment 2)

Groups	#	Means	*SD*
Closed laptop	14	59.29	26.88
Open laptop	15	39.67	15.98
Total	29	49.14	23.72

Note. SD= standard deviation.

Analysis of Covariance (ANCOVA)

One of the concerns of the recall experiment was the likely influence of the first experiment on the recall scores of participants during the second experiment. Consequently, it became necessary to control for the effects of the first experiment to mitigate its influence on the second. This control was added using a one-way analysis of covariance (ANCOVA). An ANCOVA requires at least three variables:

- One categorical independent variable with at least two levels (laptop condition—*open* or *closed* group)
- One continuous dependent variable (recall scores on experiment two)
- One continuous covariate (recall scores for experiment one)

Additionally, ANCOVAs require that certain specific assumptions are met including (1) a prior, reliable measurement of the covariate, (2) linearity between the recall scores for experiment one and scores for experiment two, and (3) similar relationships between scores for experiments one and two (homogeneity of regression slopes) (Pallant, 2007).

Once these assumptions were met, a one-way between-groups analysis of covariance was conducted to control for the effects of the first experiment on the scores of the second. The independent variable was the laptop condition (*open laptop* or *closed laptop*), the dependent variables were the recall scores for the second experiment, and the covariate was the recall scores of participants during the first experiment.

Initial tests were conducted to ensure critical ANCOVA assumptions of normality, linearity, and homogeneity were met. Figure 9 illustrates the results of the test of linearity and shows a relatively linear relationship between the dependent variable (scores for experiment two) and the covariate (scores for the experiment one), which implied assumptions of linearity were not violated. Levene's Test of Equality of Error Variances was significant (*p* = .001) signifying the assumption of homogeneity of variances was violated. Despite this violation, ANCOVAs are very robust to violations of homogeneity of variance, and the similarity in the number of participants (14 and 15) between groups makes this violation inconsequential (Leech et al., 2005).

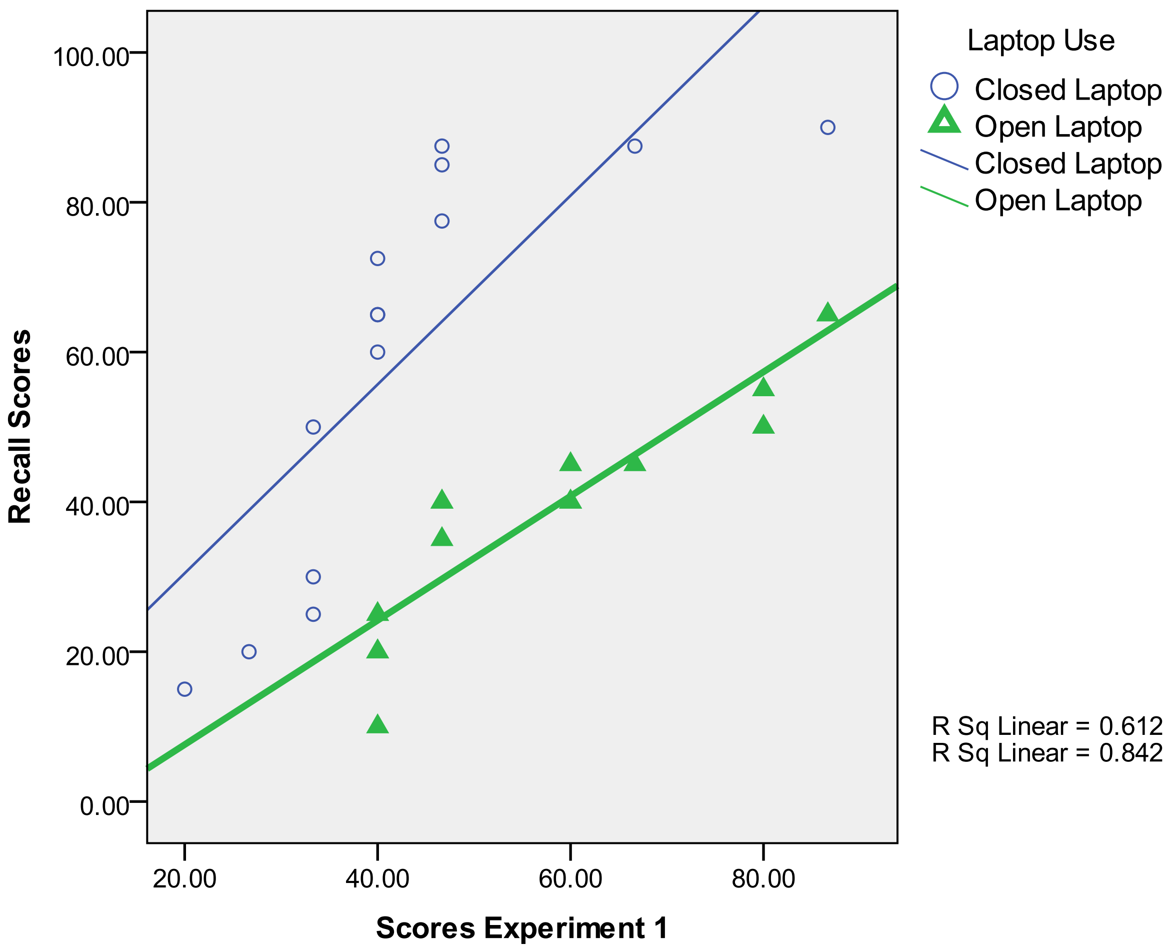


Figure 9. Test of linearity between dependent variable and covariate.

After controlling for recall scores on experiment 1, the results of the ANCOVA analysis revealed a statistically significant difference in recall tests scores between the *open laptop* and the *closed laptop* groups $F(1, 26) = 43.04$, $p = .000$. Additionally, a strong relationship was found between recall test scores on the first experiment and scores on the second experiment as shown by the partial eta squared value of .62. The data in Table 18 presents the means and standard deviations for recall scores on the second experiment and the adjusted scores after controlling for the first experiment. As is evident from this table, the differences in test scores were magnified after controlling for scores on the first recall experiment.

Table 18

Adjusted Scores (Experiment 2) after Using Results of Experiment 1 as Covariate

Groups	#	Means	*SD*	Means	*SE*
		Unadjusted		Adjusted	
Closed laptop	14	59.29	26.88	67.66	5.46
Open laptop	15	39.67	15.98	31.85	5.46

Note. SD= standard deviation.

SE = standard error.

Multiple Regression

Multiple regression analysis was performed to explore which independent variables (subscale scores for beliefs, participation, distractions, recall influence, computer-use limits, or computer activity) are most influential in predicting students' recall scores in unstructured F2F classes with Internet access. Six subscale scores for students' beliefs towards computer use served as independent variables, and combined recall scores from the two experiments served as dependent variables.

Multiple regression may be implemented using various models including standard, hierarchical, and stepwise regression. In standard regression, all predictor variables (independent variables) are entered into the model simultaneously. For hierarchical multiple regression, each independent variable is entered into the equation in an ordered approach. Finally, in stepwise multiple regression, the statistical program selects from among the available independent variables and determines whether and in what order each variable will be entered in the model (Pallant, 2007). This researcher chose the standard multiple regression analysis to conform to the exploratory nature of this study.

Equally important, multiple regression requires several assumptions to be met to ensure regression results are reliable. First, multiple regression results are affected by very high or low scores (outliers), however, an analysis of the scatter plot presented in Figure 10 did not provide values that exceeded 3.3 or were less than -3.3 (Pallant, 2007). Consequently, outliers were of no concern in this analysis.

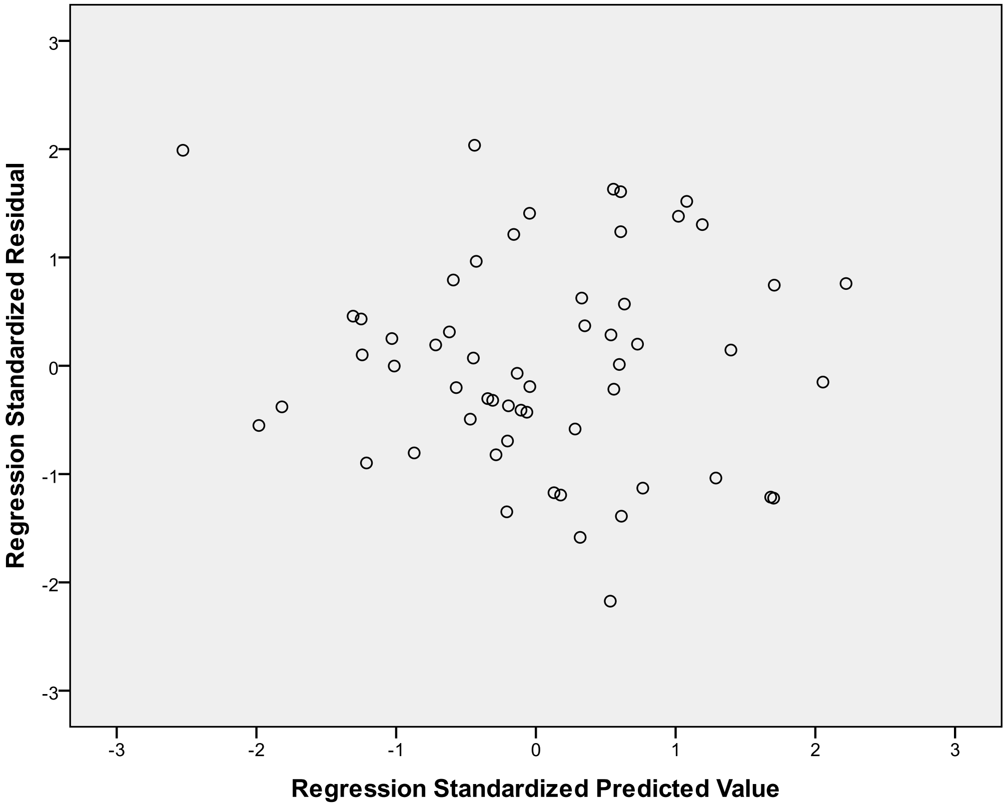


Figure 10. Scatterplot of the dependent variable (recall scores)

Second, data must be normal. A review of the Normal P-P Plot presented in Figure 11 demonstrates that the scores were plotted in a reasonably straight diagonal line from the bottom left area to the top right of the graph, which signifies that the assumption of normality was met (Pallant, 2007).

A third assumption of multiple regression is multicollinearity, which refers to the degree of relatedness between two or more independent variables and occurs when predictor variables contain similar information (Leech et al., 2005). Pearson correlation values may be used to assess multicollinearity by examining whether correlation values between independent variables exceed 0.7, which would imply a high degree of correlation between variables and may suggest multicollinearity concerns.

