HIGH SCHOOL SENIORS' COMPUTER SELF-EFFICACY AND INTEREST IN

COMPUTER SCIENCE CAREERS

by

JANET SEELEY BLOUIN

(Under the Direction of Elaine Adams)

Abstract

There is a widespread concern that colleges are not graduating enough computer science majors. The job outlook through 2018 is extremely good for a wide variety of computer science careers. Throughout the past few years, the concerns have been that students do not see computer science as a good career choice because of the dot.com bust and because they believe many computer science jobs have been outsourced overseas. Several organizations have indicated that in order to interest more college students to major in computer science, students need more exposure to computer science earlier in their educational experience, in high school and middle school. The purpose of this study was to examine the effects of gender and participation in computer science courses on high school seniors' computer self-efficacy and interest in computer science careers.

A total of 217 high school seniors, 18 years old or older, participated in the survey study. A series of t-tests revealed no statistically significant difference in gender and computer self-efficacy. The t-tests indicated a statistically significant difference in participation and computer self-efficacy, gender and interest, and participation and interest.

The results of this survey study may be used to inform school personnel, as well as parents, of the effects of participation in Computer Science classes on a student's interest in pursuing Computer Science careers. Schools may be able to create an environment where students have opportunities to participate in more Computer Science classes which may in turn lead to more students becoming interested in Computer Science careers. The results of this survey study may also be used to inform school personnel about gender differences, if any, with regard to computer self-efficacy and participation in Computer Science classes. The results may be used to adjust policies and provide resources for better marketing of programs in Computer Science.

INDEX WORDS: Gender, Participation, Computer self-efficacy, Interest, Computer science, Career choice, High school seniors

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Table of Contents

vii

List of Tables

CHAPTER 1

Introduction

During the last half of this decade there has been an outcry regarding a lack of qualified people to fill the jobs in the areas of computer science, information technology and management information systems (Becerra-Fernandez, Elam & Clemmons, 2010; Denning & McGettrick, 2005; Gates, 2007; Raines, 2011b). The United States Department of Labor, Bureau of Labor Statistics, has predicted that computer-related occupations will be one of the two occupational areas to show the most growth by 2018 (Lacey & Wright, 2009; Raines, 2011b). In addition, in a recent search on the Internet for "hottest professions," the results indicated that Monster online believes Information Technology is currently one of the top ten hottest professions and one of the hardest jobs to fill (Rossheim, 2009). This same Internet search found that HotJobs.Yahoo indicated two of the ten hottest professions are Networking/System Administrator and Software Designer/Developer (Victory, 2009). Finally, according to Manpower's annual study regarding the ten hardest jobs to fill, Information Technology staff is listed as number nine (Manpower, Inc., 2009).

In July, 2008, Rick Rashid, a senior vice president for research at Microsoft Corporation, stated, "Computing is an essential tool for discovery and advancement in virtually every field of science. And as we move forward, computing holds the key to progress in almost every human endeavor " (p. 33). The shortage of qualified employees for computer science-related careers is a serious problem because computers are used in almost every sector of the workforce today (Anthes, 2006; Association for Computing Machinery, 2003; Association for Computing Machinery et al., 2006; Marsan, 2009, 2010; McGregor, 1990; Rashid, 2008; Victory, 2009). As

computing careers continue to evolve, new challenges and opportunities will also develop

(McGregor, 1990; Rashid, 2008; Victory, 2009). People working within the computer science

fields will have vast opportunities to help shape the future (Association for Computing

Machinery et al., 2006).

The lack of qualified personnel for computer science careers has been an issue for a long

time. Twenty years ago, McGregor (1990) wrote an article about technology which is still true

today. In her article she stated:

> The occupational skills of the work force are constantly changing, largely due to the rapid
>
> pace of technological development. Technology's impact is evident throughout the
>
> economy, in both manufacturing and service industries, as companies seek ways to
>
> provide new and improved goods and services. As a result, new jobs are being created
>
> while others are being phased out (p. 1).

In order to meet the continuing computer science demands for the future, colleges need to

produce more computer science graduates (Foster, 2005; Frauenheim, 2005; Klawe &

Schneiderman, 2005). However, current educational programs are not providing the necessary

supply of computer science employees. Problems with computer and technology education exist

at all levels, K-12 and post-secondary. These issues could contribute to the shortage of qualified

employees in the future (Overby, 2006). During the last ten years the number of college students

selecting computer science as a degree option has declined (Becerra-Fernandez et al., 2010;

Downey, McGaughey & Roach, 2009; Foster, 2005; Frauenheim, 2005; Huang, Greene & Day,

2008; Klawe & Schneiderman, 2005; Locher, 2007; Vardi, 2009; Vegso, 2008). Between 2000

and 2004, the number of incoming college freshman selecting computer science as a major fell

60% (Foster, 2005). The annual Taulbee Survey conducted by the Computing Research

Association reported that undergraduate computer science enrollments dropped 20% in 2007 and encouragingly only 10% during 2008 (Computing Research Association, May, 2009).

Two of the most frequently cited reasons for the decline in computer science enrollments are that the dot.com bust eliminated all the computer science jobs and that many computer science jobs are being outsourced overseas thereby reducing the number of computer science jobs available in the United States (Anthes, 2006; Denning & McGettrick, 2005; Dewar & Astrachan, 2009; Downey et al., 2009; Foster, 2005; Frauenheim, 2004; Huang et al., 2008; Kessler, 2004; Mahmoud, 2005; Paul, 2005; Starr, Bergman & Zaubi, 2009; Summerfield, 2005). Additional reasons include the belief that computer science jobs are less than glamorous, they are stodgy, or nerdy (Denning & McGettrick, 2005); that they require strong math skills (Denning & McGettrick, 2005; Foster, 2005); that there is a general lack of understanding as to what computer science careers actually entail (Gupta & Houtz, 2000; Kastrul, 2008; Rashid, 2008); and that few minorities, including women, show interest (Summerfield, 2005).

The issue regarding the lack of women interested in computer science careers is a frequent "talking point" (Cheryan, Plaut, Davies & Steele, 2009; Harris, Cushman, Kruck & Anderson, 2008; McInerney, DiDonato, Giagnocova & O'Donnell, 2006). Concerns about women in computer science have been in existence since the early 1990s (Varmi, 2009). Women make up 46% of the United States workforce; however, in 2008, only 11.8% of students receiving a bachelor's degree in computer science and engineering were women (National Science Foundation, 2010). Because of this lack of women computer science degree recipients, the computer science field is missing out on valuable input from the female perspective (Cheryan et al., 2009). "[T]he significant underrepresentation of key sectors of the US population further exacerbates the challenges we face in developing a world-class computing workforce, and

foreshadows a significant missed opportunity for technological innovation and economic growth in service to the Nation" (National Science Foundation, 2010, p. 2).

In general, women's interest in computer science has not grown as rapidly as men's interest in computer science (Varmi, 2009). An article in *The Atlanta Journal-Constitution* indicated that according to the Bureau of Labor Statistics, females account for only 24% of the current technology-related jobs (Raines, 2011a). While studies have been conducted regarding stereotypes of women being poor at math as a reason for not entering science and technology fields, there has been much less research conducted regarding what barriers prevent women from developing an interest in computer science careers in the first place (Cheryan et al., 2009). In a study conducted by Varmi (2009), the number one reason for students, both male and female, becoming interested in computers was their exposure to computers. Another result of the study was that gender affects how a student gets interested in computers (Varmi, 2009). It is necessary to make sure computer science classrooms indicate to women that they belong in them and to make certain women see their potential involvement in computer science careers (Cheryan et al., 2009). One method that can be used to increase interest among women is through related courses in high school and college. This in turn might encourage more students to pursue advanced degrees and jobs in the computer science industry (Mercier, Barron & O'Connor, 2006).

Fortunately, recent studies have indicated a slight increase in computer science enrollments at the college level (Markoff, 2009; Marsan, 2009; Reed, 2008; Stephenson, 2009; Swartz, 2009). One suggestion as to why enrollment is improving includes the possible belief that constantly changing technologies are a contributing factor. For instance, two of the newer areas in which students are interested are cyber security and gaming (Reed, 2008). Andrew A.

Chien, Director of Research at Intel, believes that the increase in enrollment could be seen as making headway towards "increased attention, increased interest and increased investment" (as cited in Markoff, 2009). It is possible that people are seeing computer science jobs as more glamorous than just sitting in a cubicle all day long, writing code. Instead, these jobs are being seen as a toolkit for many modern careers (Markoff, 2009). Peter Harsha, Director of Government Affairs for the Computing Research Association (a trade group for about 200 university computing departments) stated, "The perception that Information Technology jobs are hard to come by is over, and the field is now considered an interesting place to be" (Swartz, 2009). However, this does not mean that continued efforts to increase computer science enrollments should stop. Now is the time to take advantage of the "image crisis" and continue efforts to improve impressions regarding computer science (Vardi, 2009).

Colleges alone cannot cure the problem of the reduced number of college students selecting computer science as a major and the resulting lack of qualified computer science graduates. The process needs to start earlier—in high school and middle school (Anthes, 2006; Denning & McGettrick, 2005; Goode, 2008; Phillips, 2006; Stephenson, 2009; Vardi, 2009; Wilson & Harsha, 2009). Arora and Chazelle (2005) have suggested that the computing world does not do a good job at broadcasting what jobs and skills are needed. They say there is a lack of knowledge by the general population as to what computer science is (Arora & Chazelle, 2005). Their belief is that

> [f]or computer science to thrive, its story needs to be told to the outside world (especially high school students and their parents and teachers, as well as policymakers and the popular media) in a way that keeps the science and the ideas center stage (Arora & Chazell, 2005).

But is it enough to talk more about computer science courses in high school? Many believe that one of the main problems with computer science courses in high school is the vast inequity of what is taught within those courses (Association for Computing Machinery, 2003; Computer Science Teachers Association, 2005; Starr et al., 2009; Stephenson, 2009). One effort made by The Association for Computing Machinery (ACM) was the creation of the Computer Science Teachers Association (CSTA). This is seen as one of the first steps towards promoting computer science at the high school level. CSTA's main issues of concern include the lack of support for teachers (administrative, curricular, funding, professional development and leadership); the lack of a standardized curriculum; the lack of understanding of the discipline and its place within the curriculum; and the lack of opportunities for teachers to develop their skills and interests (Computer Science Teachers Association, 2005). Robb Cutler, Chairperson of the Computer Science Teachers Association, states, "Unless we act quickly and decisively to remedy the disconnect between our national technological goals and computer science education at the high school level, the United States will soon face an educational, competitive, and economic crisis" (Computer Science Teachers Association, 2005, p. 5).

One area of concern facing curriculum change efforts at the high school level exists due to the fact that high school students frequently experience a lack of space within their schedule for electives such as computer science due to the constraints of required curricular demands (Carter, 2006; Overby, 2006; Wilson & Harsha, 2009). Another area of concern is that high school students do not really understand what computer science careers exist and what tasks they involve (Anthes, 2006). Those students who think they know what computer science majors do frequently believe the main focus of computer science careers is programming (Carter, 2006). Therefore part of the overhaul needs to include changing the narrow external image that

computer science is only programmers (Arora & Chazell, 2005; Carter, 2006; Denning & McGettrick, 2005; Foster, 2005). "A fundamental understanding of computer science enables students to be not just educated users of technology, but the innovators capable of using computers to improve the quality of life for everyone" (Association for Computing Machinery, 2003).

Purpose

The purpose of this survey study was to examine the effects of gender and participation in computer science courses on high school seniors' (18 years old or older) computer self-efficacy and interest in computer science careers.