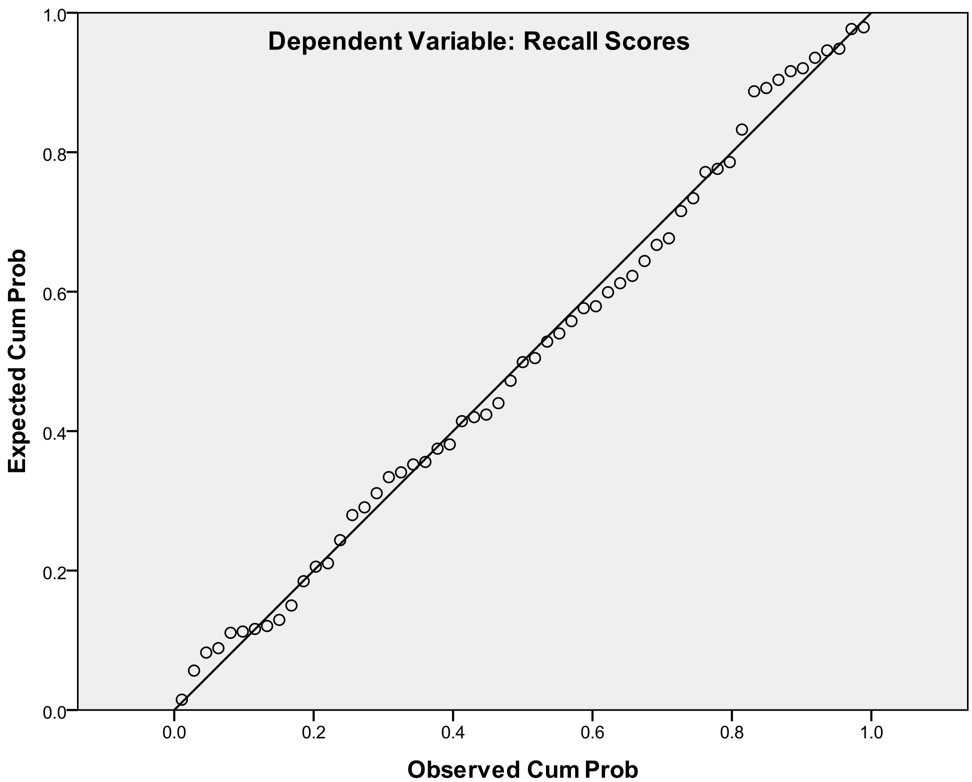


Figure 11. Normal P-P plot of regression standardized residual (dependent variable: recall scores)

After reviewing the values on the correlation matrix, this researcher found that the highest value (.68) occurred between total scores for recall influence and total beliefs scores—neither of which exceeded the 0.7 cut-off limit. Moreover, tolerance values below .10 and variance inflation factor (VIF) values above 10 may be used as additional cut-off points to determine whether multicollinearity is a factor. As such, all tolerance values in this analysis were between .33 and .66, and VIF values were between 1.5 and 3.0, which confirms multicollinearity was not a factor.

The model summary shows the amount of variance in recall scores (dependent variable) that can be explained by the subscales (independent variables) (S. Green & Salkind, 2003). When all predictors are included in the model, the multiple correlation coefficient (*R*) is .43 (R^2 = .18) and the adjusted R^2 is .09 which means 9% of the variance in recall scores may be predicted from the independent variables. Additionally, the ANOVA table shows F = 1.89, *p* = .1 and was not significant. Thus, the combined independent variables did not adequately explain the variance.

Equally important, the model included six independent variables that only accounted for 9% of the variance in recall scores. A reduction in the number of variables would likely produce an equation that provides a better explanation of the variance. A review of the coefficients table presented in Table 19 provides the standardized beta coefficients, *t* values, and significance of the independent variables. Total distraction scale and total recall influence scale provide the highest beta values (.36 and -.27 respectively) which suggest they contribute the most to the variance in the dependent variable.

A second regression analysis was conducted using only distraction and recall influence scales as independent variables. Recall scores served as dependent variables. This combination of variables (Table 20) resulted in a model that offered moderate prediction of students' recall scores, $F(2, 55) = 4.19$, $p = .02$, with both variables contributing to the prediction.

Table 19

Coefficients Table showing Standardized Coefficients of Independent Variables

Independent variables	Beta	*t*	*Sig*.
Total beliefs scale	-.01	-.05	.96
Total participation scale	-.13	-.68	.5
Total distraction scale	.36	1.76	.09
Total recall influence scale	-.27	-1.23	.22
Total computer limits scale	-.16	-.83	.41
Total computer activities scale	.26	1.62	.11

Note. *Sig*. = significance.

The data in Table 20 provide the means, standard deviations, and inter-correlations for the variables after the second regression analysis.

Table 20

Means, Standard Deviations, and Inter-correlations for Recall Scores and Independent Variables (N=60)

Variables	Mean	*SD*	*Distraction*	Recall Influence
Recall scores‡	49.31	21.26	.11	-.18
Distraction†	15.13	4.30	-	-
Recall Influence†	11.26	3.48	.68*	

Note. * = ($p < .001$); † = Independent variables; ‡ = dependent variable.

Beta weights presented in Table 21 illustrates that students' beliefs about the degree of distractions from computer use (beta = .43, $p < .05$) and their beliefs about the influence of computers on their recall ability (beta = -.47, $p < .05$) were statistically significant and contributed to this prediction. The adjusted *R* squared value was .10 and indicates that the model explained 10% of the variance in recall scores.

Table 21

Multiple Regression Analysis Summary for Beliefs about Computer Distractions and Influence on Recall in Predicting Recall Scores (N = 60)

Variables	B	*SE*	*β*	*t*	*Sig*.
Distraction†	2.12	.84	.43	2.51	.015
Recall Influence†	-2.88	1.04	-.47	-2.76	.008
Constant‡	49.65	10.25		4.84	.000

Note. R^2 = .13; $F(2, 55) = 4.19$, $p < .05$

SE = standard error; *β* = Beta*; Sig* = probability.

Results Summary

This chapter provides the results of various statistical analyses to assess both descriptive and inferential research questions concerning graduate students' beliefs about computer use in F2F classes with Internet access. A questionnaire consisting of 44 items was used to gather responses to a variety of statements, questions, and demographic variables. A sample of 116 participants provided useable responses to the survey instrument with most respondents identified as females between the ages of 20-32 years who used laptops regularly in their graduate classes.

On the question of differences in recall scores between graduate students who used computers with Internet access in unstructured F2F classes and those who do not, this researcher observed no statistically significant differences between the *open laptop* group (M = 54.90, SD = 19.65) and the *closed laptop* group (M = 42.86, SD = 16.68; t (29) = -1.82, p = .08 (two tailed)). Nevertheless, the second recall experiment in which the *open* and *closed laptop* groups were reversed provided statistical significance between the *open laptop* (M = 39.67, SD = 15.97) and the *closed laptop* group (M = 59.29, SD = 26.88; t (20.89) = 2.37, p = .03 (two tailed)).

An ANCOVA was employed to account for the effects of the first experiment on the results of the second. Again, the results of this analysis provided statistical significance between the *open laptop* and the *closed laptop* groups $F(1, 26)$ = 43.04, p = .000. Additionally, an eta squared of .62 suggests the relationship was strong.

Finally, regression analysis confirms that students' beliefs about the degree of distractions from computer use (beta = .43, $p < .05$) and their beliefs about the influence of computers on their recall ability (beta = -.47, $p < .05$) were statistically significant and may be used as a moderate predictor of students' recall scores.

CHAPTER FIVE: SUMMARY

Overview

This research study was designed to explore graduate students' beliefs about unstructured computer use with Internet access in face-to-face (F2F) graduate classes and the effects on students' memory recall. Students' beliefs include their views on whether computer use in classes:

- Is necessary and helpful (general beliefs)
- Affects their participation (participation)
- Affects distraction levels and multitasking activities (distraction)
- Influences memory recall ability (recall influence)
- Requires limitations and restrictions on use (limits)
- Is appropriately used for class-related content (computer activities)

Students' beliefs were assessed using an online survey instrument to which 116 graduate students from the University of Central Florida's College of Education responded with useable data. The response rate was 49% and included students enrolled in masters, specialists, and doctoral programs of study.

Effect on memory recall was assessed using two recall experiments implemented in two phases. The first experiment included 31 doctoral students enrolled in a research class that met in two class sections. Seventeen students in the first class-section were designated the *open laptop* group. Students in this group listened to an afternoon lecture while using their laptops and were given a fill-in-the-blank recall test consisting of 15 test items at the end of the lecture.

Students were not allowed to consult their notes or laptops during the test and did not know of the impending test until after the lecture.

The second class-section met later that same evening and listened to an identical lecture given by the same professor who instructed the previous group. Fourteen doctoral students participated in this phase and were designated the *closed laptop* group. Students were asked to close all laptop and desktop computers for the duration of the experiment. At the end of the lecture, which was delivered qualitatively and stylistically similar to the earlier lecture, students were given the same fill-in-the-blank recall test as the first group. Completed tests were collected, scored, and analyzed in SPSS.

Two weeks after the first recall experiment, a second experiment was conducted using the same methods and procedures as the first experiment with one exception—the laptop groups were reversed so that the *open laptop* group from the first experiment became the *closed laptop* group for the second experiment. Participants closed their laptops and turned off their computer screens during the lecture. Similarly, the *closed laptop* group from the first experiment was designated the *open laptop* group for the second experiment. Participants listened to the lecture while using their computers as they would for regular classes. As before, they were not told of an impending test until after the lecture.

At the end of the lectures, both the *open* and *closed laptop* groups were given the same 20-item fill-in-the-blank recall test. Student responses were collected and scored. Twenty-nine of the 31 doctoral students from the first experiment participated in the second experiment—14 students in *closed laptop* condition, and 15 in the *open laptop* group. Responses to the questionnaire and recall scores from the experiments were analyzed in SPSS.

Discussion

Results of the questionnaire revealed that most graduate students (95%) in this study use a desktop or laptop computer in their graduate classes when given the opportunity, but some students who own laptops preferred to leave them at home. To examine students' views about computer use (in the areas of general beliefs about computers in the graduate classroom, participation, distraction, memory recall influence, computer limits, and computer activities), students' overall scores on each subscale and their responses to individual questions used to create the scales were considered.

Beliefs about General Computer Use

Respondents felt positively about the usefulness and benefits of computers in unstructured F2F classes with Internet access (M_{Beliefs} = 9.31). Participants believed computers were useful academic tools capable of boosting their productivity. Yet, a review of individual question responses revealed important nuances in students' beliefs about the importance of computers. Respondents did not believe computers were essential in unstructured classes or in classes that did not explicitly require their use. While this survey did not ask about instructors' computer use, such use may be perceived as benefiting students to such a degree that some students do not feel compelled to bring or use their own computers during classes.

Moreover, males between the ages of 21–24 view access to computers and Internet access in graduate classes as important to their learning, more so than females. The trend shifts between ages 25–28 where females manifested views that were more positive. Both male and female participants between ages 29–36 share the view that computers are necessary in classes, but females between 37–52 years report comparatively more positive beliefs towards computers. While computer use was viewed as important, students did not view them as essential.

More than half the number of participants (53%) believed computer use with Internet access increased their productivity, but they had mixed opinions on whether computer use increased their grades. Twenty-six percent neither agreed nor disagreed, 39% disagreed, and 35% agreed. This result may suggest students who find computers useful do not base their decisions on increases in grades. In fact, most students in this study did not think the presence and use of computers in unstructured classes increased or contributed to improvements in their test scores. This conclusion implies graduate students in this study did not measure the productivity of computers in terms of their personal test scores, even though more than half of all participants found computers useful in classes.

These outcomes support earlier studies that found students were positively disposed to computer use and felt their learning was increased (Granberg & Witte, 2005). Unfortunately, past studies rarely present increases in test scores that were directly attributable to computer use in classes, and students were not convinced of a positive relationship between computer use and increases in grades (Warschauer, 2008; Wurst et al., 2008). Penuel (2006) proposes computer use that leads directly to increases in achievement scores will likely occur when computer use and integration is part of a larger overhaul of effective pedagogy. Yet, he noted a few studies that attributed increases in writing scores and technical proficiency to computer use in the classroom, but similar improvements were not found overall.

Beliefs about Participation during Classes

The score range for graduate students' beliefs about their participation in F2F classes with computers and Internet access was 4–20 points. Four items were combined to create the participation subscale. Respondents felt positively about their participation ($M_{\text{participation}} = 15.31$). On the question of integration, participants were overwhelming in their response. Three out of four students (75%) felt computer use with Internet access would help their productivity if instructors found better ways to integrate their use. This view of integration was consistently high for all age groups (20–52) and equal for both male and female participants.

On the question of increased class participation due to computer and Internet use in classes, 55% of students disagreed, 23% were still debating, and 22% agreed. Most students did not believe they participated more in classes when using computers and accessing the Internet. Likewise, students had similar beliefs about volunteerism in classes. The majority (55%) did not believe they volunteered more in classes while using computers, but 21% felt otherwise, and 25% were uncertain.

In contrast, 58% of students used computers to conduct online research on topics being discussed in their classes, but this flexibility came with consequences. More than half of all respondents (52%) became less attentive to the instructor while conducting searches. The data also suggests females between the ages of

37–52 were better able to listen to the instructor while using computers in classes than males.

The data from the participation scale provides additional evidence that student participation decreases when computers are used in unstructured classrooms. Student engagement with computers, even for activities related to class content, is likely to decrease the level of classroom interaction between teacher and student and between students and their peers. This finding is important because it reveals disengagement from classes occurs not only for off-task computer use, but also during legitimate computer activities. Classes that emphasize face-to-face interactions, discussions, debates, and other non-digital communication exchanges between instructors and students are most prone to the negative consequences of reduced engagement. Unstructured computer use in these settings poses a serious threat to optimal pedagogy.

While the overall mean score of 15.31 out of a possible 20 points for participation reflects a positive view, the mean score was increased not because students felt their participation increased overall, but because of other factors including high ratings on computer integration and Internet-use items that formed part of the overall participation scale. In similar studies that investigated student engagement in classrooms with computers, researchers observed a decrease in student participation and an increase in student passivity in classes where computer use is not integrated (Caron & Gely, 2004; Maxwell, 2007). It is also true that other researchers report increases in student participation after the introduction of computers and Internet access in classes, but in these settings, electronic communication and computer integration were important components of the class structure (Barak, 2006).

While questions may arise over changes in student participation, there is little doubt about students' strong beliefs that instructors must improve the ways in which they integrate computers in their classrooms to increase participation and productivity. Researchers have consistently identified this yearning while proclaiming that the real potential of computers in the classroom requires a true synergy between the technology, curricula, facilities, administrators, instructors, and students (Breslow, 2007; Kim et al., 2006; Messineo & DeOllos, 2005; Penuel, 2006; Wurst et al., 2008). Technology may be used as an effective pedagogical aid, but it is no substitute for effective instruction (Baker, 2005).

The finding that more than half the students in this study used the computer to research pertinent class topics online was helpful in highlighting one of the most important uses of Internet-enabled mobile technology in the classroom. Unfortunately, the data also reflects that a similar number of students (52%) admitted to decreased attentiveness to the instructor while using computers. This result concedes that the very act of researching online information during classes may temporarily divorce students from ongoing class activities and limit their attentiveness to the instructor. Thus, computer use in this situation is neither neutral nor additive; it provides significant benefits, but it also risks inattention.

Conscientious students should consider this utility cost as they decide whether to use computers in certain classes. Students may believe in their ability to engage multiple activities at once, but they readily admit to inattention and decreased participation. Instructors face the same decision—provide opportunities for appropriate computer use, or risk disengagement, even when students are researching topics related to ongoing class discussions.

Beliefs about Computer-based Distractions during Classes

From a range of 5-25 points for distraction subscale, the mean score of respondents was 15.07 ($M_{distractions}$ = 15.07) which suggests distractions were a source of concern. A review of the five items that comprise this scale was helpful. When asked to respond to the statement "I am not distracted from ongoing class activities when I use my computer with Internet access during F2F graduate classes," 61% of students did not agree, 28% agreed, and 11% were unsure. This outcome indicates most students believed their computer use posed a significant distraction and hindrance to their learning. Similar results occurred for the statement "I am not distracted by the online activities of other students who use computers during F2F graduate classes for activities unrelated to classes." Fifty-four percent disagreed, and 41% agreed.

These responses provide additional evidence that computer use contributes to significant student distraction in graduate classes that do not regulate computer use. Additionally, students who did not use computers in classes were also negatively influenced by their use.

Responses from students concerning distractions that occur when one student sits close to or in the line of sight of another student using computers for unrelated class activities were informative. More than two out of three students (67%) revealed they were distracted under these proximal conditions. This result decimates the personal responsibility argument some instructors and students proffer about computer use in the classroom. While it is true that students must be responsible for their own education and computer use, students who choose not use computers in classes have few options when other students abuse their technology privileges. Specifically, non-users cannot prevent computer users in the same class from using their computers as they see fit.

Consequently, an instructor who takes a “hands-off” approach on computer use in the classroom leaves non-users vulnerable to distractions from neighboring students who chose to use their computers for off-task or personal activities. This status quo is neither fair nor equitable treatment. While students can change seating arrangements, or learn coping skills, the intrusion of computer use should not be optional. This researcher recommends that instructors take deliberate steps to limit the interference of inappropriate computer use on non-users. Additionally, students should take similar measures when possible to promote their own learning unhindered from the distractions promulgated by their peers.

On the subject of multitasking or engaging in two or more activities simultaneously (such as listening to a lecture while reviewing email), students were clear in their beliefs. Seventy-two percent declared they multitasked frequently, but only 46% believed they multitasked well enough to avoid missing important class information.

These results advance two important theories. First, distractions are inherent areas of concern whenever computers are used in a class setting and are not integrated in the curricula. Students willingly admit they struggle with the temptation to explore off-task websites during typical classes. Moreover, researchers have been documenting the potential for significant distractions in unstructured classes with computers and Internet access, and many have recommended limitations, bans, compromises, and other measures to curb their impact (Brady, 2008; Truman, 2005; Yamamoto, 2008). This researcher agrees. A ban on computer use may not be the appropriate remedy for all students in all classes, but restrictions, supervision, and reminders about appropriate computer use is recommended in class settings where computer use is unstructured, or even in structured classes where the instructor requires specific focus and attention.

Second, students will multitask while using computers in classes, but they are tacitly aware that multitasking decreases their productivity and makes missing important class information more likely. Unfortunately, this awareness does not always translate into students taking appropriate actions to improve their learning. Thus, frequent reminders about appropriate computer use and its potentially negative impact on users and non-users may play an important role in helping students stay on task. Instructors may even consider changing their instructional strategies to accommodate appropriate computer use. Students should also curb their computer activities so that personal use occurs during personal time and specific class use occurs during class sessions. Additionally, students should consider keeping computers at home if their use in classes is more distracting than helpful, or they should consider sitting next to other non-users, or closer to the front of the class to limit distraction and multitasking temptations.

Beliefs about the Influence of Computer Use on Student Recall

Another question for this research study explores graduate students beliefs about the effects of computer use with Internet access on students' ability to recall recently presented information. Possible scores for this scale range from 4–20 points. Four survey items were combined to create the recall influence subscale. Two items emphasized a computer's potential for positive influence and two emphasized the potential for negative influences.

The mean score for recall influence was 11.55, which implies students were not convinced computer use was helpful to their recall. Student responses to the four items in this scale revealed interesting divisions. On the subject of computer use and concentration, 42% of students agreed, and 43% disagreed with the statement "using a computer with Internet access in F2F graduate classes does not affect my ability to concentrate on the topic being discussed in classes." The remaining 15% had trouble deciding.

Responses to student concentration do not show a clear consensus among students. They were divided on the influence of computer use on their concentration, but more participants agreed that computer use decreased their concentration in classes instead of increasing it (this conclusion seems warranted since the question was written to favor increases in concentration during computer use). While this conclusion is by no means concrete, the overall responses show that respondents did not link increased computer use with increased concentration. They were more convinced of an inverse relationship between the two.

Similar results occurred on item 15 that probed whether computer use "makes it easier to remember important class information." Twenty-six percent were undecided on this question, 36% agreed, and 35% disagreed. The neutral responses (26%) to this question item is significant and implies participants lacked credible information about the influence of computer use on their memory, attention, and recall. The 36% disagree rate also reveals a lack of consensus. Participants were not convinced computer use increased their recall of important class information. It seems students do not value computer use in unstructured classes as memory aids, or they do not consider its influence on memory when evaluating its usefulness. If this is so, then researchers should do more to investigate this area of study and inform the academic community of its findings.

Item 16 explored whether students had difficult remembering the contents of a lesson after using a computer and Internet access during the lesson delivery. Their responses reflected an overall uncertainty. Thirty-seven percent confirmed they had no problems remembering, but 44% revealed they had difficulty remembering lessons and attributed this deficiency to computer use with Internet access during classes.

This finding supports the general conclusions this author has made concerning students' beliefs about computer use and its influence on memory. Participants lack the necessary information to clarify the exact relationship between memory and computer use, but they seem to lean on the side of caution preferring to believe that unstructured computer use is likely to decrease memory performance rather than increase it. Analysis of the experiments conducted during this research study (and discussed later in this chapter) provides evidence that confirms students' suspicions—inappropriate computer use during graduate, lecture classes will likely lead to decrements in memory performance on content discussed during classes.

The final item in this scale focused on students who inadvertently *tune-out* the instructor while using computers with Internet access in graduate classes. The typical doubts encountered in previous response items were absent on this question. Students overwhelmingly agreed with this statement, and 73% confirmed they sometimes *tune-out* the instructor while using computers in classes. Only 16% disagreed. Females between 20–28 years were slightly more likely to report *tune-outs* than males, but gender ratio was perfectly even between 29–40 years, and then males between 41 and 52 years were significantly more likely to *tune-out* the instructor during classes.

This consensus should not be overlooked. If 73% of graduate students admit to *tuning out* the instructor while using computers in unstructured classes, then instructors and students should no longer view computer use in this setting as benign academic tools. This response rate elevates computers from the lowly status of simple tools to the same status of attention and engagement as instructors. In fact, some professors have often complained of their struggles to compete against the computer and the Internet for the hearts and minds of their students (Bugeja, 2007; Young, 2006). Therefore, instructors who encourage computer use but fail to integrate it should accept the imminent competition for student attention that will inevitably result when computers are used in unstructured class sessions.

Results for the overall recall influence scale imply students are still debating within themselves the effects of computer use on their memory and recall. They seem aware that computer use in classes influences their academic recall but have not yet formed a stated belief system, except in the case of *tune-outs* where they openly admit that computer use sometimes disconnects them from the instructor and from the content.

Additionally, students' beliefs about the influence of computers on academic recall lend credence to divided-attention paradigm that forms the conceptual framework of this research study. This paradigm suggests individuals attempting to encode information while engaged in a secondary demanding activity will likely yield significant decreases in their memory performance or at a minimum, store encoded data that is incomplete or diminished in important ways (Foerde et al., 2006; M. Naveh-Benjamin et al., 2000).

Beliefs about Limits Students will accept on Computer Use

Another question for this research study explores graduate students beliefs about the kind of limits they would accept on their computer use and Internet access in graduate F2F classes. Possible scores for this scale range from 3–15 points. Three survey items were combined to create the limits subscale, and all had similar grammatical structure.

The mean score for belief limits was 8.97, which concedes students believed they would be unhappy if their in-class computer privileges were terminated, their Internet access was disabled, or the instructor substantially limited their computer and Internet access.

Analysis of each question revealed there were only minimal differences between those who agreed they would be unhappy if they were not allowed to use a computer in classes (46%), and those who disagreed (44%). This finding suggests students are not committed or firmly tied to the belief that computers in their graduate classes are necessary.

Even more revealing, 49% of students confirmed they would be accepting of a decision to disable their Internet access, and 48% felt the same about the instructor taking steps to limit their computer use and Internet access. In fact, only 37% of respondents conceded they would be unhappy if the instructor imposed limits. These results lead this researcher to conclude that most students are aware of the negative consequences of computer use, but prefer the convenience of having regular access to a computer in classes, or are convinced that the multitudinous advantages of computer use outweigh their potential for distraction, decreased participation and engagement, and negative influence on memory recall.

Other studies that include limitations on student access to computers and Internet in classes provide results on both sides of this issue. Students, including law students frequently object to laptop bans and Internet "kill switches" even when instructors are adamantly opposed (Adams, 2006; Brady, 2008; Bugeja, 2007; Young, 2006). On the other hand, some researchers report students were very accepting of computer and Internet limitations. McCreary (2009) successfully restricted laptop use from the first few rows of her classes with minimal repercussions from students, and Yamamoto (2008) instituted a complete laptop ban in his law classes despite some difficulties.

Yet, banning laptops or Internet access also removes their potential benefits (Brady, 2008), so compromises between students and instructors should be explored. McCreary's (2009) solution to ban laptops from the first few rows of her classes may be one potential solution to protect students who are easily distracted when neighboring students engage in distracting online activities. This solution may also allow students who require or desire computers in classes to engage their use without distracting non-users, and is one suggestion supported by this researcher.