The area of computer science reaches far and wide. Some definitions for computer science found within respected organizations include software-related jobs (programmers, engineers), support specialists, network specialists and data analysts (Association for Computing Machinery, 2010; U.S. Department of Labor, Bureau of Labor Statistics, 2010). Some individual authors have included computer information systems, information technology, computer science, computer engineering and more when discussing computer science (Becerra-Fernandez et al., 2010; Mahatanakoon, 2006). For the purposes of this study, five undergraduate degree programs identified in *The Overview Report* published by The Joint Task Force for Computing Curricula 2005 will be used (Association for Computing Machinery et al., 2006). The Joint Task Force for Computing Curricula 2005 was a cooperative project of The Association for Computing Machinery (ACM), The Association for Information Systems (AIS), and The Computer Society (IEEE-CS). In this report, five computing degree areas were presented: (a) Computer Engineering (designing and constructing computers and computer-based systems), (b) Computer Science (designing and implementing software; devising new ways to use computers; developing

effective ways of solving computing problems), (c) Information Systems (integrating information technology solutions and business processes to manage the information needs of businesses and other enterprises), (d) Information Technology (meeting the computer technology needs of government, healthcare, schools, and other kinds of organizations), and (e) Software Engineering (developing and maintaining software systems that behave reliably and efficiently, are affordable to develop and maintain, and satisfy all the requirements that customers define for them). These five areas together will be referred to as "computer science" or "CS."

All people have areas where they believe they have expertise (Betz & Hackett, 2006). Bandura (as cited in Betz & Hackett, 2006) states that self-efficacy is an assessment of future possible actions. Self-efficacy must be considered along with some type of performance (Bandura, as cited in Betz & Hackett, 2006). As used in this study, self-efficacy refers to whether a student believes he or she is good at working with and using computers to solve problems and enhance production and will be referred to as "computer self-efficacy."

For the purpose of this study, "high school seniors" will refer to students 18 years old or older. "Interest" will refer to the level of interest a student self-reports on the survey instrument. The survey instrument presents a list of computer science-related job tasks that are included in the five CS careers stated in The Joint Task Force for Computing Curricula 2005. "Participation" will refer to whether or not a student self-reports that he or she has taken any CS courses while in high school and will be reported as either "yes" or "no." Finally, "gender" will refer to a student's self-reported gender, male or female, and will be used to examine the effects of gender on students' computer self-efficacy and interest in computer science careers.

Research Questions

This study will address the following research questions:

1. What is the computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

2. What is the computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

3. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on gender?

4. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on participation in high school computer science courses?

5. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on gender?

6. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on participation in high school computer science courses?

Theoretical Framework

This study uses the Social Cognitive Career Theory (SCCT) of Lent, Hackett and Brown (1999). SCCT suggests that a person's environment influences career decisions. Social Cognitive Career Theory represents a relatively new effort to understand the processes through which people form interests, make choices, and achieve varying levels of success in educational

and occupational pursuits (Lent, Brown & Hackett, 1994 as cited in Lent, Brown & Hackett, 2000). Lent et al. (1999) derived SCCT from a series of previously espoused social cognitive theories, primarily the social cognitive theory (SCT) developed by Bandura in 1986 (as cited in Betz & Hackett, 2006). The four basic elements of SCCT are (a) self-efficacy, (b) outcome expectations, (c) goals and (d) contextual supports and barriers (Lent & Brown, 2006). Self-efficacy, outcome expectations, interest and goals, as well as supports and barriers influence career decisions (Lent & Brown, 2006).

The first element of SCCT, self-efficacy, refers to one's belief as to whether one has the ability to demonstrate specific talents (Lent & Brown, 2006). A person's self-efficacy may be very different for different tasks—how a person feels about one's skills in a particular area is not necessarily how they feel about their skills in all areas (Lent & Brown, 2006). One of two main concepts used for measuring self-efficacy in SCCT is content or task-specific self-efficacy, which is a person's own beliefs about his ability to perform specific tasks (Lent & Brown, 2006). Self-efficacy is not an entity unto itself, but rather the result of some potential activity (Betz & Hackett, 2006). For self-efficacy to be measured, it must be calculated in relation to some specific task (Betz & Hackett, 2006). One of the first and most important steps in measuring an aspect of self-efficacy is determining the construct that will be used for the measurement (Betz & Hackett, 2006). In this study, the task-specific self-efficacy that will be examined is computer self-efficacy. The second concept used for measuring self-efficacy in SCCT is coping efficacy, or one's beliefs about one's aptitude for negotiating obstacles encountered (Lent & Brown, 2006). In this study, coping efficacy will be examined as it pertains to participation. Outcome expectations are beliefs about what the outcome of certain actions will be, or imagined costs (Lent & Brown, 2006). Outcome expectations involve the level of accomplishment one might be

10

able to attain if one selects a particular career path (Lent & Brown, 2006). Goals are what one

uses to determine whether a particular task is worth undertaking (Lent & Brown, 2006). SCCT

is concerned with two primary types of goals—choice-content goals and performance goals

(Lent & Brown, 2006). Choice-content goals are those goals that one would like to pursue and

performance goals are the level of performance one hopes to attain through a given action (Lent

& Brown, 2006). Selecting a college major is a choice goal while attaining good grades is a

performance goal (Lent & Brown, 2006). The last element of SCCT, contextual supports and

barriers, refers to the support and non-support one receives when completing a task (Lent &

Brown, 2006). SCCT looks at contextual supports and barriers as what people think will

supplement their goal pursuits (Lent & Brown, 2006). Some supports and barriers include

parental influences, availability of career role models and the presence of gender bias (Lent &

Brown, 2006). Gender bias is a major component of this study and is examined in connection

with computer self-efficacy and interest in CS careers.

Bandura (1999) stated that SCT is an interactive experience. He indicated that effects of

interactions from others are based on the personal factors and background of the person

interacting (Bandura, 1999). People are participants in their life decisions, not just bystanders

(Bandura, 1999). People do not always recognize opportunities when they are presented because

their past experiences have affected their line of thinking. If a person is able to make the most of

an opportunity when it arises, that person has a greater chance of shaping his or her own future

opportunities (Bandura, 1999). SCCT focuses on the methods through which academic and

career interests develop. Interests along with other variables support career-relevant choices, and

people reach different levels of performance and perseverance in their educational and career

pursuits (Lent & Brown, 1996). Social cognitive theory is a "triadic reciprocal causation"

11

(Bandura, 1999). In other words, three aspects of the theory all act in accordance with one another, bi-directionally (Bandura, 1999). Within the SCT model, cognitive events interact with behavioral patterns which interact with environmental events and each aspect can affect one or more of the other aspects (Bandura, 1999). "The nature, scope and strength of the impact that chance encounters will have on human lives are based on the reciprocal interplay of personal attributes and the characteristics of the social milieus into which one is inaugurated" (Bandura, 1999, p. 24). SCCT adds a career component to SCT (Lent & Brown, 2006).

One of the most relevant aspects of SCT is self-efficacy (Bandura, 1999). As Bandura (1999) indicated, self-efficacy expectations are the beliefs a person has in his or her ability to perform a specific task or behavior. Perceptions about one's self-efficacy are very important to SCT as they affect what actions a person might or might not take (Bandura, 1999). Similarly, the self-efficacy element of SCCT will be helpful in understanding possible effects of computer self-efficacy for high school seniors based on gender and participation in high school computer science courses. Just as self-efficacy is considered a major component of SCT, it is also a major component of SCCT. "…[S]elf-efficacy is conceived as a dynamic set of self-beliefs that are linked to particular performance domains and activities" (Lent, 2005, p. 104, as cited in Lent & Brown, 2006). The level of self-efficacy expectations, or the degree to which a person believes he or she can do something, will influence whether that person tries to do something or not. Being overconfident regarding personal abilities can lead to disappointment about those abilities and might lead to an unsuccessful performance of a task that was previously of interest. Similarly, having too little confidence in personal abilities can prevent a person from attempting a task because he or she did not think the task could be performed adequately (Bandura, 1999). In SCCT, self-efficacy is not an overall trait like self-esteem, but rather one that is acquired

through performance and activities (Lent & Brown, 2006). In career research, self-efficacy is also studied as process efficacy, or one's perceived ability to manage general tasks necessary for career preparation across a variety of occupational paths (Lent & Brown, 2006). In general, individual endeavors have the potential to apply the greatest influence on self-efficacy—success increases self-efficacy while failure lowers it (Lent & Brown, 2006).

Social cognitive theory involves the process of experiencing events and then gaining feedback to match or correct a mismatch between the idea and its fruition. To manage successfully, people need to develop a variety of skills under different conditions as opposed to finite skills (Bandura, 1999). Actions that bring positive results are usually kept while those that produce negative results are stored mentally and not used again. People can benefit from observing others' successes or failures as well as their own (Bandura, 1999). Perceived barriers have an impact on career decision making efforts for individuals (Albert & Luzzo, 1999). SCCT also recognizes the reciprocal effects between people, their behavior and their environment (Albert & Luzzo, 1999). Social Cognitive Career Theory expands on Bandura's theory by adding the career component. SCCT adds the elements of the development of career and academic interests, the career choice process, and performance outcomes (Chartrand, as cited in Albert & Luzzo, 1999). SCCT will allow me to examine high school seniors' self-efficacy through their computer self-efficacy; outcome expectations and goals through their interest in CS careers; and contextual supports and barriers through their gender and participation in high school CS courses.

Rationale for the Study

Understanding whether or not high school students are interested in CS careers and determining whether there are connections between gender, computer self-efficacy, prior

participation in CS classes, and interest in CS careers will provide insight for school personnel, as well as parents, about the effects of participation in CS classes on a student's interest in pursuing CS careers. The school environment itself may also be changed based on the findings to make it more appealing to students and to provide more opportunities for students to participate in more CS classes which may in turn lead to more students becoming interested in CS careers. In addition, if this study indicates differences in computer self-efficacy or participation based on gender, more targeted programs could be developed to help students build confidence in their computer skills overall. It is important to address these issues as early as possible so students can make appropriate choices regarding course selection in school (Mercier et al., 2006, p. 336).

In 2007, ACM created an Education Policy Committee. The committee produced two main goals—to educate policymakers and others regarding the importance of computer science and the value of teaching a CS curriculum and to make sure that rigorous CS classes count towards the core curriculum in high school programs (Wilson & Harsha, 2009). Science, technology, engineering and mathematics (STEM) programs have been brought to the forefront in recent years whenever education reform is discussed. Concerns from the CS arena include whether or not this will be just another case where state and local agencies will prevent the needed reform from happening and where CS reform will actually fit into the overall STEM education reform for all grades, K-12 (Wilson & Harsha, 2009).

The problems begin early in school and continue. Students have very little opportunity to take CS courses with current curriculum requirements (Wilson & Harsha, 2009). Because we are losing a large number of students around grade 10, it is necessary to shift the focus of CS courses from strictly programming to more problem-solving and puzzles. We need to include things that

are fun, like robot dogs, and reduce the amount of code writing that we currently require (Anthes, 2006). A great deal of the current curriculum is ancient and suggests that all CS classes are centered on programming languages, such as Java (Anthes, 2006). In order to reconnect with high school students, the CS curriculum needs to be revamped—a new design needs to be developed (Starr et al., 2009). The ACM also believes it is important to make the curriculum materials more appealing, including the titles of courses (Denning & McGettrick, 2005).

One necessity is to develop innovative and effective methods in order to change the perceptions that currently exist (Huang et al., 2008). It is important to begin taking steps now to encourage more students to enroll in CS courses (Phillips, 2006). There needs to be a group effort to publicize why CS is important for K-12 (Wilson & Harsha, 2009). Nurturing talents and interests in the area of CS at an early age is an important task (Zarrett & Malanchuk, 2005).

Most states do not have CS standards and the "core" focus does not include CS standards (Wilson & Harsha, 2009). This study attempted to identify factors that contribute to the current shortage of students majoring in CS or selecting CS careers. The factors that were studied included whether gender affected computer self-efficacy and interest, as well as how participation affected computer self-efficacy and interest. The results of this study may be used to inform school personnel, as well as parents, of the effects of participation in CS classes on a student's interest in pursuing CS careers. Schools may be able to create an environment where students have opportunities to participate in more CS classes which may in turn lead to more students becoming interested in CS careers. The results of this study may also be used to inform school personnel about gender differences, if any, with regard to computer self-efficacy and participation in CS classes. The results may be used to adjust policies and provide resources for better marketing of programs in CS.

CHAPTER 2

Review of the Literature

John White, chief executive of the Association for Computing Machinery, recently explained that CS is a major part of all areas of study, from communications to health care to national security to improving energy and more (Chandler, 2009; Foster, 2005). Bill Gates, chief software architect and chairman of Seattle-based Microsoft Corporation, gave a speech at Howard University in Washington, D.C., in 2005, where he explained that CS would become a seamless part of all aspects of business (Chew, 2005). He was concerned with the declining numbers of students selecting computer science (CS) as a major because he said the demand will be even greater in the future (Chew, 2005). Gates was also concerned that the right information must not be getting to students because CS jobs are great paying jobs and this would make one think there would be more interest (Chew, 2005).

This review of the literature begins with a brief discussion of legislation relating to Career and Technical Education. Next, computer science (CS) is addressed, including CS at the college level, CS at the high school level, and CS workforce needs. Before discussing career theories, a brief review regarding gender, a recurring topic of concern, is included.

Legislation

Career and Technical Education in the late 1960s and early 1970s was referred to as vocational education. Over time, vocational education has evolved into career and technical education (CTE). As changes continue to occur in the workforce, they occur in education as well. Modern CTE evolves at a rapid rate—distance learning, IT, CAD, genetic engineering, and high-speed computer chips and more provide constant opportunities for students to learn with

16

everything they do (Lozada, 1999). Fortunately, secondary and postsecondary institutions have accommodated needs from the workforce on a consistent basis. "Economic, educational, and societal issues have repeatedly exerted influence on the definition of vocational education, as well as on how, when, where and to whom it will be provided" (Walter, 1993, p. 1). Summarized below are some of the important pieces of legislation that have assisted with the ongoing development of career and technical education.

Early in the century, President Wilson signed the Vocational Education Act of 1917, also known as the Smith-Hughes Act. The Smith-Hughes Act was designed to make vocational education a cooperative venture between the states and the federal government and also to establish the federal government's role in shaping vocational education programs provided by the states (Walter, 1993).

In October 1961, President Kennedy created a Panel of Consultants on Vocational Education. Their recommendations were released in the spring of 1963, in the report "Education for a Changing World of Work" (Walter, 1993). When President Johnson then signed the Vocational Education Act of 1963, in December, it incorporated many of the recommendations from the report. The report had suggested replacing subject-area funding with distribution of funds for five areas: (a) high school youth preparing for job entry, (b) youth with special needs precluding their success in traditional vocational education programs, (c) youth and adults preparing for job entry at the postsecondary level, (d) unemployed youth and adults, and (e) provision of adequate facilities to provide quality instruction. The Vocational Act of 1963 also called for creating an Advisory Council in 1966, to review implementation of the provisions (Walter, 1993).

The Vocational Amendments of 1968 eliminated all previous vocational education acts, except the Smith-Hughes Act, and re-affirmed the 1963 Act, which emphasized postsecondary education (Walter, 1993).

In 1976, Title II of the Vocational Education Act referenced elimination of sex discrimination and stereotyping in vocational programs (Walker, 1993). And in 1982, the Job Training Partnership Act authorized job training for economically disadvantaged individuals who face serious barriers to employment (U.S. Department of Labor, Women's Bureau, 1982).

The Carl D. Perkins Vocational Education Act of 1984 was the first of several legislative acts simply referred to as "Perkins." This act had three main objectives: (a) provide improved access and programs for special needs populations, (b) improve the quality of all vocational education programs, and (c) increase the economic impact of vocational education (Walter, 1993). The Department of Education created the National Assessment of Vocational Education to oversee five areas of the plan: (a) effects of provisions of the act, (b) accessibility of programs for special needs populations, (c) secondary programs, (d) postsecondary programs, and (e) the relationship between skills training and the economy (Walter, 1993).

The Carl D. Perkins Vocational–Technical Education Act Amendments of 1998 were signed into law on October 31, 1998. This legislation restructured and reformed programs previously authorized by the Carl D. Perkins Vocational and Applied Technology Education Act, setting out a new vision of vocational and technical education for the 21st century (U. S. Department of Education, Office of Vocational and Technical Education, 2006). In August, 2006, President Bush signed the Carl D. Perkins Vocational and Technical Education Act of 2006. This version of Perkins provided an increased focus on the academic achievement of career and technical education students, strengthened the connections between secondary and

postsecondary education, and improved state and local accountability (U. S. Department of Education, Office of Vocational and Technical Education, 2006). Also referred to as "Perkins III," this act included a number of provisions designed to support the preparation of individuals for nontraditional training and employment and "occupations or fields of work, including careers in computer science, technology, and other emerging high skill occupations, for which individuals from one gender comprise less than 25 percent of the individuals employed in each such occupation" (U. S. Department of Education, Office of Vocational and Technical Education, 2006).

Computer science has been in the career and technical education arena for many years. In the 1970s, the introduction of computers for word processing and spreadsheet applications began to take hold. Then in the 1980s, computers became more of a personal tool—to keep up with students' grades and information through database systems. By the mid 1980s, business education research had started looking at software skills (Skinner and White, 2004). By the mid-1990s, as the Internet became more accessible, business educators began looking at the Internet and electronic communications (Skinner and White, 2004). Today we use CS as both a means of presenting information to our students and a means of efficiently handling information. Just as the word processor completely changed how a secretary did her work, databases changed how educators were able to extract information and use that information (Dede, 1980). As technology has changed, the way students use and respond to technology must also change. Preparing students to handle the rapid changes and innovations is a challenge for business educators. Educators need to encourage students to learn through discovery (Skinner and White, 2004).

The changing technology and need for high-skilled workers during the last 20 years has provided the transformation platform for vocational education (Lee, 2009). Today, vocational

education is incorporated into Career Technical Education (CTE). Career and technical

education has been a significant element of the high school curriculum for years (U. S.

Department of Education, National Center for Education Statistics, 2011) and incorporates

several areas of study—family and consumer science, general labor market preparation, and

occupational education (U. S. Department of Education, National Center for Education Statistics,

2009). Within occupational education, computer technology is one of three areas of study, along

with business services and construction (U. S. Department of Education, National Center for

Education Statistics, 2009). Career Technical Education can be a pathway for any student, both

those going to college as well as those choosing to enter the workforce (Lee, 2009). Although

computer science was originally introduced at the high school level in the 1980s through the

programming language, Pascal, as the focus (Tsai, Chen, Cheng, Sun, Bitter & White, 2008),

today computer science can be integrated into course designs across the board (Becerra-

Fernandez et al., 2010; Markoff, 2009; Guzdial, 2009).

Computer Science

Defining computer science (CS) with one clear, specific definition is difficult. Included

in the next few paragraphs are various descriptions for computer science. The United States

Bureau of Labor Statistics includes an assortment of CS careers under the general heading

Computer & Mathematical Science Occupations—Computer and Information Scientists,

Research; Computer Programmers; Computer Software Engineers, Applications; Computer

Software Engineers, Systems Software; Computer Support Specialists; Computer Systems

Analysts; Database Administrators; Network and Computer Systems Administrators; Network

Systems and Data Communications Analysts; and Computer Specialists (U. S. Department of

Labor, Bureau of Labor Statistics, 2009).

The Association for Computing Machinery (2010) includes similar, but slightly different career titles for CS, including Computer Engineering, Computer Science, Information Systems, Information Technology, Software Engineering and Mixed Disciplinary Majors. An article by Becerra-Fernandez, Elam and Clemmons (2010) used the combined Computer and Information Science/Systems (CIS) description for the areas they studied in CS—computer science, information technology and management information systems. Other articles pertaining to CS discuss a variety of aspects relating to CS, including information technology, information systems, computer science, computer engineering and more (Mahatanankoon, 2006; Martz & Cata, 2008).

For this study, CS will include the five areas of CS identified in *The Overview Report* published by The Joint Task Force for Computing Curricula (Association for Computing Machinery et al., 2006). These five areas are Computer Engineering (designing and constructing computers and computer-based systems), Computer Science (designing and implementing software; devising new ways to use computers; developing effective ways of solving computing problems), Information Systems (integrating information technology solutions and business processes to manage the information needs of businesses and other enterprises), Information Technology (meeting the computer technology needs of government, healthcare, schools, and other kinds of organizations), and Software Engineering (developing and maintaining software systems that behave reliably and efficiently, are affordable to develop and maintain, and satisfy all the requirements that customers define for them).

Computer Science at the College Level

Over the last eight to ten years, a growing concern has been the decline in student enrollments at the college level for all areas of CS (Agosto, Gasson & Atwood, 2008; Becerra-

Fernandez et al., 2010; Benamati, Ozdemir & Smith, 2010; Carter, 2006). In a study conducted comparing college students who left CS as a major with those who remained in CS, it was determined that the leavers believed careers in CS would be focused only on programming. This belief was probably due to the first year computing courses which were predominantly coding, and students could not see actual everyday uses for coding (Biggers, Brauer & Yilmaz, 2008). Another finding was that students were not confident about their abilities as well as about what careers existed. These feelings were from a lack of pre-college CS courses and a lack of understanding which CS careers existed and what was involved (Biggers et al., 2008). "Experience has shown that when freshmen are properly introduced to Computer Science, they are attracted to it, even to the point of changing their majors" (Carter, 2006, p. 27).

A recurring reason as to why more students do not major in CS is that many jobs have been outsourced. Although some jobs have been outsourced, there are many jobs still available that require CS skills (Mahmoud, 2005). CS departments need to realize the need for change and begin redefining what CS actually involves (Mahmoud, 2005). As stated previously, one particular problem is that CS is usually equated with programming (Mahmoud, 2005). Although programming will be needed for some jobs, it is important for students to realize that CS does not only involve programming (Mahmoud, 2005). Another of the reasons there are not more students in the CS profession may be the negative perceptions about computer careers and a lack of true understanding about what CS entails (Gupta & Houtz, 2000). The profession needs to endorse itself as well as enlighten the public as to exactly what CS is (Mahmoud, 2005). Mahmoud (2005) believes that there are several ways to help more students understand what CS is. His recommendations include (p. 98):

- Offering multidisciplinary and cross-disciplinary programs—developing courses that allow students opportunities to combine computer science with other studies such as biology, chemistry, marketing and finance.

- Fixing computer science's image—making the public aware that there is more than just programming, web design and spam.

- Moving toward a Bachelor of Arts program—providing opportunities for students to receive degrees by taking fewer CS courses.

- Increasing women's enrollment in CS—working towards increasing the number of women enrolled.

- Training high school computing science teachers—providing summer workshops that can help high school teachers become more knowledgeable and including college CS departments to assist with redesigning curriculum.

- Making CS courses fun—possibly designing computer programming courses that would interest students in fine arts.

Mahmoud is not alone in his thoughts. There are many who believe changes need to be made. One proposed framework suggests the integration of four components: mentoring, social cohesion and peer support, role modeling and curriculum redesign (Agosto et al., 2008). An example of one school that has implemented a curriculum redesign is Georgia Institute of Technology. Professor Mark Guzdial, along with Barb Erickson, has developed an introductory computer course, *Introduction to Media Computation*, that uses the manipulation of data (photos and sounds) to teach the rudimentary elements of computer programming. Students enjoy the course and are asking for additional courses (Agosto et al., 2008). Another suggestion is that universities should collaborate with local schools and business organizations to demonstrate that

CS careers are tied directly to solving real world problems that affect real people around them (Agosto et al., 2008).

At Drexel University, a framework was suggested that universities should partner with local schools and business organizations to encourage more students to get involved in CS careers (Agosto et al., 2008). Also at the college level, Florida International University (FIU) implemented some changes to their Business Administration curriculum that could be used as well in high schools. Their first change was to adjust their course content to include CS knowledge for all disciplines (Becerra-Fernandez et al., 2010). The second was to increase awareness about how valuable courses in their department could be to enhance other degree areas (Becerra-Fernandez et al., 2010). The third change was to redesign their lower level CS courses so that the subject matter did not include the same topics used for off-shoring jobs (Becerra-Fernandez et al., 2010). There have been new areas of study developed at many universities over the last decade to accommodate the changing needs of industry (Foster, 2005).

Recently, college CS enrollments have seen a slight improvement (Harsha, 2010; Markoff, 2009; Marsan, 2009; Vegso, 2008). Some reasons include the thought that more teenagers are becoming interested in CS careers because of their own personal interest with social networking and other budding technologies (Marsan, 2009; Reed, 2008; Stephenson, 2009). The University of Illinois at Urbana-Champaign has indicated that more non-CS majors are also taking CS courses now that they have implemented a new Informatics minor (Marsan, 2009).