Beliefs about Computer Activities in which Graduate Students Engage

The final descriptive question for this research study explores graduate students beliefs about the kind of computer activities they pursue during classes. Possible scores for this scale range from 14–55 points and were scored on a different Likert-scale than the previous items. Scores ranged from 1-4 for *Never*, *rarely*, *sometimes*, and *frequently*. Fourteen survey items were combined to create the computer activities subscale, and all had similar grammatical structure.

The mean score for computer activities was 29.37, which reveals scores were on the low end of the distribution. Most students used computers in classes for note-taking (67%) and 70% engaged in online research that was directly related to class content. These results were encouraging because they affirm most students used their computers in classes productively.

Unfortunately, off-task use was noticeable. Thirty-six percent of students used their computers in one class to complete assignments for another, 23% communicated via instant messaging, 33% visited social sites such as Facebook and Twitter. Additionally, 47% revealed they browsed the web for content unrelated to class activities, 39% read the news, 33% updated their electronic calendars, and 2 out of 3 students (67%) managed their emails during classes.

Computer use for job hunting was 10%, and 13% for playing online games or entertainment. The only listed activity for which students showed very little interest was watching videos or movies while in classes. Results for this item were only 4% of responses. While most students (57%) spent more than half their class times using a computer for activities directly related to classes, at least 22% did not. For graduate students who sit in classes for three or more hours per course, a 22% response rate of students spending more than half their class time in activities unrelated to class creates some concern that requires further investigation.

Instructors who believe computer use is the sole responsibility of the student may wish to reconsider that conclusion in light of these findings. The amount of time participants admit to spending on off-task activities completely unrelated to class content points to a greater problem of indifference. It is possible students do not find the class content engaging, or important, or they may overestimate their multitasking abilities. It is also likely students do not believe class lectures are tied to specific assessment or achievement so attentive listening is not a prerequisite for classroom excellence. Despite the reasons for the indifference, computers are providing students with a tempting outlet to disengage from classes. Unfortunately, this study does not address whether the disengagement would occur even in the absence of computers in unstructured classes.

Survey Item 35 (On-task Computer Use)

Survey item 35 asked respondents to state the amount of time (in percentage) they spent using a computer for on-task and off-task activities during a typical class session. Seventy-five percent of participants claimed engagement in class-related activities, while 25% engaged in computer activities unrelated to classes. These results reveal that computer use in classes is shared between academic and personal pursuits. Instructors must be aware of this dual use as they interact with students in graduate classrooms and adjust their instructional strategies accordingly.

Previous studies on computer activities in classes reports note-taking, content research, communication with friends, email management, assignments for other classes, and visits to social sites were the major activities pursued by students (DeGagne & Wolk, 2007). This finding supports those results.

Comments Analysis for Survey Item 36

One survey item provided participants with the option of adding comments about their views or beliefs about computer use in classes. Analysis of their comments confirmed most students acknowledged the potential benefits of unstructured computer use including note-taking, online research, and learning flexibility. A few students who admitted learning disabilities felt strongly about the necessity of computer use in the classroom to support their learning. Instructors who consider banning computers in classrooms should be aware of this minority group who view computers as necessary tools and are more likely to stay on task and use their computers responsibly.

Nevertheless, most respondents who added comments were strongly opposed to computer use in unstructured classes. Their comments revealed strong emotions ranging from outright bans on computer use to passing judgment on students who abused their computer privileges in class.

Typical comments include “computer use in class can be useful to learning. However, it is really annoying and distracting to sit behind grad students using computers to play games, go on facebook [sic], etc.” Dozens of similar comments demonstrated students' concern about the intrusions of computer use on their learning.

Students who identified the distracting influences of computer use also made a direct link to the associated decreases in learning. In other words, students tied inappropriate computer use with decreased learning. If students believe their learning suffers when they engage in off task computer use, or they are distracted by the computing activities of their peers in unstructured classes, then the general quality of learning suffers. Worse, if sufficient numbers of students in a class are of the same opinion against unstructured computer use, then the instructor faces difficult odds trying to reach the entire class.

Remaining findings from student comments reflect the overall results of their responses to scaled items. Students overwhelmingly desired instructors to integrate computer use in classes and for graduate students to own their education and monitor their computer use without supervision. While the students in this group represent only 24% of comments, they are the ones most likely to resist a paradigm shift in computer use and Internet access in classrooms.

Analysis of these comments provide further evidence of students' perceptions that computers and Internet access are valuable academic tools, but are also significant sources of distractions and a drain on academic productivity for many graduate students in F2F classes. Nevertheless, students believed their productivity would increase, and distractions from computers would decrease, if instructors learned to integrate their use.

Students also desire improved instructional strategies that accommodate computer technology. Consequently, instructors and institutions of higher learning that allow computer use should adapt these suggestions and embrace the technology; otherwise, partial commitment to computer use may be more detrimental for most students than a complete ban, or non-use. In other words, universities should encourage computer use, and fully support it, or discourage student use of computers in unstructured classes, but a partial commitment or a lack of integration is a disservice to students and their learning.

Discussion of Inferential Research Study Questions

Overview

Two inferential questions are included in this study. Is there a statistically significant difference between recall test scores of graduate students who use computers equipped with Internet access in unstructured F2F graduate classes and those who do not, as measured by test scores on a recall test?

The second question states: which independent variables (scores for beliefs, participation, distractions, memory recall influence, limits, or computer activity as measured by a questionnaire) are most influential in predicting recall test scores of graduate students who use computers in unstructured F2F graduate classes with Internet access? These questions were analyzed using independent *t* tests, ANCOVA, and multiple regression. Each will be examined in turn.

T-Tests Results

The first experiment did not yield statistical significance between the *open laptop* and the *closed laptop* groups (M_{open} = 54.90; M_{closed} = 42.86; p = .08). Nevertheless, the results changed in the second experiment when the *open* and *closed* laptop groups were reversed. In the second experiment, the *closed laptop* group showed a significant difference in mean recall scores compared to the *open laptop* group (M_{closed} = 59.29; M_{open} = 39.67; p = .03). The effect was also large (eta squared = .17).

An ANCOVA was performed to control for the effects of the first experiment on the results of the second. This analysis was also statistically significant between the *open laptop* and the *closed laptop* groups $F(1, 26) = 43.04$, $p = .000$. The adjusted means (after controlling for the first experiment) was 67.66 for the *closed laptop* group and 31.85 for the *open* group.

The results of the first experiment (in which the *open laptop* group had higher mean scores than the *closed laptop* group) is different from expected results in many other studies in which the *non-laptop* group had higher scores than the *laptop* group. This reversal of results may indicate problems with the instrument or research protocol. One student who participated in both experiments and completed the questionnaire hinted at this possibility in responses provided in the comments section:

> Also, I think today's material was easier because we had already applied some of the knowledge in making our own questionnaires, while the info you asssessed [*sic*] us on in the past was very new and different to me...and I never had a chance to apply any of it prior to be [sic] assessed on the info. Just curious as to how you account for these differences.

Upon reflection, it is likely students in the College of Education at the University of Central Florida who participated in the experiments may have been unprepared for a fill-in-the-blank recall test after a lecture because assessments of this type are rare at the doctoral level. A second problem developed during the first experiment that may help to explain the results. The recall test was originally designed before the lecture was given with 21 questions, but six were removed from consideration posttest because the instructor of the class did not feel comfortable those items were adequately covered during the lecture. The removal of these test items after students completed the test may have skewed the results.

Another potential factor may be timing. The first experiment had two parts. The first occurred in the afternoon with the class designated *open laptop* group, in which students used their computers normally during the lecture. After the lecture, they were given a fill-in-the-blank recall test, and this researcher observed that students were alert, attentive, and responsive to the instructor.

In contrast, the second part of the first experiment occurred during evening hours with a group of students designated *closed laptop* group. Observational evidence suggests students in the evening class seemed less attentive and participated less in the lecture compared to students in the afternoon class. Some participants in the evening classes may have worked all day and left work just before coming to classes.

Anecdotal evidence suggests students in the afternoon classes were enrolled full-time, while students in the evening classes were balancing full-time jobs with their academic pursuits. These personal circumstances might help explain the distinct differences in alertness levels between the evening class and the afternoon class. These differences in groups may account for the variation in recall test scores.

Finally, the *open laptop* group (afternoon class) had better mean scores than the *closed laptop* group on the first experiment. In the second experiment in which laptop groups were reversed, the *closed laptop* group (afternoon class) had better mean scores. Consequently, students in the afternoon class did better on memory recall tests in all phases of the experiments regardless of computer use—they had better recall scores (compared to the evening group) when they used laptops and better recall scores when they did not use laptops during the lecture.

One conclusion posits students in the afternoon classes were more alert, more attentive, or simply better at managing their computer activities during the lecture than their counterparts in the evening class regardless of laptop use or non-use. Therefore, attentiveness, environmental factors, and human factors (such as fatigue during the first experiment) may have played an influential role in the results and should be explored further. In an earlier study, Grace-Martin and Gay (2001) hinted at this when they suggested the benefits of pervasive wireless access in classes hinged on the characteristics of students, class structure, and the computing infrastructure available to students on campus.

On the other hand, a further review of the *t* test results that compare the recall scores of the same group of students over the duration of both experiments provides an interesting finding. In the first experiment, the afternoon class had a mean score of 54.9 (after using laptops and Internet access during the lecture). In the second experiment, students in the afternoon class (who did not use laptops during the lecture) saw their mean score increased to 59.29, representing an 8%

increase (4.39 points) over the previous results. Similarly, in the first experiment, the evening class (that did not use computers during the lecture) had a mean score of 42.86 for memory recall, and a mean of 39.67 for the second experiment (in which students used computers during the lecture) representing a 7% decrease (3.19 points) in scores over the previous results.

These results suggest students at a given ability for memory recall (with computers) are likely to improve their recall scores if distractions from computers and Internet access are removed. Likewise, students at a given ability for memory recall (without computers) are likely to see a further decrease in recall scores if computers are added. In other words, the students who used computers during the lecture for the first experiment scored higher when computer use was restricted during the second experiment. Additionally, students who did not use computers during the first experiment scored lower on memory recall tests when they were allowed computer use and Internet access during the lecture. The percentage change in scores between the first and second experiment falls between 7-8% depending on whether unstructured computer use with Internet access was allowed or restricted.

The Ancova results reveal that the adjusted mean differences in recall scores for the second experiment was 67.66 (*closed* laptop) and 31.85 (*open* laptop) which demonstrates a larger margin (more than double) between the recall scores of students who used computers during the lecture and students who did not.

The *t* tests and ANCOVA evinces statistically significant differences in recall test scores between graduate students who use computers equipped with Internet access in unstructured F2F graduate class sessions and those who do not. These results demonstrate that the presence and use of computers with Internet access in unstructured graduate class sessions is associated with decreased recall, and the removal or restrictions on use is likely to lead to increases in memory recall.

Students who have difficulty concentrating on a lecture during classes while using computers will exacerbate their inattention if they engage in off-task computer use, and will likely result in decreased recall. Similarly, class content that emphasizes engagement, recollection, or attentiveness is not optimized for unstructured class sessions unless the engagement incorporates the existing technology.

While more studies are needed to explore the influence of human factors (such as fatigue) on student recall in classrooms with computers, this experiment provides additional support for the growing body of research that ties computer use in unstructured classes with decreased recall. Conversely, restrictions on computer use in unstructured class sessions may lead to improved memory recall scores. Moreover, students who do not use computers while listening to a lecture will likely benefit from the reduction in distraction levels (if they can also avoid peripheral distractions from other students' computer use). Thus, students and instructors interested in improving recall or attention in unstructured class sessions should consider limiting computer use during critical discussions or exchanges as an important learning strategy.

The results of these experiments support previous research that found decreases in test scores among students who used computers with Internet access during assessed activities (Fried, 2008; Hembrooke & Gay, 2003). These findings also corroborate the results of an earlier study by Hembrooke and Gay (2003) on which portions of this current study are modeled.