Peter Harsha, director of government affairs at the Computing Research Association, believes that more students are showing interest in CS because it can be used in almost all other careers (Markoff, 2009). Mr. Harsha also believes this increased interest in CS is significant

24

with regard to perceptions of CS careers in general (Markoff, 2009). The Computing Research Association (CRA) believes the upturn is due in part to the fact that CS has better future job prospects than some other areas of specialty, and with the economy as it is, CS prospects look even better (Marsan, 2009).

While there has been some success in the area of increasing enrollments, it is important to keep working and to keep designing new curriculum initiatives to secure increased CS enrollments (McGettrick, 2009). Chris Stephenson (2009), executive director of CSTA, wants to make sure that members do not lose their main focus of improving CS education throughout all of K-12. Many parents and students still believe that off-shoring is taking away all of the CS jobs and that the market is not a good one (Becerra-Fernandez et al., 2010; Benamati et al., 2010). Additionally, these same parents and students believe that CS jobs only involve coding (Benamati et al., 2010). As technology continues to change, so do the demands for what students will need to learn (Association for Computing Machinery, 2003).

Many colleges and universities that were suffering declining CS enrollments determined that it was necessary to connect with students at a much earlier age—throughout K-12 (Stephenson, 2009). These colleges and universities realized that waiting until students get to college before trying to entice them into CS is too late; it is necessary to interject CS into the K-12 curriculum at the same time that other academic disciplines do so (Stephenson, 2009). Changes need to be made in the high school curriculum, better marketing efforts need to be incorporated, and these strategies need to be targeted directly at high school students (Benamati et al., 2010; Paul, 2005).

Moshe Vardi (2009), Editor in Chief for *Communications of the ACM*, hopes that businesses and colleges will not let the "image crisis" relating to CS careers go to waste now that there appears to be a slight improvement.

Computer Science at the High School Level

It is imperative that interest in CS begins long before enrollment at the university level (Stephenson, 2009).

> The United States, a nation once proud of its leadership in education, is sitting quietly on
> the sidelines while other countries make improvements to ensure their high school
> graduates will be ready to meet the demands of tomorrow's high-tech society. (Computer
> Science Teachers Association, 2005, p. 13)

There are several areas to review regarding high school CS. These include addressing the factors that appear to deter students from enrolling, looking at curriculum changes that are currently being discussed, and checking what actions are being undertaken by business and industry to get the word out about what CS really includes.

Research has indicated that low enrollments in high school CS courses can be attributed to a variety of factors. These factors include the misunderstanding of what CS actually is by students, parents and educators; few role models for CS who are women or other minorities; the belief that the content is difficult or uninteresting; misunderstandings by counselors and teachers as to who would benefit from CS courses; a lack of support for students outside the classroom; a lack of qualified teachers at the high school level; and weak academic approaches in the classroom setting (Goode, 2008). Other concerns include the problem that CS courses frequently do not count towards college-prep diplomas, but rather as electives thus preventing many students from selecting them (Goode, 2008). Also, Chris Stephenson, Executive Director of the

Computer Science Teachers Association has reiterated the fact that part of the problem is that there is no room in student schedules for CS courses (Locher, 2007). As states continue to increase requirements for graduation in the core areas, there are fewer elective opportunities for students (Chandler, 2009). Chris Stephenson is concerned that CS may become a casualty in the No Child Left Behind platform because it is not considered one of the core subjects (Chandler, 2009).

Some of the misconceptions about what CS involves may stem from the fact that the AP Computer Science exam is strictly Java, a programming language—there are no other aspects of CS covered on the exam (Foster, 2005). The College Board has created the AP Computer Science Exam to be totally about Java—whereas the field of CS is much more broad and involved (Arora & Chazelle, 2005). High school students need to be exposed to other more interesting aspects of computer science (Foster, 2005). Rick Rashid, senior vice president for Microsoft Research, says, "You need to talk about the romance of the field. It's not all about people sitting in cubicles eating pizza and typing away endless hours on a keyboard" (Foster, 2005, p. 31).

Changes to curriculum need to be made to adjust students' perceptions about CS careers (Becerra-Fernandez et al., 2010). Current CS courses across the United States vary widely in content—from AP Computer Science to general CS literacy (Starr et al., 2007). CS courses need to be redesigned and should be implemented early on—in middle and high school—so that students may better understand the potential for careers (Goode, 2008). Kate Kaiser, Associate Professor of Management at Marquette University College of Business Administration, believes that although the number of CS majors has seen a small increase, it is vital to get the word out to high school students, parents and counselors that there are still jobs waiting to be filled in CS

(Locher, 2007). Geoff Smith, president of LP Enterprises, told Margaret Locher (2007) that it is important for colleges to work on marketing their programs to high school students, parents and counselors. He also said K-12 is the best place to shape the future (Locher, 2007). Samuel Bright, an analyst for Forrester Research, also believes it is important for professionals to go into the high schools and provide insight and guidance as to what CS careers exist (Locher, 2007).

Another problem associated with teaching high school CS classes is actually determining what the content should include. There are three areas into which CS classes may be taught— educational technology (using technology to assist in other classes), information technology (hardware and software, installing, maintaining, customizing), and computer science (incorporating a wide range of topics from foundations to robotics to future needs) (Computer Science Teachers Association, 2005, p. 18).

Unfortunately, high school CS courses are most frequently used for helping students succeed in other classes, rather than standing alone as their own discipline (Computer Science Teachers Association, 2005). "…[P]olicymakers, and hence funding agencies, treat computer science as a provider of services and infrastructure rather than as an exciting discipline worth studying on its own" (Arora & Chazelle, 2005, p. 33). More than 20 years ago, a task force headed by Peter Denning for ACM discussed the need for developing a separate CS curriculum (Denning, Comer, Gries, Mulder, Tucker, Turner & Young, 1989). One of the goals of this task force was to eliminate the idea that CS is strictly programming (Denning et al., 1989). "High School students are not provided with the opportunities to find out what the field of computing encompasses. How are they to choose as a major a subject they know nothing about" (Carter, 2006, p. 28)? "…[V]ery few school administrators and educational policy leaders understand

the profound need for computer science education at the high school level" (Computer Science Teachers Association, 2005, p. 17).

One idea that has received some support is that CS provides an overall basis for critical thinking and problem solving (Norris, 1992). A study conducted by Norris (1992) indicated that students completing a beginning programming class did indeed show improved problem solving abilities as well as general overall mental improvement. Furthermore, research relating to education and CS use has shown that there is a positive relationship between using the Internet and academic performance.

Computers are a part of every discipline (Anthes, 2006; Denning & McGettrick, 2005). As CS becomes more necessary in all areas of study, how do we integrate CS into all courses at the high school level? In a study conducted by Starr, Bergman and Zaubi (2007), the authors hypothesized that a new curriculum design approach is necessary for high schools in order to improve enrollment. They proposed a framework that they believe can be updated easily (Starr et al., 2007). Their framework focuses on the need for all students, high school and college, to understand CS concepts as CS continues to become all-encompassing (Starr et al., 2007).

Several professional organizations have also recognized the need to get the word out as to what CS actually involves. The Society for Information Management (SIM) is one organization that is making an effort to interest high school students because high school is the time when students are trying to make decisions regarding their futures (Benamati et al., 2010). SIM's target audience includes high school students, counselors and teachers (Benamati et al., 2010). Another agency, the National Science Foundation, is promoting CS to help address issues in telecommunications, transportation and defense systems (Foster, 2005).

In addition, ACM's Education Board began promoting CS education in a variety of ways, and enrollment was a key component (McGettrick, 2009). To combat the declining enrollment, ACM launched a three-part plan in an effort to improve the ongoing beliefs regarding CS (Denning & McGettrick, 2005). The first part was the creation of the Computer Science Teachers Association (CTSA). Their goal is that this organization will be able to work more directly with high schools to promote CS and to help high school students understand that CS is more than just Java programming (Denning & McGettrick, 2005). The second part of the plan was to increase visibility of ACM overall (Denning & McGettrick, 2005). Finally, the third part was that the Education Board will support methods to create better curriculum ideas that better promote what CS involves (Denning & McGettrick, 2005).

In 2006, Lori Carter conducted a study entitled, *Why Students with an Apparent Aptitude for Computer Science Don't Choose to Major in Computer Science*. Along with the standard hypotheses that (a) students don't major in CS due to the dot.com bust, (b) the image of CS is that all majors are programmers, and (c) the reasons differ based on gender, Carter (2006) hypothesized through her own experience that students do not select CS as a major because they really do not know anything about CS careers (Carter, 2006). Her experience has been that most high school students are not provided opportunities to take CS courses and that if college freshmen are properly introduced to CS, they are more attracted to it and more likely to select CS as a major (Carter, 2006). She is concerned that high school students are forced to make decisions regarding careers about which they know nothing (Carter, 2006).

The results of her study indicated that high school students lack experience with CS classes solely dedicated to CS studies (Carter, 2006). Her findings indicated that 80% of the students surveyed had no idea of what CS involved and only 2% actually had a good

30

understanding of what CS careers involved (Carter, 2006). Her study also indicated that the top three negative influences upon high school students' major selections were (a) their lack of interest to sit in front of a computer all day, (b) they already had focused on another major, and (c) they wanted a career that was more people-oriented (Carter, 2006). Her overall conclusion was that students do not choose CS as a major because they do not truly understand what CS careers entail or they have absolutely no idea what CS majors do (Carter, 2006).

Another study, conducted by Gupta and Houtz (2000), suggested that integrating CS into all courses and training teachers to use technology is not enough. They suggested a five-point "action agenda" that included the following:

1. Develop a high standard, uniform mandatory computer science high school curriculum—a well-thought out computer science curriculum should be developed nationally and implementation mandated.

2. Identify and implement software that has appeal for both genders—software should be intellectually challenging and appealing to both boys and girls.

3. Make computers exciting and challenging for students—teachers should focus on computer science uses in all subject areas.

4. Develop and implement a vigorous computer career-counseling program—active partnership between business and education is necessary to help students truly understand what computer science actually entails.

5. Explore race differences and interest in computer careers—more research needs to be conducted to determine factors related to racial and cultural factors affecting interest in computer science (Gupta & Houtz, 2000, p. 7).

Changes need to be made to encourage more students to take CS courses in high school, and hopefully, to select CS as a major leading to their future career (Anthes; 2006; Arora & Chazelle, 2005; Stephenson, 2009). Although high schools offer CS courses, students do not appear to be taking these courses. "Students once saw computer-science classes as their ticket to wealth. Now, as more technology jobs are outsourced to other countries, such classes are seen as a path to unemployment" (Foster, 2005, p. A31). "We encourage decision-makers at the federal, state and local levels to give serious thought to the potential of CTE programs as a leverage point for school improvement in both secondary and postsecondary systems" (DeWitt, 2009, p. 15).

Computer Science Workforce Needs

In order for our nation to remain competitive in the global market, our business community needs a substantial and constant supply of CS professionals (Gupta & Houtz, 2000). ". . . [I]f we are to remain competitive, we need a workforce that consists of the world's brightest minds" (Gates, 2007, p. 1). In an article online at education.yahoo.net (2010), the top five fastest growing careers that pay well included as the number one career, network systems and data communications analysts and the number two career as computer software engineers (Moton, 2010). Additionally, at search4careercolleges.com (2010), of the top ten hottest jobs listed, the number one career area was computers & information technology and the number six area was computer networking. There are favorable job opportunities and a demand for skilled professionals in all areas of CS (Zarrett & Malanchuk, 2005).

As CS jobs become more advanced, there will be a need for people with more advanced training and education (Zarrett & Malanchuk, 2005). This is not a new phenomenon. For over a decade the problem of determining what future careers will be needed has been difficult (McGregor, 1990). "Technology's impact is evident throughout the economy, in both

manufacturing and service industries, as companies seek ways to provide new and improved

goods and services. As a result, new jobs are being created while others are being phased out"

(McGregor, 1990, p. 22).

The Association for Career and Technical Education (ACTE) published a report in 2007

emphasizing the need for improving both secondary and postsecondary education in order for the

United States to remain a global power (DeWitt, 2007). ACTE believes that CTE is in the

perfect position to affect change (DeWitt, 2007). Two areas where ACTE wants to make

improvements are in the areas concerning the need to develop curriculum with more of a

connection to career selection and the need to improve student advising and educational supports

(DeWitt, 2007).

In the Georgia General Assembly 2010 session, a bill (SB 387) was signed into law on

May 24, 2010, by Governor Perdue, relating to career counseling. The bill stated:

Beginning in school year 2010-2011, the Georgia Student Finance Commission shall:

(1) Provide students in grades six through 12 with web based counseling advisement,

career awareness inventories, and information to assist them in evaluating their academic

skills and career interests; and

(2) Provide students in grades eight through 12 with a web based resource to develop a

graduation plan to detail the courses necessary for a student to graduate from high school

and to successfully transition to postsecondary education and the work force. (Georgia

General Assembly, Senate Bill 387, 2010)

It is not only time to work on recruiting more students into the CS arena, but it is important to

emphasize the future of CS with regard to all subject areas (McGettrick, 2009). The focus of

concerns regarding increasing CS enrollments has turned towards how to prepare graduates for a

workforce that can understand CS concepts in general (Starr et al., 2007). "Working closely with CSTA and K-12 is vital to move educational initiatives in the upward direction" (McGettrick, 2009, p. 5). CTSA encourages its members in the business arena to get involved with schools in order to produce the needed CS workers of the future (Overby, 2006). Chris Stephenson, executive director of CSTA, recommends connecting student interests to future needs, such as health care and environmental issues—both of which can be connected through CS courses at the high school level (Overby, 2006).

The need to increase enrollments in CS is immediate. As more and more baby boomers begin to retire, an increasing number of CS graduates will be needed to fill new technology-related jobs (Paul, 2005). Phil Zweig, vice president of IT for Northwestern Mutual, believes that part of the solution for generating more CS graduates is to reach out not just to college students, but also to high school students, and even to middle school students (Paul, 2005).

Is Gender a Factor?

One topic of interest frequently at the forefront of discussions pertaining to how to increase CS enrollment is the need to involve more women. Many believe that encouraging more women and minorities to study CS will help with the problem of the shortage of workers (Ash, Coder, DuPont & Rosenbloom, 2009). While there are about the same number of men and women working in upper-level positions throughout all high-level professional and technical occupations, there is not an equal proportion of women in CS fields (Ash et al., 2009). "Men are still 2.7 times more likely to hold high-level technology positions than women" (Raines, 2011a, p. G1).

While the concern for interesting more women is frequently seen as a need for CS studies, research has indicated that men and women differ in general with regard to gender roles

(Byrne & Lyons, 2001). Women have a tendency to look at CS with a more practical approach than men (Foster, 2005). While some may suggest that women opt out of specific high-level careers because they do not have the drive, it is possible they are being judged by the wrong criteria. The terms, "opting out," "off ramping," "mommy track," and "nonlinear" are used to judge women's career choices against criteria such as working part-time or taking time off from work and are seen as a deficiency in women. Rather, these women should have different criteria by which they are judged (Shapiro, Ingols & Blake-Beard, 2008). Men and women differ in their attitudes and actions to both physical and social risks. Males are more likely to see situations as challenging and therefore interesting, while females have a tendency to avoid situations that appear too risky (Arch, 1993).

Learning theorists have been discussing the reasons for gender differences in career choices from Super (1954) to Holland (1959) to Eccles (1994) to Betz and Hackett (2006, 1981) and to Lent, Brown and Hackett (2000). Sex segregation in careers can be detrimental to both men and women. Women might be missing out on careers in a fast-growing industry and men might be avoiding service careers which could hold rewarding returns for them as well (Evans & Diekman, 2009). If men and women avoid certain careers because they seem sex-inappropriate, they may be denying themselves opportunities to use their skills and knowledge to their best advantage (Evans & Diekman, 2009).

From a study conducted by Clarke and Teague (1996), it was determined that most women spend their time helping others solve problems with computers and working with people at all levels, inside and outside of the company setting. Most saw potential for future growth within their career choice. "The women found most satisfaction in their jobs from helping people and from seeing a finished product, be it a completed system or trained user" (Clarke &

Teague, 1996). Men have a tendency to be more interested in taking risks associated with high-prestige jobs, in working longer hours to accomplish their goals and in gaining status while women have the tendency of wanting to be more involved with day-to-day experiences of their children (Clarke & Teague, 1996).

Both gender differences and individual differences within each gender in educational and occupational choices can be associated with expectations for success and the value of the task at hand. In particular, in the areas of math and science, women are less likely to enter the field because they have less confidence and because they place less value on occupations in this area than in other occupational areas. Major influences in shaping individual differences in self-perceptions and task values occur at home, in school and among peers (Eccels, 1994).

When one group of women, employed in the CS field, were interviewed, they talked about features of their jobs they liked and disliked and they usually didn't mention the stereotypical images that students had indicated—the negative features mentioned by secondary school girls were not mentioned by the professional women (Clarke & Teague, 1996). In addition, the successes and failures discussed by the professional women were not the same as those experienced by the high school students (Clarke & Teague, 1996). Most of the women interviewed had not selected computing as their original career. However, they thought it was an excellent choice for lateral moves or as a change in career. They also thought that the combination of another discipline with computing had advantages (Clarke & Teague, 1996).

It has been shown that girls and boys have differing career-related interests (Clarke & Teague, 1996; Tang, Pan & Newmeyer, 2008). These differences stem from a variety of sources, some of which can be affected through intervention and some of which may be affected through everyday life experiences. One specific area that influences a student's career interest is that of

36

self-efficacy. All students, both male and female, need a feeling of self-efficacy and confidence to tackle nontraditional occupations (Tang et al., 2008). Another influence that may affect career selection stems from a person's beliefs about one's abilities (Downey et al., 2009). If a person believes he or she can do well in something, he or she is more likely to try that something (Downey et al., 2009). Students' interests are frequently based on their feelings of self-efficacy. Studies have indicated that men and women tend to lean towards careers that let them express their self-efficacy (Ji, Lapan & Tate, 2004). Tan, Pan and Newmeyer (2008) conducted a study that attributed a person's self-efficacy and interests to one of the areas of Holland's vocational choice theory. They determined that girls were more likely to choose careers that would allow them to help others and express themselves while boys were more interested in careers involving data and things (Tang et al., 2008). These outcomes align with Holland's occupational environments (Holland, 1959). Girls fall under the Artistic and Social types while boys fall under the Realistic, Investigative, Enterprising and Conventional types (Holland, 1959; Tang et al., 2008). Another result of this study was that learning experiences have a strong affect on the development of career self-efficacy—more so for girls than boys (Tang et al., 2008).

When looking at what elements will affect high school seniors' career-related interests, one must look at several contributing factors. An early factor could be how boys and girls see a computer's purpose. Studies have shown that boys are more likely to play games on the computer and girls are more likely to use the computer as a tool—for communication (Bleeker, 2005, Jackson, Zhao, Kolenic, Fitzgerald, Harold & Von Eye, 2008). Another factor is how students perceive people employed in the computer industry. Girls do not see computing as a viable career choice due to limited knowledge about computing careers available. Public perceptions regarding computing include stereotyping, emphasizing of programming skills and

apparent lack of relevance for computer studies and these perceptions deter girls from studying

computing (Clarke & Teague, 1996). When girls were asked about what they thought computing

careers were like, they replied that they thought the jobs would be "boring," "menial," "not

sufficiently challenging," and that they "wouldn't want to be stuck in an office with just a

computer." After further questioning, it was apparent that they actually had no idea what tasks

were involved in computing careers and what careers existed in general (Clarke & Teague,

1996). The perception of most of the girls was that computer users were usually young males,

who frequently hacked into computers while the image of women in the computing field was that

of word processing operators (Clarke & Teague, 1996).

Differences in career-related interests can also be connected to long-range goals. One

study asked men to predict what success in their mid-30s would be and they indicated status

goals were most important. Women in this study, on the other hand, indicated that care giving

goals were most important (Evans & Diekman, 2009). The gender differences associated with

these long-range goals correspond with gender differences in career interests. This indicates that

gender differences in career interest are at least partly due to distant goals (Evans & Diekman,

2009). In a separate part to this study, it was determined that "[g]ender differences in goals and

career interest can be fully accounted for by differences in gender beliefs" (Evans & Diekman,

2009, p. 245). In other words, men's and women's role-related goals are connected to their inner

beliefs regarding gender goals (Evans & Diekman, 2009). Gender differences are strong and

remain as an influence regarding career decisions (Zarrett & Malanchuk, 2005).

The selection of a nontraditional occupation as a career and having interests that are seen

as leading to nontraditional goals is one more issue of interest. One wonders how many girls are

avoiding careers in computing when the actual computing jobs are what they are trying to find

(Clarke & Teague, 1996). Some are concerned for males entering the computing field should they find that it does not fit the stereotype they perceived—would they in fact be disappointed (Clarke & Teague, 1996)? In the area of CS one problem is that students do not truly understand what careers exist and whether their interests align with those careers. Men see it as a formidable occupation and affluent career while women see it as one that requires less educational attainment and is less prestigious (Zarrett & Malanchuk, 2005).

Career Choice Theories

Influences

Bandura (1999) indicated that effects of interactions from others are based on the personal factors and background of the person interacting. Similarly, people do not always recognize opportunities when they are presented because their past experiences have affected their line of thinking. If a person is able to make the most of opportunity when it arises, he or she has a greater chance of shaping his or her own future opportunities (Bandura, 1999). Super (1954) also believed that differences in interests and abilities would affect a person's vocational opportunities.

Another influence that can affect career choice pertains to external influences from parents, teachers, counselors, friends and other students (Downey et al., 2009). "Students choose majors based in part on the influence of others" (Downey et al., 2009, p. 359). Additional ideas that may influence a person's selection for a career include monetary compensation that can be expected from a certain career, perception of what the work involves, the challenges available within the career and whether there is prestige associated with a particular career (Downey et al., 2009; Frauenheim, 2004).

Occupational Desires

Occupational roles afford goal pursuit—this stems from the logic that individuals tend to select roles that will allow them to succeed the most while at the same time reduce the chance of failure. Gottfredson's (1981, as cited in Eccles, 1994) theory of circumscription and compromise discusses the individual's choice for career as being the result of the alignment of self-concepts and beliefs about occupations. Both of these theories describe how self-beliefs, including gender beliefs, cross into perceived social structure to influence career options (Evans & Diekman, 2009). According to Eccles' Expectancy Value Model (1994), individuals' educational and vocational choices are greatly influenced by their interests, values, and expectations for success. These choices are connected to causal attributions, input of socializers, gender role beliefs and cultural norms, self-perceptions, aptitude and one's perceptions of the task itself (Eccles, 1994, Zarrett & Malanchuk, 2005). One way to help improve students' ability to adapt to adversity which may be encountered in pursuing careers that they perceive as not employing more of their own sex is to provide career role models that address the possible gender specific barriers they might face (Betz & Hackett, 1981; Ji et al., 2004). The findings confirm that occupational desires are influenced by a conglomeration of both early and current social psychological influences in developmental trajectories. The determination to pursue CS careers is related to perceived ability and mastery within the field, experiences and interpretations of subject matter, cultural norms and stereotypes and the influence of socializers and peers (Zarrett & Malanchuk, 2005).

Holland (1959) believes that when a person is ready to make a vocational choice it will be the result of the interaction of his particular heredity with a variety of cultural and personal forces including peers, parents and significant adults, his social class, American culture, and the

physical environment. From these interactions and experiences, a person formulates a set of preferred methods for dealing with patterns of abilities. People will then look for situations that will fit into their methods and past experiences (Holland, 1959). The most likely time for social influence to have an effect is during adolescence (Holland, 1959).

Interest

Using SCT as a starting point, Eccles (1994) created a theory model based on three areas of interest. First, she concentrated her efforts on achievement-related choices as a result of interest. She believed decisions are based heavily on pressures from society and pre-set cultural norms. By looking at why men and women make the choices they do make, she was able to look at gender differences from a choice perspective and not as a deficit perspective for women (Eccels, 1994). The second area of interest pertained to looking at an individual's field of choices. Although we do make choices from a set of options, we usually do not consider (consciously or unconsciously) the full range of available options when making our choice. The third area of interest pertained to one's perspective regarding achievement-related decisions affected by long-range and immediate consequences. Previous work has suggested that women make decisions regarding course selection and career selections in isolation of one another. Eccles believed it was important to understand the psychological meaning of the reason one option was not selected as well as the reasons behind why the option selected was selected. One of the major undertakings for Eccles was to determine the differences in men's and women's achievement-related choices (Eccels, 1994).