Discussion of Multiple Regression Analysis

Analysis of the regression analysis indicates students' beliefs about computer-based distractions, and their beliefs about the influence on computers on student recall were important predictors of students' recall scores (independent variable) in F2F graduate unstructured classrooms. Unfortunately, this model only accounted for 10% of the variance in recall scores. Therefore, a better model is needed to predict this dependent variable.

Conclusions and Recommendations

Computers are necessary components of academic life, but are not required for every class and should not be encouraged for use in every class. Students are flexible; most are not zealously tied to their computers and will accept limits on computer use and Internet access if such limits benefit their education.

Distractions from computer use are significant problems for students using computers and Internet access for activities unrelated to classes and for innocent peers and non-users. Students who struggle with distractions should avoid bringing their laptops to classes when their use is not required for class content and (when possible) should avoid sitting in the line of sight of peers who abuse their computer usage in classes.

Most students will improve their memory recall in unstructured class sessions if they restrict their computer use during activities that require student attention.

Likewise, students should understand that unstructured computer use is not a benign activity; it is likely to reduce by 8% their existing memory recall levels.

Instructors in classes where computers are not required should be sensitive to the needs of students regarding potential distractions from computer use. Instructors should create an environment that promotes optimized learning for students who use computers and those who do not. Consequently, seating preferences may be arranged so that laptop users sit behind non-users to minimize peripheral distractions. One implementation of seating preferences may include designating the first few rows of a classroom as *laptop free* and allowing only students who choose not to use computers in these rows. Thus, students who prefer to use laptops may sit behind them (McCreary, 2009) to avoid contributing to line-of-sight distractions. This seating arrangement is not practical for all classes, but it is one option that may be considered in some settings.

Participation, volunteerism, and classroom interaction may decrease as unstructured computer use increases. Students and instructors should recognize that even students who use computers and Internet access to review online resources directly related to ongoing class content risk missing important information delivered while they were completing their searches. Therefore, instructors should consider providing in-class "computer time" that allows students time to research related content without missing ongoing instruction.

Instructors in colleges and universities should not assume that in-class computer use is directly related to class content. Students multitask when given the opportunity and will share a computer between personal and academic use. Students should also recognize that multitasking may allow for the exploration of multiple activities simultaneously but reduces the effectiveness and performance of each. In some cases, the decrease may be significant and academically harmful.

Instructors must also communicate their computer use policies in the syllabus and regularly throughout the semester. Enforcement is also recommended to ensure students are sensitive to the academic needs of their peers and limit computer abuses that may distract non-users.

All instructors who allow computers in their classrooms should learn to integrate their use to improve student productivity, optimize teaching efficiency, and lessen student distractions. University administrators play an integral role in providing professional development, training, and workshops that assist instructors as they develop curricula that incorporates technology rather than compete with it. Making appropriate computer use the sole responsibility of students may not be advantageous to non-users who are negatively affected by their abuse. Effective computer use in classes must be a collaborative process with all players involved.

Students must arm themselves with evidence-based recommendations about computer use in unstructured classrooms. For instance, this research study and others found evidence that decreased classroom participation, decreased volunteerism, decreased student recall, decreased recall test scores, and increased distractions were strongly correlated with unstructured computer use. Even students who did not use computers in classes but were in the line of sight of other students using their computers for both on-task and off-task purposes were also negatively affected.

Thus, students who are prone to distractions or other negative consequences of computer use should adjust their seating preferences to limit their exposure to off-task use. They may also choose to close their laptop screens when computer use is not mandatory, or leave their computers at home when their presence in classes is unnecessary, or make a conscious effort to avoid computer activities that encourage disengagement from classes. Instructors play an important role in helping students learn, but ultimately, students must take the reins of their own academic success.

Limitations

This research study has some limitations. First, the self-reported nature of student responses is always open for criticism because questionnaires rely on the honesty and goodwill of participants. Second, the students who participated in this study were from the College of Education at the University of Central Florida—a large, metropolitan university with over 50,000 students and ubiquitous wireless access that allows students with wireless receivers to access online resources from any location on campus. UCF has multiple labs with reliable desktop computers tethered to wired connections and available for student use (University of Central Florida, 2008). Consequently, the computing experiences of students in this research study may not extrapolate well to other academic institutions that are structurally different from UCF.

Third, the research protocol used in the first experiment did not adequately prepare students for the recall test. While this process ensured that recall scores were not tainted by foreknowledge or familiarity, the unexpected recall assessment may have influenced the results. Fourth, this researcher removed six test items from the 21-item assessment instrument used in the first recall test experiment to ensure students were only tested on content adequately taught during the class session. The reduction of test items posttest from 21 to 15 may have affected recall score results.

Fifth, the two recall experiments occurred in two parts over a two-week period, but the test results of the first experiment may have been skewed by students' personal circumstances including fatigue, alertness levels, or job status (students in evening classes may be balancing full-time jobs with academic pursuits, while daytime students are less likely to have full-time jobs). Sixth, female participants (75%) were over-represented in the sample of students who responded to the questionnaire. An optimally balanced representation of both genders would have been preferable.

Seventh, the increases in recall test scores in this study (when computer use is restricted in unstructured classes) may be a temporary result that may diminish over the academic life of a graduate student. Consequently, the results of this study may change over an academic career. Long-term studies using multiple computer conditions may be necessary to assess systematic trends. Additional experiments over a longer testing period such as an entire semester or academic year might prove useful. Eighth, this study investigates computers paired with Internet access in the classroom but ignores other useful classroom technologies including smart phones, cell phones, net books, PDAs, and similar devices that have the potential to add to, interfere with, or change classroom dynamics.

Additionally, this study investigates graduate students' beliefs about and use of computers in the classroom but does not address beliefs or teaching strategies of the instructor, which may be important considerations when assessing quality and effectiveness of classroom pedagogy.

Finally, most students used their personally owned laptops during the experiments; however, the experiments were held in a computer lab, so a few enterprising students used university-owned desktop computers to complement their own. In these instances, students may have adjusted their computing behavior based on the ownership of the computers they use. Thus, their computing habits on their laptops may be more representative of their overall computer use in classes than their computer use on university-owned desktop computers in a lab.

Future Studies

The efficacy of computer use in unstructured class sessions will remain a divisive issue for students, academicians, and anyone concerned about pedagogy. Therefore, future studies should explore the relationship between test scores of computer users over multiple semesters (long-term trends) and should include a control group (Kirkup & Kirkwood, 2005). The leading factors that account for or predict variances in tests scores attributable to computer use in the classroom deserves some scrutiny to develop a better model, and the effects of unstructured computer use on non-users in classes where more than 50% of students use computers warrants examination.

Cognitive load theory may provide a theoretical framework for further research that explores the reasons for computer-based distractions on students in unstructured class sessions. Additionally, the effects of distractions from computer use on males versus females warrant more investigation.

The complex interplay between human factors (such as fatigue), environmental factors, and computer use in an unstructured classroom and how these factors influence distraction offers fertile areas for research. Similarly, an investigation into the precise reasons some students embrace computer use in classes, while other students, in the same class, reject them warrants additional investigation.

Other research questions may probe whether instructors are sufficiently aware of the myriad ways in which students use computers in unstructured class sessions, and whether students who use computers to disengage from classes would be similarly inclined if computers were absent from classrooms.

Finally, devices capable of accessing the Internet in graduate classrooms are not limited to computers. Netbooks, smart phones, PDAs, and other emerging devices are increasingly used in classrooms by enterprising students. Their influence on classroom interaction and distractions should also be explored.

APPENDIX A: FINAL QUESTIONNAIRE

QUESTIONNAIRE

BELIEFS OF GRADUATE STUDENTS ABOUT UNSTRUCTURED COMPUTER USE IN F2F GRADUATE CLASSES WITH INTERNET ACCESS AND ITS INFLUENCE ON STUDENT RECALL

Note: This questionnaire seeks information about your computer beliefs and use of computers in graduate ***face-to-face*** *(F2F) classes and your demographic background.*

Completing this questionnaire indicates your voluntary consent to participate in this study. You may choose not to participate at any time without penalty; however, your participation will be very helpful in providing essential data for this study. Completing this questionnaire should take 10-15 minutes.

Instructions: Circle the number on the right that best represents your responses to the statements below. If a statement does not apply to you, circle N/A, otherwise, select 1 when you strongly disagree, 2 when you disagree, 3 when you neither agree nor disagree, 4 when you agree, and 5 when you strongly agree.

		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Does not Apply
START HERE		**SD**	**D**	**N**	**A**	**SA**	**N/A**
1	**Using a computer with Internet access during face-to-face (F2F) graduate classes is <u>essential to my learning</u> even in classes that do <u>not</u> require computer use.**	1	2	3	4	5	N/A
2	**Using a computer with Internet access during F2F graduate classes helps me to be more productive <u>academically</u>.**	1	2	3	4	5	N/A
3	**Using a computer with Internet access during F2F graduate classes helps me improve my grades.**	1	2	3	4	5	N/A
4	**Using a computer with Internet access would be more productive in graduate F2F classes if <u>instructors</u> did a better job <u>integrating</u> computer use.**	1	2	3	4	5	N/A
5	**I participate more in F2F graduate class discussions when I use a computer with Internet access.**	1	2	3	4	5	N/A
6	**I volunteer more in F2F graduate class activities when I use a computer with Internet access.**	1	2	3	4	5	N/A
7	**I access the Internet regularly during F2F graduate classes to get more information about a topic being discussed by the instructor.**	1	2	3	4	5	N/A
8	**I listen very attentively to the instructor when I use a computer with Internet access during F2F graduate classes.**	1	2	3	4	5	N/A

Please continue to the next page ➔

Instructions: Please circle one answer for each statement below.

CONTINUE HERE		SD	D	N	A	SA	N/A
9	**I am <u>not</u> distracted from ongoing class activities when I use my computer with Internet access during F2F graduate classes.**	1	2	3	4	5	N/A
10	**I am <u>not</u> distracted by the online activities of <u>other students</u> who use computers during F2F graduate classes for activities unrelated to classes.**	1	2	3	4	5	N/A
11	**I am sometimes distracted when <u>I sit close</u> to or in the line-of-sight of graduate students in F2F classes who use their computers and Internet access for activities <u>unrelated</u> to classes.**	1	2	3	4	5	N/A
12	**I frequently <u>multi-task</u> when using a computer with Internet access during F2F graduate classes.** (Multi-tasking is doing two or more unrelated activities at the same time such as listening to a lecture while checking personal email.)	1	2	3	4	5	N/A
13	**I am able to multi-task <u>well</u> with a computer and Internet access <u>without missing</u> important information discussed in F2F graduate classes.**	1	2	3	4	5	N/A
14	**Using a computer with Internet access in F2F graduate classes does <u>not</u> affect my ability to <u>concentrate</u> on the topic being discussed in classes.**	1	2	3	4	5	N/A
15	**Using a computer with Internet access during F2F graduate classes makes it <u>easier</u> for me to <u>remember</u> important class information.**	1	2	3	4	5	N/A
16	**Sometimes, at the <u>end</u> of a F2F graduate class in which I used a computer with Internet access, I have difficulty <u>remembering</u> what was discussed in the class.**	1	2	3	4	5	N/A
17	**Sometimes, I inadvertently <u>tune out the instructor</u> while using a computer with Internet access in F2F graduate classes.** ("Tune out" occurs when you focus on your computer activities and temporarily ignore the instructor.)	1	2	3	4	5	N/A
18	**I would be unhappy if I was <u>not</u> allowed to use a computer during F2F graduate classes.**	1	2	3	4	5	N/A
19	**I would be unhappy if I was <u>not</u> allowed <u>Internet access</u> during F2F graduate classes.**	1	2	3	4	5	N/A
20	**I would be unhappy if my instructor <u>limited</u> how I could use a computer and Internet access in a F2F graduate class.**	1	2	3	4	5	N/A

Please continue to the next page ➔

PLEASE TELL US ABOUT YOUR COMPUTER USE.