Self-efficacy

As Bandura (1999) indicated, self-efficacy expectations are the beliefs a person has in his or her ability to perform a specific task or behavior. The level of self-efficacy expectations, or

the degree to which a person believes he or she can do something, will influence whether someone tries to do something or not. Also, the strength of self-efficacy, a person's confidence with one's own abilities, will influence persistency when encountering behaviors (Betz & Hackett, 1981). Social Cognitive Theory (SCT) involves the process of experiencing and then gaining feedback to match or correct a mismatch between the idea and its fruition. To manage successfully, people need to develop a variety of skills under different conditions as opposed to finite skills (Bandura, 1999). Actions that bring positive results are usually kept while those that produce negative results are stored mentally and not used again. People can benefit from observing others' successes or failures as well. The advent of technology provides a much greater opportunity for increasing human capabilities—Bandura believes psychological theorizing must also keep up with this technological impact (Bandura, 1999).

Parents, teachers, and school counselors can all influence the field of options through the information and experiences they share. Peers can affect options by either showing support or non-support for options—both directly and indirectly. Social agents can either encourage or discourage a person from considering options—this leads to the frequent choice of staying consistent with gender role stereotypes (Eccels, 1994). Self-efficacy expectations affect both men and women and can be useful for both. At the present time, men and women tend to follow gender-stereotyped occupations, but the choices are not necessarily based on individual aptitudes and interests (Eccels, 1994). The results of Eccles' studies indicated that although expectations for success and personal efficacy predicted occupational choice, they were not the only predictors. Evidence indicated that positive experiences may also be a predictor of occupational choice. Specific occupations were selected based on the value of a variety of occupational characteristics (Eccels, 1994).

Betz and Hackett (1981) conducted a study to look at two things: (1) the connection between self-efficacy theory and the types and range of occupational choices from undergraduate men's and women's career viewpoints, and (2) sex differences between self-efficacy expectations and the educational requirements and job duties necessary for traditional male and female occupations and the connection to the differences in the number and types of career options thought to be available. The overall findings indicate that self-efficacy with regard to sex differences is an important determinant with regard to both traditional and nontraditional occupational selections. The findings indicated that the best predictors of the variety of career options available were interests and self-efficacy and that the two variables were connected (Betz & Hackett, 1981). These findings provided a viable source for studying vocational behavior with regard to career-related self-efficacy expectations. There were indications that the overall process of career decision making can be connected to self-efficacy expectations, but self-efficacy can be most useful when looking at the roles of females in traditional and nontraditional occupations (Betz & Hackett, 1981). Betz and Hackett (1981) viewed self-efficacy as a means of understanding women's career development in relation to the development of sex-roles. Basically, women are either not encouraged or are specifically discouraged from pursuing certain paths which in turn affects their expectations regarding self-efficacy (Betz & Hackett, 1981). The continued low participation in many professions is believed to be at least partially connected to low self-efficacy expectations. Low self-efficacy expectations may be one reason women's career options are limited—specifically within nontraditional careers thought to be more masculine (Betz & Hackett, 1981).

Self-efficacy is the most important mechanism people use. Unless a person believes he or she can do something, no effort will be made. Perceived self-efficacy plays an important part

in SCT as well (Bandura, 1999). In order for self-efficacy to be measured, it must be calculated in conjunction with a specific area (Betz & Hackett, 2006). The specific construct used to evalute self-efficacy in this study is computer self-efficacy—a person's beliefs in their level of computer knowledge and skills. Based on self-motivation and desired goals, and on self-efficacy beliefs, people will determine what actions to attempt and how much difficulty will be acceptable to accomplish their goals. Those with doubts will settle for less and step back while those that have strong belief in their abilities will try even harder to accomplish a task (Bandura, 1999). "The stronger the sense of coping efficacy the bolder people are in tackling the problems that breed stress and anxiety, and the greater is their success in shaping the environment to their liking" (Bandura, 1999). People assimilate information all the time through their experiences and actions. They are able to change what they do or think based on information received and then recalculating. In addition, people are able to model influences when they view others' experiences (Bandura, 1999). Frequently people are willing to turn control over to someone else because they don't want the responsibility of being in charge (Bandura, 1999). In the area of course enrollment, for example, people are more likely to sign up for courses they believe they will do well in or for which they believe some value will be attained by taking the course. People's expectations for success are dependent on their confidence in their mental abilities to do well in the class in comparison to how hard they think the class might be. These beliefs have been shaped over time from past experiences and how people view the success or failure of those experiences—whether they think success was due to intelligence or the result of a lot of hard work (Eccels, 1994).

Career Choices

More specifically related to this study is the Social Cognitive Career Theory (SCCT) developed by Lent et al. (1999). SCCT expands on Bandura's (1999) Social Cognitive Theory by including more study of career behavior (Betz & Hackett, 2006). Their theory suggests that a person's environment and social-cultural influences affect career decisions (Lent, Brown & Hackett, 2000). As proposed by Lent et al. (1999) SCCT indicates that career choice behavior is shaped by outcome expectancies, career interests, and career self-efficacy (affected by background and outcome expectations). Career self-efficacy is influenced by predispositions such as gender, race/ethnicity, health status and contextual factors like family background and learning experiences. In this career development model, contextual factors (background) and individual characteristics will affect learning experiences which in turn will affect self-efficacy. From there, self-efficacy influences a person's interests and outcome expectations which ultimately influence career choices (Tang et al., 2008). As an extension of this theory, Lent, Brown and Hackett. (2000) proposed the Concentric Model of Environmental Issues. This consists of three ecological layers: the person, surrounded by an immediate environment, and then the social-cultural layer. The outer layers influence perception of potential career options (Ji et al., 2004). One of Lent's contentions is that social-cultural influences affect career selection (Lent et al., 2000).

Within SCCT, three interlocking models exist to provide the basis for career-related interest, choice and performance (Lent, Brown & Hackett, 2002). These models are the Interest Development Model, the Choice Model and the Performance Model (Lent et al., 2002). The interest model purports that self-efficacy and outcome expectations about what activities are chosen have a definite impact on the development of career interests. If people are interested in

something they are doing, they are likely to believe they are proficient as well. The alternative is also true in that if people do not feel they will do something well or are afraid of negative feedback, they are less likely to develop that interest (Lent et al., 2002). The choice model expands on the interest model by including contextual and learning influences on choices made (Lent et al., 2002). Specifically, the choice model is composed of three pieces that work together: (1) the articulation of a goal; (2) specific actions taken to implement the training needed to attain the goal; and (3) the ensuing level of success or failure. These three together form a loop which affects career choices (Lent et al., 2002). The performance model looks at the level of people's success as well as their determination of their actions in career-related goals (Lent et al., 2002). SCCT suggests professional and educational performance, and perseverance, as being influenced by ability, self-efficacy, outcome expectations, and performance goals (Lent et al., 2002). "Self-efficacy plays an especially important role in determining how people employ their abilities" (Lent et al., 2002, p. 279).

Another contributing factor when making career choices is perceived cost—the value of the task the individual will experience if the task is selected. Cost can include anticipated fear or anxiety, concern with regard to social factors, or failure to do one task if another task is selected (Eccels, 1994). Two important factors to consider when looking at this are (a) attainment value, or the value an activity has because it is engaging and it is consistent with one's self image and (b) the cost of engaging in the activity (Eccels, 1994). Attainment value refers to the needs and values the activity could fill (Eccels, 1994). The parts of an individual's self-image are the most important influencers with regard to the value attached to various educational and vocational options (Eccels, 1994).

46

Although many of the studies conducted have not specifically involved high school students, in 1998 Byers and Hackett (as cited in Betz & Hackett, 2006) conducted a study to determine if gender differences are factors related to the SCCT model among the high school population. They concluded that gender influences may affect career self-efficacy and outcome expectations and also impact career choice and adjustment (Tang et al., 2008). Another study was conducted to determine why youth are not participating in the CS area by identifying social and psychological factors within their development of occupational decisions. The research findings of this study suggest that occupational choice is an ongoing process in which previous experiences will influence career decisions (Zarrett & Malanchuk, 2005).

According to the Eccles choice model (1994), occupational choices are assumed to be influenced by an individual's personal hierarchy of expectations and efficacy. The model predicts that people select activities for which they feel they have the highest expectations of success. Therefore, the comparison that should be studied is not gender comparisons within area, but area comparisons within the individual (Eccels, 1994).

Summary

Computer science is an integral part of all areas of study (Anthes, 2006; Association for Computing Machinery, 2003; Association for Computing Machinery et al., 2006; Guzdial, 2009; Mahmoud, 2005; Margolis, Goode & Bernier, 2011; Marsan, 2010, 2009; McGregor, 1990; Rashid, 2008; Victory, 2009). The literature has indicated there is a shortage of qualified CS workers to fill the jobs that currently exist as well as the jobs that will be created within the coming years (Becerra-Fernandez et al., 2010; Denning & McGettrick, 2005; Gates, 2007; Raines, 2011b). One major reason for the shortage of qualified CS workers is that colleges are not producing enough CS graduates to fill the needs of business and industry (Foster, 2005;

Frauenheim, 2005; Klawe & Schneiderman, 2005). As a potential solution for colleges not producing enough CS graduates, several organizations, ACM and CSTA, are making concerted efforts to promote CS and its value by sharing information about CS at the high school level. The aim for these organizations is that by getting high school students interested in CS while in high school, more students will select CS as a major upon entering college (Association for Computing Machinery, 2003; Association for Computing Machinery et al., 2006; Computer Science Teachers Association, 2005). Previous studies regarding high school students and computer science have been conducted (*Moving Beyond the Toy vs. Tool Hypothesis: An Examination of Gender Differences in Adolescents' Computer Activities, attitudes and Technology-Related Career Plans*, Bleeker, 2009; *Are Computer Science and Information Technology Still Masculine Fields? High School Students' Perceptions and Career Choices,* Papastergiou, 2008), but the focus of these studies was predominantly on gender differences and how computers were used by students and not whether computer self-efficacy or interest were gender specific or could be influenced by increased participation in CS.

CHAPTER 3

Method

A concern has existed for several years regarding the decline in Computer Science (CS) enrollment at the college level. The belief is that students are not selecting CS courses, or CS as a viable major, because of several common concerns (Becerra-Fernandez et al., 2010; Downey et al., 2009; Foster, 2005; Frauenheim, 2005; Huang et al., 2008; Klawe & Schneiderman, 2005; Locher, 2007; Vardi, 2009; Vegso, 2008). These concerns include the belief that the dot.com bust reduced the need for CS students and that all of the CS jobs are being outsourced overseas (Anthes, 2006; Denning & McGettrick, 2005; Dewar & Astrachan, 2009; Downey et al., 2009; Foster, 2005; Frauenheim, 2004; Huang et al., 2008; Kessler, 2004; Mahmoud, 2005; Paul, 2005; Starr et al., 2009; Summerfield, 2005). In reality, because of this drought there are many in the CS profession who are concerned that the demand for qualified workers will be greater than the supply (Kessler, 2002). In order to meet the continuing computer science demands for the future, colleges need to produce more CS graduates (Foster, 2005; Frauenheim, 2005; Klawe & Schneiderman, 2005). In order to produce more CS graduates, colleges need to increase the number of students enrolling in CS as a major (Foster, 2005; Frauenheim, 2005).

Increasing enrollment in CS as a major is not something colleges can fix on their own. The process needs to start much earlier in the educational process—definitely in high school, and possibly even in middle school (Anthes, 2006; Denning & McGettrick, 2005; Goode, 2008; Phillips, 2006; Stephenson, 2009; Vardi, 2009; Wilson & Harsha, 2009). Developing an interest in a specific area can lead to pursuit of a career in that area. Therefore, it is important that all

students, from middle school through high school, receive adequate career counseling with regard to determining their areas of interest (ACT, 2005; Ayotte & Sevier, 2010). As students' interests become clearer through participation in high school courses, they will be better prepared to make good decisions regarding career choices (ACT, 2005; Ayotte & Sevier, 2010; Reese, 2010). In addition to career counseling efforts, CS professionals and organizations need to do a better job of getting information about CS careers out to the general public (Arora & Chazell, 2005). One specific individual, Bill Gates of Microsoft, is concerned because CS jobs are great paying jobs which would make one think there would be more interest. He believes that the right information about CS is not getting to the students (Chew, 2005).

Computer science curriculum needs to be revamped—a new design needs to be developed (Starr et al., 2009). As a first step in trying to solve this problem, the Computer Science Teachers Association (CSTA) produced a publication in 2006 entitled, *A Model Curriculum for K-12 Computer Science: Final Report of the ACM K-12 Task Force Curriculum Committee.* This publication was an attempt to help "fix" what is currently wrong with the high school CS curriculum across the country (Association for Computing Machinery, 2003; Computer Science Teachers Association, 2005; Stephenson, 2009). However, before changes are implemented, studies should be conducted to determine why students do not select CS in their high school programs. "In choosing high school courses, students often seem to focus on everything except preparation for an intended major or career" (Ayotte & Sevier, 2010, p. 21). We must consider what students think about the nature of the current programs (Lewis, Jackson & Waite, 2010).

Purpose

The purpose of this survey study was to examine the effects of gender and participation in computer science courses on high school seniors' computer self-efficacy and interest in computer science careers. Computer science courses in this study were limited to five careers/clusters as identified in *The Overview Report* published by The Joint Task Force for Computing Curricula 2005 (Association for Computing Machinery, 2005). These five careers/clusters were (a) Computer Engineering which included the tasks of designing and constructing computers and computer-based systems; (b) Computer Science which involved designing and implementing software, devising new ways to use computers, and developing effective ways of solving computing problems; (c) Information Systems which involved integrating information technology solutions and business processes to manage the information needs of businesses and other enterprises; (d) Information Technology which involved meeting the computer technology needs of government, healthcare, schools, and other kinds of organizations; and (e) Software Engineering which involved developing and maintaining software systems that behave reliably and efficiently, are affordable to develop and maintain, and satisfy all the requirements that customers define for them.

The dependent variables in this study included computer self-efficacy and interest. Computer self-efficacy is a person's belief about one's capabilities to use a computer proficiently (Compeau & Higgins, 1995). Perceptions about one's abilities influence selections people make regarding what interests to pursue (Bandura, 1999; Betz & Hackett, 1981). For this study computer self-efficacy was measured using the Computer Science Interest Survey (Appendix A). Computer self-efficacy was a continuous variable with a total score that was calculated by adding together the responses for fifteen statements about one's computer skills. The highest

51

score possible was 60 and the lowest score possible was 15. A low total score indicated a greater degree of computer self-efficacy. The mean was used to provide descriptive statistics as well as to compare the overall scores with gender and with participation. Interest is the satisfaction one gets from completing a specific activity (Wigfield & Cambria, 2010). For this study, interest was measured using the Computer Science Interest Survey (Appendix A). Interest was measured by calculating the total score from responses provided on 13 computer science job-related tasks. Interest was a continuous variable with a total score that was calculated by adding the thirteen responses together for an overall total. The highest possible total was 52 and the lowest possible value was 13. A high total indicated more interest in computer science job tasks. The mean was used to provide descriptive statistics as well as to compare the overall scores with gender and participation.

The independent variables included in this study, gender and participation, were both categorical variables. Gender had two categories—male or female. Participation also had two categories—yes or no. The response of "yes" was used if a student had taken any of the six CS courses listed on the Computer Science Interest Survey (Appendix A). The response of "no" was used if a student had not taken any of the six CS courses listed. The courses listed were the courses that were available for the four years the respondents had attended the target high school. The results of this study may be used to inform school personnel, as well as parents, of the effects of participation in CS classes on a student's interest in pursuing CS careers. Schools may be able to create an environment where students have opportunities to participate in more CS classes which may in turn lead to more students becoming interested in CS careers. The results of this study may also be used to inform school personnel about gender differences, if any, with

regard to computer self-efficacy and participation in CS classes. The results may be used to adjust policies and provide resources for better marketing of programs in CS.

Research Questions

This study addressed the following research questions:

1. What is the computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

2. What is the computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

3. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on gender?

4. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on participation in high school computer science courses?

5. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on gender?

6. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on participation in high school computer science courses?

Design

A survey design was selected for use in this study because a multitude of information is available by asking people questions (Desselle, 2005). Survey research encompasses the

collection of data through questionnaires and interviews (Creswell, 2009). In general the survey method is a good choice in a quantitative study because the results will be numeric and provide opportunities for statistical comparison. The results provide a numeric value of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell, 2009). Also, when large numbers of respondents are involved, as in this study, a survey instrument is a good selection (Hill, 2001). Surveys gather information relating to people's characteristics, behaviors, beliefs, and attitudes. In addition, demographic information can be obtained easily from surveys and is typically gathered to determine differences between groups (Desselle, 2005).

Survey research has both advantages and disadvantages. Some of the advantages of survey research are that it is frequently less expensive to administer, the collection of data is easy to manage, and the data can be collected from people not geographically near to the person conducting the study (Hill, 2001). Another advantage to using survey research pertains to sensitive data. The anonymity provided by surveys may be appealing to some respondents (Hill, 2001).

Some of the disadvantages of survey research include the limitations on the types of data that can be obtained, respondents' possible attitudes, little opportunity for adjusting questions or follow-up questions, and the inability to refine complicated issues to limited response items (Hill, 2001). It is important to provide enough time for the survey to be completed; however, in the same vein, surveys need to be kept somewhat short. People have a tendency to try and decipher why the questions are being asked and might lose interest or be put off if the survey is too long or contains questions that could be viewed as unnecessary (Desselle, 2005).

After considering the advantages and disadvantages of survey research, it was determined a survey instrument would be a good choice. The survey was administered to students at the

target high school which was easily accessible to the researcher. This enabled mailing costs to be eliminated although costs were incurred to copy the consent letters and surveys. Conducting the survey at the target high school was an efficient method because it was completed all in one school day during the six different GS periods.

<div style="text-align:center">Participants</div>

A convenience sample was used for this study. A convenience sample is one that is exactly what the name implies—convenient. Some examples of a convenience sample include location in relation to the researcher, association with the person required to approve the research, and familiarity with the site to be used for the sample or prior collection of a portion of the necessary data (Gall, Gall & Borg, 2007). For this study, the sample was from the target high school in the largest school system in Georgia, which was easily accessible by the researcher.

The target population was high school students in grade 12. These students were all from one high school. The current enrollment at the four-year high school is approximately 3400 students. Individual grade level sizes range from approximately 750 in the current senior class to over 1000 in the current freshman class. The majority of graduating seniors (more than 90%) will go on to post-secondary education after high school. Only students in grade 12 were surveyed because those students had more opportunity to select CS courses while in high school for four years. Based on feedback from the pilot study, the difficulty in getting parental permission forms returned in a timely manner, the fact that a large number of seniors were already 18 years old or older, and the challenge of getting permission by the target school administration for more than one day to be used for completing the survey, it was decided to only use students who were at least 18 years of age. The number of 18 year old seniors at the time the survey was completed was 453 students.

Instrument

The instrument was created by the researcher after a thorough review of the literature. During the review of the literature several similar studies were discovered to be in existence (e.g., *Moving beyond the toy vs. tool hypothesis: An examination of gender differences in adolescents' computer activities, attitudes, and technology-related career plans,* Bleeker, 2005; *USG student computing survey,* Guzdial, 2009; *School to career transitions: career awareness and CTE students,* Roberts, 2008). One study, *Are Computer Science and Information Technology Still Masculine Fields? High School Students' Perceptions and Career Choices* created by Papastergiou (2008) provided ideas used in the creation of the final survey. Permission was received from Papastergiou (Appendix B) to use her survey; however, it was determined that the entire instrument was not suitable for the researcher's purpose, therefore, only a portion of the survey was incorporated into the final survey. As a result, the researcher created a new survey while attending a class at The University of Georgia during the Fall, 2009 semester which included proper techniques for questionnaire construction. After the survey instrument was constructed, it was reviewed by Barb Ericson, a member of the Computer Science Teachers Association and a liaison for Georgia Institute of Technology and Georgia high school teachers of computer programming. In addition, the survey instrument was reviewed by Tom McKlin, Ph.D., of The Findings Group. Dr. McKlin also directs evaluation activity for Georgia Institute of Technology's Center for Education Integrating Science, Mathematics, and Computing. An additional review of the survey was conducted by Colin Martin, Ph.D., Executive Director of Research and Evaluation, Gwinnett County Public Schools, during the local county approval process required to allow the researcher to conduct the study. Finally, the researcher's committee reviewed the survey and suggested the specific career titles be removed

leaving a list of tasks for which respondents could indicate their level of interest. This change was made to the final survey instrument.

Participants were asked to report their responses on a paper and pencil survey. The survey consisted of four parts. For the first two parts of the survey a Likert-type scale was used for indicating responses. Likert-type scales are used frequently in research because of their ease of use for obtaining a lot of attitudes in a short amount of time (Johns, 2005). Many people use the 5-point Likert-type scale which provides an option for a neutral response. It has been determined that by removing the neutral response the researcher is removing the option for ambivalence from the respondent. The respondent is forced to decide in a specific direction which will cause the respondent to use some cognitive thought processes (Johns, 2005). For this study, respondents were limited to a 4-point Likert-type scale.

In Part I, students were asked to indicate their responses to 15 statements relating to computer self-efficacy. Responses were based on a 4-point Likert-type scale (1-Strongly Disagree, 2- Disagree, 3-Agree, 4-Strongly Agree). Responses were totaled for this section with scores ranging from 15 to 60, with scores closer to 15 indicating students felt more comfortable with their computer self-efficacy than those students with scores closer to 60. When the data were analyzed, selected questions (1, 3, 5, 8 and 13) were reverse coded for accurate computation. Part II of the survey consisted of 13 descriptions of CS career-related job tasks associated with the five computer science careers stated previously. The original survey design included each of the five specific career titles along with the associated tasks for each career listed in conjunction with a specific CS career. These five career titles and tasks were (a) Computer Engineering which includes the tasks of designing and constructing computers and computer-based systems; (b) Computer Science which involves designing and implementing

software, devising new ways to use computers, and developing effective ways of solving computing problems; (c) Information Systems which involves integrating information technology solutions and business processes to manage the information needs of businesses and other enterprises; (d) Information Technology which involves meeting the computer technology needs of government, healthcare, schools, and other kinds of organizations; and (e) Software Engineering which involves developing and maintaining software systems that behave reliably and efficiently, are affordable to develop and maintain, and satisfy all the requirements that customers define for them. After suggestions provided by Dr. McKlin, Ph.D., of The Findings Group (Appendix C), and discussion with the researcher's committee, it was determined that students would be more likely to identify specific tasks in which they were interested or not interested if they could see each task in an individual statement rather than looking at specific CS career titles associated with the specific tasks. The specific career titles were removed to provide less influence on the respondents' level of interest. Students were asked to respond to their level of interest for each task described and responded using a 4-point Likert-type scale (1-Not Interested at All, 2-Not Very Interested, 3-Somewhat Interested, 4-Very Interested). Responses were totaled for this section with scores ranging from 13 to 52. Scores closer to 13 indicated students had little or no interest in CS careers and scores closer to 52 indicated students had greater interest in some aspect of CS careers.

Part III of the survey asked students to respond "yes" or "no" as to whether they had taken any of the six CS courses listed that were available during the previous four years at the target high school. The response of "yes" indicated a student had participated in at least one of the six listed CS classes and a response of "no" indicated a student had not participated in any of the listed CS classes. Finally, Part IV asked students to indicate their gender as either male or

58

female. To ensure confidentiality, no survey respondents were identified by name or student number. All respondents were categorized only by whether or not they had taken a CS course in high school and by gender.

Procedure

After the survey was created, and before it was implemented, approval by the Institutional Review Board (IRB) was required and obtained from the University of Georgia (Appendix D). In addition, local school district policy required approval before proceeding with the survey. A research proposal was submitted to the local school district and approval was received in mid-December 2010 (Appendix E). In January, 2011, UGA IRB approval was granted (Appendix D) and the pilot study was conducted shortly thereafter.