> **Instructions:** Circle the number on the right that best represents your responses. If a statement does not apply to you, circle N/A, otherwise, select 1 for **Never**, 2 for **Rarely**, 3 for **Sometimes**, and 4 for **Frequently**.

	CONTINUE HERE	Never **N**	Rarely **R**	Sometimes **S**	Frequently **A**	Does Not Apply **N/A**
21	**While in F2F graduate classes, I use a computer to take class notes.**	1	2	3	4	N/A
22	**While in F2F graduate classes, I use a computer to conduct <u>online research</u> that is directly <u>relevant</u> to the class content.**	1	2	3	4	N/A
23	**While in F2F graduate classes, I use a computer to do assignments for <u>another class</u> or project.**	1	2	3	4	N/A
24	**While in F2F graduate classes, I use a computer to <u>communicate via IM</u> (Instant messaging) (unrelated to class).**	1	2	3	4	N/A
25	**While in F2F graduate classes, I use a computer to <u>browse social sites</u> such as Facebook or Twitter (unrelated to class).**	1	2	3	4	N/A
26	**While in F2F graduate classes, I use a computer to <u>search job postings</u>, job opportunities, or vacancies (unrelated to class).**	1	2	3	4	N/A
27	**While in F2F graduate classes, I use a computer to <u>view videos or movies</u> from sites such as YouTube (unrelated to class).**	1	2	3	4	N/A
28	**While in F2F graduate classes, I use a computer to conduct <u>general Internet and web browsing</u> (unrelated to class)**	1	2	3	4	N/A
29	**While in F2F graduate classes, I use a computer to manage <u>email</u> (unrelated to class).**	1	2	3	4	N/A
30	**While in F2F graduate classes, I use a computer to read the <u>news</u> or current information that interests me (unrelated to class).**	1	2	3	4	N/A
31	**While in F2F graduate classes, I use a computer to <u>play</u> games, read jokes, or entertain myself.**	1	2	3	4	N/A
32	**While in F2F graduate classes, I use a computer to plan my day, update my <u>calendar</u> etc., (unrelated to class).**	1	2	3	4	N/A
33	**While in F2F graduate classes and using a computer with Internet access, I spend <u>more than 50%</u> of my class time engaged in computer activities directly <u>related</u> to classes.**	1	2	3	4	N/A
34	**While in F2F graduate classes and using a computer with Internet access, I spend more than 50% of my class time engaged in computer activities <u>unrelated to classes</u>.**	1	2	3	4	N/A

Please continue to the next page ➔

35 **During F2F graduate classes in which I have access to a computer with Internet access, I spend some of my time using a computer to do the following:** (Express each activity as a percentage of your class duration so that the list of activities adds up to 100 percent. If you do not use a computer in classes, enter zero for each activity.)

Engage in computer activities <u>directly related</u> to classes	__________	% of class time
Engage in computer activities <u>unrelated</u> to classes	__________	% of class time
	TOTAL = 100% of class time	

36 **Please share any additional comments you have about the <u>use of computers in the classroom</u> in the box provided below:**

PLEASE TELL US ABOUT YOURSELF

Instructions: Check the box next to the response that best fits your current situation.

37 **What type of computer do you use <u>most often</u> in F2F graduate classes?** (Select one.)

- ☐ Laptop
- ☐ Desktop
- ☐ Other ____ (Please specify)

38 **What is your major or program of study?**

- ☐ ____ (Please specify)

39 **What degree level are you currently pursuing?** (Select one.)

- ☐ Master's degree
- ☐ Specialist degree
- ☐ Ed.D.
- ☐ Ph.D.
- ☐ Other ____ (Please specify)

Please continue to the next page →

CONTINUE HERE:
Check the box next to the response that best fits your current situation.

40 **What is your student status?** (Select one.)

- ☐ First year student
- ☐ Second year student
- ☐ Third year student
- ☐ Fourth year student
- ☐ Other ____ (Please specify)

41 **What is your gender?** (Select one.)

- ☐ Male
- ☐ Female

42 **What is your ethnic or racial group?** (Select one.)

- ☐ African American / Black
- ☐ Asian American / Asian
- ☐ Caucasian American / White
- ☐ Latin American / Hispanic
- ☐ Native American / Indian
- ☐ Other ____ (Please specify)

43 **What is your age range?** (Select one.)

- ☐ 21-24
- ☐ 25-28
- ☐ 29-32
- ☐ 33-36
- ☐ 37-40
- ☐ 41-44
- ☐ 45-48
- ☐ 49-52
- ☐ 53-55
- ☐ Other ____ (Please specify)

44 **Is English your first language?** (Select one.)

- ☐ Yes
- ☐ No

END

Thank you for completing this questionnaire. Your input is greatly appreciated!

APPENDIX B: BLUEPRINT FOR FINAL QUESTIONNAIRE

BLUEPRINT

RESEARCH QUESTIONS & SURVEY INSTRUMENT

#	RESEARCH QUESTIONS	SECTION ON INSTRUMENT	# OF QUESTIONS ON INSTRUMENT	QUESTION REFERENCES
1	What are the beliefs of graduate students about the effects of unstructured computer use in face-to-face, graduate classes equipped with Internet access on the following?	**Beliefs**	4 questions	See questions **1-3 & 36*** on survey instrument
2	Degree of classroom participation	**Participation**	5 questions	See questions **4-8** on survey instrument
3	Degree of student distraction (computer users and non-users)	**Distraction**	5 questions	See questions **9-13** on survey instrument
4	Degree of influence distractions impose on memory recall	**Recall Influence**	4 questions	See questions **14-17** on survey instrument
5	Types of limits students are willing to accept on their computer use	**Limits**	3 questions	See questions **18-20** on survey instrument
6	Types of computer activities in which students engage	**Computer Activities**	15 questions	See questions **21-34 & 35*** on survey instrument

Note: Question 35 allows respondents to enter estimates of time spent using a computer for class related and unrelated activities. Question 36 allows respondents to enter general information about computer use and beliefs. Both questions will be analyzed separately and are not included in the scaled items or total score used for this instrument.

The instrument also includes demographic data:

7	Demographic Information	**Demographics**	8 questions	See questions **37-44** on survey instrument
			44 TOTAL	

#	DESCRIPTIVE QUESTIONS FOR RESEARCH STUDY	ASSOCIATED QUESTIONS/STATEMENTS ON SURVEY INSTRUMENT
1	**What are the beliefs of graduate students about the effects of unstructured computer use in face-to-face graduate classes equipped with Internet access on the following?** Likert scale 1-5 (SD/D/N/A/SA)N/A	Using a computer with Internet access during face-to-face (F2F) graduate classes is essential to my learning even in classes that do not require computer use.
		Using a computer with Internet access during F2F graduate classes helps me to be more productive academically.
		Using a computer with Internet access during F2F graduate classes helps me improve my grades.
		Additional comments (will be placed at end of questionnaire before demographic information)
2	**Degree of classroom participation** Likert scale 1-5 (SD/D/N/A/SA)N/A	Using a computer with Internet access would be more productive in graduate F2F classes if instructors did a better job integrating computer use in classrooms.
		I participate more in F2F graduate class discussions when I use a computer with Internet access.
		I volunteer more in F2F graduate class activities when I use a computer with Internet access.
		I access the Internet regularly during F2F graduate classes to get more information about a topic being discussed by the instructor.
		I listen very attentively to the instructor when I use a computer with Internet access during F2F graduate classes.
3	**Degree of student distraction (computer users and non-users)** Likert scale 1-5 (SD/D/N/A/SA)N/A	I am not distracted from ongoing class activities when I use my computer with Internet access during F2F graduate classes.
		I am not distracted by the online activities of other students who use computers during F2F graduate classes for activities unrelated to classes.
		I am sometimes distracted when I sit close to or in the line-of-sight of graduate students in F2F classes who use their computers and Internet access for activities unrelated to classes.
		I frequently multi-task when using a computer with Internet access during F2F graduate classes. (Multi-tasking is doing two or more unrelated activities at the same time such as listening to a lecture while checking personal email.)
		I am able to multi-task well with a computer and Internet access without missing important information discussed in F2F graduate classes.

4	**Degree of influence distractions impose on memory recall** Likert scale 1-5 (SD/D/N/A/SA)N/A	Using a computer with Internet access in F2F graduate classes does not affect my ability to concentrate on the topic being discussed in classes.
		Using a computer with Internet access during F2F graduate classes makes it easier for me to remember important class information.
		Sometimes, at the end of a F2F graduate class in which I used a computer with Internet access, I have trouble remembering what was discussed in the class.
		Sometimes, I inadvertently tune out the instructor while using a computer with Internet access in F2F graduate classes. (Tune out occurs when you focus on your computer activities and temporarily ignore the instructor.)
5	**Types of limits students are willing to accept on their computer use** Likert scale 1-5 (SD/D/N/A/SA)N/A	I would be unhappy if I was not allowed to use a computer during F2F graduate classes.
		I would be unhappy if I was not allowed Internet access during F2F graduate classes.
		I would be unhappy if my instructor limited how I could use a computer and Internet access in a F2F graduate class.
6	**Types of computer activities pursued in classes** Likert scale 1-4 (Never/Rarely/Sometimes /Always for each option)	While in F2F graduate classes, I use a computer to take class notes
		While in F2F graduate classes, I use a computer to conduct online research that is directly relevant to the class content.
		While in F2F graduate classes, I use a computer to do assignments for another class or project.
		While in F2F graduate classes, I use a computer to communicate via IM (Instant messaging) (unrelated to class).
		While in F2F graduate classes, I use a computer to browse social sites such as Facebook or Twitter (unrelated to class).
		While in F2F graduate classes, I use a computer to search job postings, job opportunities, or vacancies (unrelated to class).
		While in F2F graduate classes, I use a computer to view videos or movies from sites such as YouTube (unrelated to class).
		While in F2F graduate classes, I use a computer to conduct general Internet and web browsing (unrelated to class).
		While in F2F graduate classes, I use a computer to manage email (unrelated to class).
		While in F2F graduate classes, I use a computer to read the news or current information that interests me (unrelated to class).
		While in F2F graduate classes, I use a computer to play games, read jokes, or entertain myself.
		While in F2F graduate classes
		While in F2F graduate classes, I use a computer to plan my day, update my calendar etc., (unrelated to class).
		While in F2F graduate classes and using a computer with Internet access, I spend more than 50% of my class time engaged in computer activities directly related to classes.
		While in F2F graduate classes and using a computer with Internet access, I spend more than 50% of my class time engaged in computer activities unrelated to classes.

7	**Demographic Information**	What type of computer do you use most often in graduate F2F classes? (Select one.) Laptop/ Desktop/ Other/ None
		What degree level are you currently pursuing? (Select one.) Master's/Specialist/Ed D/Ph D/Other
		What is your major or program of study? (Please specify)
		What is your student status? (Select one) 1st yr/2nd yr/3rd yr/4th yr/Other
		What is your gender? (Select one) Male/female
		What is your ethnic or racial group? (Select one) African American/ Black Asian American / Asian Caucasian American / White Latin American / Hispanic Native American / Indian Other _____________
		What is your age range? (Select one) 21-24/25-28/29-32/33-36/ 37-40/41-44/45-48/49-52/53-55/Other
		Is English your first language? (Select one) Yes/No

IDENTIFICATION OF VARIABLES (QUESTIONNAIRE)

#	DESCRIPTIVE RESEARCH QUESTIONS	INDEPENDENT VARIABLES	DEPENDENT VARIABLES
1	What are the beliefs of graduate students about the effects of unstructured computer use in face-to-face graduate classes equipped with Internet access on the following?	**Beliefs** (Beliefs of graduate students about unstructured computer use in classes)	Scores on the beliefs section of the instrument scale
2	Degree of classroom participation	**Participation** (Degree of classroom participation)	Scores on the participation section of the instrument scale
3	Degree of student distraction (computer users and non-users)	**Distractions** (Degree of student distraction)	Scores on the distraction section of the instrument scale
4	Degree of influence distractions impose on memory recall	**Recall Influence** (Degree of influence distractions impose on memory recall)	Scores on the recall influence section of the instrument scale
5	Types of limits students are willing to accept on their computer use	**Limits** Limits students willing to accept	Scores on the limits section of the instrument scale
6	Types of computer activities pursued in classes	**Computer Activities** (Computer activities pursued in classes)	Scores on the computer activities section of the instrument scale

The instrument also includes demographic data:

Demographic Information	**Demography** (Computer type, degree, student status, gender, ethnicity, age, first language)	Responses to demographic information

APPENDIX C: SURVEY DESCRIPTION AND CONSENT

SURVEY DESCRIPTION AND CONSENT FORM

BELIEFS OF GRADUATE STUDENTS ABOUT UNSTRUCTURED COMPUTER USE IN F2F GRADUATE CLASSES WITH INTERNET ACCESS AND ITS INFLUENCE ON STUDENT RECALL

Dear Participant:

My name is Gregory Johnson, and I am a doctoral candidate for a degree in Instructional Technology at the University of Central Florida. I am currently completing a dissertation entitled "**Beliefs of Graduate Students towards Unstructured Computer Use in Face-to-Face (F2F) Graduate Classes with Internet Access and Its Influence on Student Recall**."

Many colleges and universities provide Internet access in their classrooms, and students often use these data services to access class content, library and research sources, email, news, social sites, and web searches while in classes. Some researchers note that computer use with Internet access in classes influence learning. The research I am currently conducting investigates specific elements of the relationship between computer use and learning, but it needs your input to improve the quality of data I collect.

I have included a short questionnaire in this packet that asks questions about your computer use, beliefs, and background. Alternatively, you may access this questionnaire at http://www.surveygizmo.com/s/171071/researchstudy. The purpose of this questionnaire is to learn more about your beliefs towards computers and the ways in which you use them in graduate classes with Internet access. You do not need to own a computer to participate. The responses you provide will be used as part of my research study, so it is very important you answer honestly and completely if you choose to participate.

The results of this questionnaire will be published in summary form at a later time. Your name or other personally identifiable information will not be included in the results. Moreover, individual information you provide will be kept in the strictest confidence, and only the researcher will have access to the original records. After three years, the original records will be destroyed. Therefore, there is little or no risk to you to participate.

My research would benefit greatly from your participation. However, you are under no obligation to participate in this study, and you may refuse participation at any time. Additionally, you have the option of completing an alternative assignment if you choose not to participate in this study. There are no direct benefits for completing this questionnaire, however, it does require approximately 10-15 minutes of your time to complete the questions and statements.

Thank you very much for your consideration. The data you provide is critical to the success of this study and will provide me with important information about computer use in the classroom. You may contact me at gregory@mail.ucf.edu, or my dissertation chair at ggunter@mail.ucf.edu, or my co-chair at ssivo@mail.ucf.edu if you have questions regarding this study.

For questions about your rights as a research participant, you may contact the UCF IRB office at University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246. The telephone number is (407) 823-2901.

CONSENT FORM – SURVEY QUESTIONNAIRE

BELIEFS OF GRADUATE STUDENTS ABOUT UNSTRUCTURED COMPUTER USE IN F2F GRADUATE CLASSES WITH INTERNET ACCESS AND ITS INFLUENCE ON STUDENT RECALL

Thank you for your kind consideration and for agreeing to complete this questionnaire. The information you provide will be very helpful to my research study.

By completing this questionnaire, I certify I have read and understood this consent form. I understand I will be participating as a subject in the research described. I have been given an opportunity to ask questions about this study and its related procedures and risks, as well as any of the other information contained in this consent form and survey description. I agree that known risks have been described to my satisfaction, and I understand what has been explained in this consent form and survey description about my participation in this study. I do not need any further information to make a decision whether or not to volunteer as a participant in this study.

By completing this survey, I give my voluntary, informed consent to participate in the research as it has been explained to me. Furthermore, I acknowledge I am over 18 years of age and am able to give consent to participate in this study. Finally, I have read the description of the survey described above and received a copy for my records.

Completing this survey constitutes my informed consent.

APPENDIX D: EXPERIMENT DESCRIPTION AND CONSENT

EXPERIMENT DESCRIPTION AND CONSENT

BELIEFS OF GRADUATE STUDENTS ABOUT UNSTRUCTURED COMPUTER USE IN F2F GRADUATE CLASSES WITH INTERNET ACCESS AND ITS INFLUENCE ON STUDENT RECALL

Dear Participant:

My name is Gregory Johnson, and I am a doctoral candidate for a degree in Instructional Technology at the University of Central Florida. I am currently completing a dissertation tentatively entitled "**Beliefs of Graduate Students about Unstructured Computer Use in Face-to-Face (F2F) Classes with Internet Access and Its Influence on Student Recall**."

Many colleges and universities provide Internet access in their classrooms, and students often use these data services to access class content, library and research sources, email, news, social sites, and web searches while in classes. Some researchers note that computer use with Internet access in classes influence learning. The research I am currently conducting investigates specific elements of the relationship between computer use and learning, but it needs your input to improve the quality of data I collect.

I have included a short quiz in this packet that asks questions about the lecture you just heard. The purpose of this quiz is to assess your recollection of important concepts discussed during the lecture. You do not need to own a computer to participate. The responses you provide will not affect your grade for this class, but will be used as part of my research study, so it is very important you answer accurately and completely if you choose to participate.

The results of this quiz will be published in summary form at a later time. Your name or other personally identifiable information will not be included in the results. Moreover, individual information you provide will be kept in the strictest confidence, and only the researcher will have access to the original records. After three years, the original records will be destroyed. Therefore, there is little or no risk to you to participate.

My research would benefit greatly from your participation. However, you are under no obligation to participate in this study, and you may refuse participation at any time. Additionally, you have the option of completing an alternative assignment if you choose not to participate in this study. There are no direct benefits for completing this questionnaire, however, it does require approximately 10-15 minutes of your time to complete the questions and statements.

Thank you very much for your consideration. The data you provide is critical to the success of this study and will provide me with important information about computer use in the classroom. You may contact me at gregory@mail.ucf.edu, or my dissertation chair at ggunter@mail.ucf.edu, or my co-chair at ssivo@mail.ucf.edu if you have questions regarding this study.

For questions about your rights as a research participant, you may contact the UCF IRB office at University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246. The telephone number is (407) 823-2901.

CONSENT FORM - EXPERIMENT

BELIEFS OF GRADUATE STUDENTS ABOUT UNSTRUCTURED COMPUTER USE IN F2F GRADUATE CLASSES WITH INTERNET ACCESS AND ITS INFLUENCE ON STUDENT RECALL

Thank you for your kind consideration and for agreeing to complete this questionnaire. The information you provide will be very helpful to my research study.

By completing this questionnaire, I certify that I have read and understood this consent form. I understand that I will be participating as a subject in the research described. I have been given an opportunity to ask questions about this study and its related procedures and risks, as well as any of the other information contained in this consent form and survey description. I agree that known risks have been described to my satisfaction, and I understand what has been explained in this consent form and survey description about my participation in this study. I do not need further information to make a decision whether or not to volunteer as a participant in this study.

By completing this survey, I give my voluntary, informed consent to participate in the research as it has been explained to me. Furthermore, I acknowledge I am over 18 years of age and am able to give consent to participate in this study. Finally, I have read the description of the survey described above and received a copy for my records.

Completing this survey constitutes my informed consent.

APPENDIX E: IRB APPROVED DOCUMENTS

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

Notice of Exempt Review Status

From: **UCF Institutional Review Board**
FWA00000351, Exp. 10/8/11, IRB00001138

To: **Gregory K. Johnson**

Date: **August 07, 2009**

IRB Number: **SBE-09-06353**

Study Title: **Beliefs of Graduate Students About Unstructured Computer Use in F2F Classes with Internet Access and its Influence on Student Recall**

Dear Researcher:

Your research protocol was reviewed by the IRB Vice-chair on 8/7/2009. Per federal regulations, 45 CFR 46.101, your study has been determined to be **minimal risk for human subjects and exempt** from 45 CFR 46 federal regulations and further IRB review or renewal unless you later wish to add the use of identifiers or change the protocol procedures in a way that might increase risk to participants. Before making any changes to your study, call the IRB office to discuss the changes. **A change which incorporates the use of identifiers may mean the study is no longer exempt, thus requiring the submission of a new application to change the classification to expedited if the risk is still minimal.** Please submit the Termination/Final Report form when the study has been completed. All forms may be completed and submitted online at https://iris.research.ucf.edu.

The category for which exempt status has been determined for this protocol is as follows:

2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures, or the observation of public behavior, so long as confidentiality is maintained.

(i) Information obtained is recorded in such a manner that the subject cannot be identified, directly or through identifiers linked to the subject, **and/or**

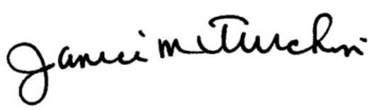
(ii) Subject's responses, if known outside the research would not reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability or reputation.

The IRB has approved a **waiver of documentation of consent** for all subjects. Participants do not have to sign a consent form, but the IRB requires that you give participants a copy of the IRB-approved consent form, letter, information sheet. For online surveys, please advise participants to print out the consent document for their files.

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

On behalf of Joseph Bielitzki, M.S., DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 08/07/2009 03:12:01 PM EDT



IRB Coordinator

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

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Gregory K. Johnson**

Date: **September 03, 2009**

Dear Researcher:

On 08/07/2009, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review: Addendum/ Modification request
Project Title: Beliefs of Graduate Students About Unstructured Computer Use in F2F Classes with Internet Access and its Influence on Student Recall

Investigator: Gregory K Johnson
IRB Number: SBE-09-06353
Funding Agency:
Grant Title:
Research ID: N/A
Grant ID:
IND or IDE:

You may proceed with the requested modifications to this study. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 09/03/2009 11:15:47 AM EDT

Joanne Muratori

IRB Coordinator

APPENDIX F: RESPONSES TO SURVEY ITEM 36

Additional comments by graduate students about computer use in the classroom

1	I think this is a great topic for investigation. Computers with internet access are just too tempting for all of us, however, it is up to us to get the most out of the class, we are the owners of our own education!
2	I use the computer to take notes even though this often distracts from what is being said. I may write the words down, but lack and understanding of their meaning or context.
3	My life is so busy that it is almost impossible for me NOT to check my email. Otherwise, I end class with, literally, 20-30 emails from professors, students, and research assistants that have a domino effect onto my next classes for the day or homework for the evening. Just being able to browse what is there helps me to prioritize the rest of my day, because otherwise, I get overwhelmed and cannot plan accordingly. I do not think it greatly affects my performance in the classroom to just quickly glance at my email every 20 minutes, but if it is an email that is of high importance, that thought of "what's to come" does greatly influence my concentration.
4	I think using an open ended questionnaire will skew your results. Should have been multiple choice , as this lecture had a lot of information with new terms. Additionally, the content of the lecture is not that stimulating.
5	It is hard to discipline myself to listen fully to the instructor and not check email or work on other projects.
6	Frequently use laptop for notes, locating course content when professor uses web ct, look up a definition that's not clear, etc.
7	The best thing about using a computer in-class for my graduate life is that I can type my notes in class and do not need to go home and transcribe my hand written notes (I do not know if this removal of an extra step has cut down on my retention, but I know I would not have time to do the extra step). The thing is being in graduate classes one does not have the same amount of extra time. So, if I had extra time I would probably not re-type/transcribe notes, but use to re-read the notes taken. I also know we need that information to be stored in an electronic file that can be accessed quickly in the future (my hand-written notes do not have an information find button :). GOOD LUCK ON YOUR DISSERTATION!! Computers are essential these days...cannot wait to see the access of technology the next generation of graduate students will get...hope it betters their retention of valuable information (though that may not matter -- at least they will be able to access more when they need it)!!
8	I don't think that it is necessary to use a computer in a number of different graduate courses aside from statistical classes in which a type of software (SPSS) needs to be used.
9	Great for note taking with endless sheets of paper.

10	although access to the internet is a distraction. . . when it is needed (as determined by the student) then it's nice to have
11	It depends on the class. If the class is engaging, the computer supports me to take notes effectively. When the class is not engaging, I am more likely to use the computer for unrelated activities.
12	I have a learning disability so using the computer helps to facilitate and guide my learning. The recall of language is very difficult for me to manage, so I browse for multiple resources to support the language that the graduate work brings.
13	I think at this level is it up to the students to determine what is appropriate use of the computer. Honestly teachers should incorporate more hands-on learning with the computer. This would make lecture based classes not so boring. Also professors need to understand we have 1 million things to to, therefore time in class for project in very important. I know some student miss use their computers, but really it's our learning and our responsibility. I think this is a great survey and research study. Honestly at times ia m more distracted when looking at the white borad then when typing note and working on the computer :)
14	If unrelated to the discussion at the time, while listening, I use computer to complete assignments for the class I am in; for looking at what is due, coming due soon, etc.
15	I feel that computers are helpful for instructural delivery if the environment or tool being used is controlled and access to other distractions are limited (e.g., email and online games)
16	Computer use in class can be useful to learning. However, it is really annoying and distracting to sit behind grad students using computers to play games, go on facebook, etc.
17	In today's modern, technologically advanced society, I feel as though I learn more when I have an ”outlet” such as my computer. If I didn't have a computer, I would be writing down my ”to-do” list and my mind would be distracted by waiting for the opportunity to check my email; whereas, when I am able to instantly check my mail, write a note, check my Facebook, etc. the task is done and over with.
18	When I actually use the computer, it is usually to look up terms I dont know so if I am asked to respond I dont sound stupid. I really try not to do other things while the teacher is teaching. I really like having the internet in class.
19	Computers are helpful when taking notes, but allowing internet access can be very distracting for students. Many of my professors do not allow computer access during their lectures for fear of distractions and disrespect.

20	I have never found that bringing laptops to class was helpful. All the student is supposed to be doing is typing their notes and that can easily be done by hand. When the professor asks people who are using laptops to stay on topic and not surf the web, the students NEVER obey them. I always see people on Facebook or checking their e-mail. It's more of a distraction than a benefit. My answer to #35 wouldn't let me put 2 zeros in the boxes so I put 50 so I could finish the survey. I don't use computers in the classroom.
21	Unless the instructor has something planned for the students to use a computer with internet access with then I don't feel that powered on computers are necessary in the immediate educational setting. There are too many web based distractions.
22	computers can be great, but in order for them to become part of the classroom the teacher must have control over the students terminal. Using remote desktop software a teacher can display what the student is doing to the entire class, which allows everyone to learn. It is also good to be able to turn of an internet browser when it is time to pay attension.
23	Other students using their computers is distracting whether class related or not because I am distracted by the key stroke noise.
24	I think that they can be a major distraction for many people, and it is something else teachers will have to monitor. If someone is looking at something unrelated to class on the computer/internet, then I think that the student should have not even come to class (not get credit for being there either). Computers can enhance learning greatly, but only when used properly and at appropriate times.
25	It is very useful for the professor to have any powerpoints and other media, access to resources related to the class, etc. online, whether in Webcourses or on their website.
26	I do not use a computer during face to face classes.
27	I specifically do not bring my computer to class because I know I will not pay attention.
28	i think that the use of computers WITH INTERNET ACCESS in a F2F classroom will only deter students from doing coursework and concentrating on the lecture given.
29	Computer use in my classes is not allowed. Most of my research is done outside of class. I think if professors were to use it in their curriculum and allowed time for it, it would be helpful but not during lecture time. In my BA program we had a few people playing games, paying bills etc. Found this an extreme distraction. This page could not be processed when I entered 0 in the unrelated box. Please note that both should be 0%

30	Computers in F2F classroom are only beneficial if they are tools for the lecture. It is a valid instrument to take notes. Also, it can help to browse for information or use programs directly related to the lecture. In other instances I think is fair if an instrucutor restricts the use of computers. Activities that are not related to class must have their own time appart.
31	My participation and desire to surf the internet and complete other tasks directly correlates to my interest in the class topic and my respect for the teacher. If the teacher enlists my peers to teach most classes, then I am less likely to be engaged. I wish that the norm would be for professors to enlighten the students and impart their knowledge to students, not just fill the space of the class time with fluff. I also feel like many classes are not taught in the right forum or presented in the right way. It seems that little thought goes into how the instructors teach the class and what strategies would best support the students' learning and transfer. Thus, in response to the purpose of this survey, my participation has little to do with the fact that I have a computer with the internet. If I like the class and I feel that it benefits me, then I participate earnestly and am engaged. If the professor doesn't care or I don't care about the information, then I find a way to disengage from the class. If I didn't have the internet, I would find another way to disengage. Before computer were readily available in the classroom, I would doodle (or draw) on notebook paper. I would make a list of things that I needed to do, and mark them in my calendar. The computer just offers more options of things to do when disengaging.
32	I think they should be discouraged based upon what I see students doing on their personal computers during class time. Most are distracting themselves and compromising the class. I had classes where computers were utilized and monitored, which proffered a better learning environment.
33	I have a hard time taking hand written notes and still paying attention to the lecture. I use my laptop to take notes because I type faster than I can hand write. It helps me focus because I can keep up when I type.
34	I personally rarely use the a laptop in class, I but the rare times I do, I would be mainly using it for note taking.
35	I have really poor handwriting and this is compounded by trying to write quickly to catch all the information being relayed when taking handwritten notes. Therefore having my computer available to take notes in microsoft word really helps me take better and more organized notes. plus if I get behind on notes I can use microsoft word to take voice recordings which is nice for especially complex topics it would be hard to take handwritten notes on. Also, if i'm the only person who has a laptop in class(even if its allowed) i usually don't use it because I feel awkward and feel that the professor and other people often think i'm not paying attention to class.

36	I have not used a computer during a graduate class at all. Although I did in undergraduate classes and I definitely did not pay attention at times. I think computer use is fine if the class is doing an assignment in a computer lab. Question 35 did not allow me to answer 0% and I have never used a computer during graduate classes.
37	My previous grad school experience was before the advent of computers in the classroom. I am presently attending my 1st mixed mode graduate class, and during the f2f's I find the whole concept of a computer at my fingertips to be fascinating, distracting, engaging - I suspect that, with time, the novelty will wear off, and my responses THEN might be less oriented toward depicting computer as an ”attractive nuisance”
38	In graduate school, it's necessary to multitask. I'm glad we have access to the internet because we need to find lots of information fast, and we also need to schedule ourselves frequently. Therefore, I would be unhappy if they took this opportunity away.
39	I do not have a problem with the professor telling me that I cannot use the computer in the classroom. If I am allowed to use the computer I will multi-task. To me it's like being a mother. If at all possible for you to do many things at the same time, you should. Yes, your attention is not going to be 100% on any of those things you are doing, but somethings do not need 100% of your attention. In class sometimes 100% of your attention is not needed, as long as the important material is understood (and being is school for all my life I know how to recognize the important material) then there is no problem.
40	Whenever I have brought my laptop to class (not in graduate school, but undergrad), I would get distracted and go on Facebook, personal email, etc when I was bored with class material. To use a computer in class can really hinder my learning experience because I don't have that kind of discipline.
41	I never use a computer in class because I find it distracting. I've been in classes with computers and from my experience, the students where spending most of their time on sites not related to the class.
42	I don't have access to computers in my F2F classes and I don't bring my laptop to my classes.
43	I do not own a laptop so I never had access to a computer during class. I think that I would probably be distracted if I could use a laptop becasue I think I would be tempted to use the internet for unrelated activities, but I've never had that experience before to know for such how I would react. I didn't know how to answer the above question about percentages. I don't use a computer in class at all so they whould both be 0% but it wouldn't let me do that.
44	I like the use of internet searches to research what my professor is lecturing about. I wish the professors would sometimes direct us to website with visuals or additional info while they are lecturing.

45	I would call myself a person who is not interested in computers. I only use them as required, not by choice. I am, however, fustrated by the era of students that disrespect instructors by using computers frequently to their own personal interests that are completely unrelated to the course.
46	I find it distracting when other students use laptops in F2F classes. Some F2f classes are structured where a laptop is useful, but many are not. Mostly, I see students playing solitaire or cruising facebook. It just provides a distraction for them under the guise of a school related tool.
47	I rarely remember someone using internet in a class to do something other than browse facebook/IM. I do think computers are beneficial as far as notetaking, but to be honest, I'd rather browse the internet than take notes on Word. This is why I stopped bringing my laptop to class. Old fashioned notebook paper works just fine!
48	I don't use a computer in the classroom at all and I usually see the people who do have computers multitasking or checking unrelated things.
49	I don't bring a laptop or notebook to class.
50	If it's a class that I'm not completely intrested in, I find myself more easily distracted when my computer is in front me. I also find it hard to concentrate when people next to me are instant messaging and checking their facebook.
51	I think taking notes is fine but that generally speaking the teacher should control WiFi acces and keep it off
52	I believe that the bottom line is when the instructor engages the class in interesting activities and discussions, students are less likely to browse the Internet, attend to personal email, communicate via IM, etc. Even without the use of a computer, students can tune out an instructor by doodling, making "to do" lists or by simply thinking about unrelated things.
53	I would be distracted by the use of computers in the classroom unless the professor specifically used them as part of the curriculum.
54	Computers are distracting. I am a visual learner and prefer what was conducted today, the old - fashioned way.
55	i feel distracted when I use computer in class.
56	Using computers during class, helps the student explore what was learned in the engaged moment and demonstrate learning took place.
57	I wish that there were questions about being distracted in class when computers were/are not present in class! I was a bit distracted after a certain amount of time passed (w/ my thoughts, cellphone, clock, etc).
58	Thank you!!! Good luck with your project
59	Although access to computer was allowed actual class content was not visible making this experience much like not having a computer at all as that is how having a computer helps me---seeing and hearing the material

60	(I think your presence in the class alerted people in the class that they might be receiving an assement of material...since you came in class and gave us an assessment in the past. Just wondering how you account for this possible data bias at the end of your survey as I assume your measuring how much we retain from a lecture based on having access to computer/internet vs no access. Also, I think today's material was easier because we had already applied some of the knowledge in making our own questionnaires, while the info you asssessed us on in the past was very new and different to me...and I never had a chance to apply any of it prior to be assessed on the info. Just curious as to how you account for these differences...........Good luck with your dissertation!!!Please type your response here.)
61	It can be usufel if it's used with proper planning.
62	I use my computer for taking notes. it is much faster to type than to hand write things. I learn more when I have a computer because I don't miss as much information as I would if I were handwriting the notes.
63	I will update my calendar with due date materials that need to be taken care of for assignments and responsibilities.
64	The current graduate program I am in does not put much emphasis on using computers in class. In the courses for the first Master's I received (which I graduated from in May of this year), having and using our computers was required for every class. Therefore, I feel as though I can make a good comparison between both experiences. Having the laptop with internet access was definitely a distraction. I would find myself checking my email, doing work for other classes and for my job, checking social networking sites, etc. I believe that distraction did affect my performance in class discussions and my ability to actively listen during lectures. My classmates were distracting as well because they would be involved in similar activities. The professors struggled to keep the attention of the class. Comparatively, I feel more engaged and retain more information because I don't have the laptop with me in my current courses. In my opinion, the use of laptops is effective if it is a structured activity.
65	Computers are not used effectively in the graduate courses I have taken. Instructors are uncertain how to use them as an effective teaching tool, thereby decreasing my ability to use them as an effective learning tool.
66	I don;t see how theres time to listen to instructor and do internet searches. In order to use a computer in the class the instructor needs to allow time for that.
67	I do not usually use a computer in class at all. I only use a computer in class if I am very bored or behind on another project. I prefer to take notes by hand.
68	I am sorry to see so many students on unrelated sites during class. Shame, shame.

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