Pilot Study

When creating an original survey to conduct research, it is a good idea to include a pilot study (Gall et al., 2007). Through the pilot study, data-collection methods can be studied and revised and problems with the survey itself can be found so that corrections can be made before administering the final study (Gall et al., 2007). It is suggested that the researcher use a similar population to that of the final sample population when conducting a pilot study (Gall et al., 2007). For the pilot test associated with this study, which was conducted in February, 2011, a sample was drawn from a neighboring high school with similar socio-economic standing as well as similar class offerings.

Initial contact was made with a neighboring high school's principal and a contact person was assigned to work with the researcher. Arrangements were made for the researcher to visit the pilot school during Guided Study (GS) classes on a Tuesday and Thursday during a one-week time period. At the high school where the pilot test was conducted, Guided Study classes

meet daily. They are made up of students all in one grade level, randomly assigned, and are used for students to work on homework, make up missed work in academic classes, do silent sustained reading, disseminate information and view school-produced video productions. On Tuesday of the assigned week, the researcher attended two GS classes and distributed Parental Permission letters (Appendix F) and Parental Permission forms (Appendix G) to students who were under the age of 18 and Consent Letters (Appendix H) and 18 Year Old Consent forms (Appendix I) were provided to students who were 18 or older. On Thursday of the same week, the researcher returned to the two GS classes to collect paperwork and to administer the survey. Prior to administering the survey, Parental Permission letters (Appendix F) and Parental Permission forms (Appendix G) which had been signed were collected and Student Assent letters (Appendix J) were provided to those students before they completed the survey. A total of 27 Parental Permission letters were handed out on Tuesday and 14 were returned on Thursday (52%). A total of 23 Consent Forms were handed out to students 18 years of age or older and 22 were returned (96%). After all paperwork had been collected, the Computer Science Interest Survey (Appendix A) was distributed to those students electing to participate. The surveys were returned to the researcher within the GS class period. The pilot study provided an opportunity to uncover inconsistencies in items that might be unclear within the survey instrument (Gall et al., 2007; Krueger, 2001). In addition, the pilot study provided an opportunity to verify that the wording of the survey was succinct and could be understood by the target population (Hill, 2001, p. 201). One typographical error was found and reported to the researcher and the correction was made before the administration of the final survey.

A total of 33 surveys were returned, 15 male and 18 female. After the surveys were collected, data was entered into an Excel spreadsheet and exported into SPSS software.

Statistical tests were run to determine whether there was consistency among the items included in the survey and that it was measuring only one concept (Gloeckner, Gliner, Tochterman & Morgan, 2001). A popular process used in educational research, in lieu of running more than one pilot test to determine internal consistency, is finding Cronbach's alpha (Gloeckner et al., 2001). A Cronbach's alpha reliability coefficient of .77 was calculated for the first 15 statements of the Computer Science Interest Survey (Appendix A). These statements pertain to computer self-efficacy. Cronbach's alpha coefficients generally fall between 0 and 1, with a value closer to 1 indicating greater internal consistency of the items (Hinkle, Wiersma & Jurs, 1998). Hinkle, Wiersma and Jurs (1998) provided the following guidelines for evaluating the reliability coefficient: "…+.10 or -.10 indicates that there is little, if any relationship between the variables, whereas a coefficient of +.90 or -.90 indicates a strong relationship" (p. 109). Therefore, the internal reliability for the first 15 statements of the Computer Science Interest Survey (Appendix A) is considered to fall closer to a strong relationship. A Cronbach's alpha was also run for the 13 statements relating to computer science job-related tasks listed on the Computer Science Interest Survey (Appendix A). The Cronbach's alpha for this section was .93, indicating a very strong relationship.

Final Study

The final survey was administered at the target high school in early March during Guided Study classes to students in grade 12, who were 18 years old or older. Guided Study classes are organized by grade level. For this study, all senior Guided Study classes were asked to participate—a total of 26 Guided Study classes. Similar to the high school where the pilot study was conducted, Guided Study classes are used to disseminate advisement information, for students to make up missed work in academic classes, for students to work on silent sustained

reading, to conduct homeroom activities and to view student-produced video broadcasts. During most of the school year Guided Study classes at the target high school meet three times each week, Monday, Wednesday and Friday, for 27 minutes.

Based on the return rates of the pilot study, a query was conducted through the Curriculum Office at the target high school which indicated a total of 453 students in the senior class had already reached the age of 18. Using the 96% return rate of students 18 years of age or older from the pilot study as a guide, it was determined that a large pool of respondents could be obtained in a one-day time period. Due to a great number of demands and activities that needed to be completed during Guided Study periods in February and March at the target high school, the administration at the target high school required the researcher to complete the survey in a one-day time period. Permission was granted by the Associate Principal to conduct the survey on a day when Grades 9, 10 and 11 were completing a counseling-related survey and seniors would not be otherwise involved in an activity. It was determined that it would be an excellent time to administer the researcher's survey to the seniors. Email was sent to all senior Guided Study teachers on Monday to let them know that the surveys would be forthcoming and that they would be hand-delivered to each teacher during the morning of the implementation—Wednesday. In addition, the email indicated that written directions would be provided in addition to oral instructions that each GS teacher would receive at the time the surveys were hand-delivered by the researcher. The surveys were grouped by Guided Study classes and the researcher hand-delivered each stack to the specific Guided Study teachers. At the time of delivery, oral directions were provided in conjunction with the written directions which were attached to each stack of surveys. Consent Letters for students 18 years of age or older (Appendix K) and Consent Forms for students 18 years of age and over (Appendix L) were

included and distributed before the surveys were completed. Surveys were returned to the researcher within a two-day time period. Initially, three Guided Study teachers did not return the surveys as requested. An additional follow-up email was sent to the three GS teachers asking for the surveys to be returned, and all but one of the GS teachers was able to provide the surveys in a timely fashion. This was an extremely efficient method of completing the surveys and only the costs for reproducing the consent letters and surveys was incurred by the researcher; there were no mailing costs incurred.

The survey was completed in a one-day time period. The potential sample size for respondents was 453 students from grade 12. A total of 453 surveys were distributed and 233 were returned (51%). Of the 233 returned, 16 were deemed unusable, leaving 48% useable. A variety of reasons accounted for the return rate—only one side was completed, there were missing responses in the sections requiring a total score for continuous variables, there were missing responses to participation or gender, and the obvious lack of sincerity when completing the survey (all 4s circled or all 1s circled). Based on the 51% return rate, it was apparent that a number of students chose not to participate. The lack of participation could be attributed to a variety of reasons—GS teacher apathy or lack of encouragement to participate when instructing the students while distributing the surveys, a desire to not complete any additional surveys (several other surveys had been completed within a two-week time period), or students simply electing not to acknowledge they were 18 years or older so they would not have to participate.

Upon completion of the final survey implementation, data was collected and entered into an Excel spreadsheet and then imported into SPSS software for statistical analyses. Descriptive statistics and *t*-tests were used for analyzing data for this study. Descriptive statistics were used to discuss mean, standard deviation, variance, and range of high school seniors' computer self-

efficacy and interest in CS careers. For comparing independent variables to dependent variables, *t*-tests were used. Specifically, a *t*-test was used to compare the independent variable, gender, with the dependent variable, computer self-efficacy, as well as to compare the independent variable, participation, with the dependent variable, computer self-efficacy. A *t*-test was also used to compare the independent variable, gender, with the dependent variable, interest, as well as to compare the independent variable, participation, with the dependent variable, interest. Rather than ANOVA, *t*-tests were selected for analyzing data because the results were not being examined to find causation, or how one variable changed as a result of the other variable, but rather to determine if there was a relationship between the independent and dependent variables (Hwang, Zhang and Chen, 2001). The independent variable, gender, referred to whether a respondent self-reported being male or female. The independent variable, participation, referred to whether a respondent self-reported having taken any of six CS courses currently being taught at the target high school at any time during their high school experience. The dependent variable, self-efficacy, was determined as a single score between 15 and 60 and was calculated by adding the respondents' scores on 15 statements pertaining to computer self-efficacy. The lower end of the range coincided with stronger feelings of computer self-efficacy while the upper end of the range coincided with little or no sense of computer self-efficacy. The dependent variable, interest, was determined as a single score between 13 and 52 and was calculated by adding the respondents' scores on 13 statements which described specific CS tasks associated with the five careers/clusters used in this study, specifically (a) Computer Engineering; (b) Computer Science; (c) Information Systems; (d) Information Technology; and (e) Software Engineering. The lower end of the range coincided with little or no interest in computer science tasks while the upper end of the range coincided with greater interest in computer science tasks.

Data Analysis

As a first step in analyzing the data for this study, descriptive statistics were used to describe computer self-efficacy and interest as stated in the first two research questions. Computing descriptive statistics for each comparison group in a study is the first step in data analysis (Gall et al., 2007). The mean, standard deviation, variance and range of computer self-efficacy and interest were reported. The next step in data analysis is usually to conduct tests of statistical significance (Gall et al., 2007). For this study, *t*-tests were appropriate because the data were being analyzed to test the significance between two sample means (Gall et al., 2007). The third research question compared computer self-efficacy with gender. The dependent variable, computer self-efficacy, was a continuous variable ranging from 15-60 and was computed by adding the responses of 15 statements relating to confidence, or lack thereof, in one's abilities to use a computer. The independent variable, gender, was a categorical variable consisting of either male or female. In the fourth research question, computer self-efficacy was compared to participation. The dependent variable, computer self-efficacy, was a continuous variable and was compared to the independent variable, participation, which was a categorical variable consisting of either yes or no. For the fifth research question, interest was compared to gender. The dependent variable, interest, was a continuous variable ranging from 13-52 and was computed by adding the responses of 13 statements relating to interest in computer job-related tasks. The independent variable, gender, was a categorical variable consisting of either male or female. The sixth research question was a comparison of the dependent variable, interest, with the independent variable, participation. Again, the dependent variable, interest, was a continuous variable and the independent variable, participation, was categorical consisting of either yes or

no. For research questions three, four, five and six, *t*-tests were used to determine if there was a

statistical significance between the mean scores of the variables (Gall et al., 2007).

In this study, *t*-tests were conducted to determine whether or not to reject the null

hypotheses. In determining whether to reject each hypothesis or not, a significance level must be

determined (Hinkle et al., 1998; Moore, 2007). The significance level of a test is the probability

of making the wrong decision when the null hypothesis is true. The two most widely used levels

of significance are .05 and .01. If an alpha level of .05 is used it means the decision to reject the

hypothesis may be incorrect 5% of the time, or if .01 is used, then the decision to reject the

hypothesis may be incorrect 1% of the time (Hinkle et al., 1998; Moore, 2007). For this study,

an alpha level of .05 was used, meaning that if the null hypothesis is rejected at the .05 level of

significance, the findings can be reported as being statistically significant (Hinkle et al., 1998;

Moore, 2007). For any *t*-test resulting in a statistically significant difference in findings, a

Cohen's *d* was calculated to determine the effect size. The larger the effect size, the more

powerful the test (Hinkle, et al., 1998). When interpreting Cohen's *d* , .2 is considered a small

effect, .5 a medium effect and .8 a large effect (Olejnik, 2007). Another consideration is the

possibility of producing false results, Type I and Type II errors.   A Type I error occurs when the

null hypothesis is rejected but is actually true. A Type II error occurs by not rejecting a false null

hypothesis (Hinkle et al., 1998; Moore, 2007).

Table 1 summarizes the variables and how they were analyzed. Included in the table are

the statistical analyses for each research question. The independent and dependent variables for

each research question are also included.

Table 1

Data Analysis Approach

Research Questions	Independent Variables	Dependent Variables	Analysis
1. What is the computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia as measured by the Computer Science Interest Survey			Mean, Std. Dev., Variance, Range, Sample Distribution
2. What is the computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia as measured by the Computer Science Interest Survey ?			Mean, Std. Dev., Variance, Range, Sample Distribution
3. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia based on gender?	Gender Categorical 1-Male 2-Female	Computer self-efficacy Continuous	*t*-test effect size
4. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia based on participation in high school computer science courses?	Participation Categorical 1 – Any CS course 2 – No CS courses	Computer self-efficacy Continuous	*t*-test effect size
5. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia based on gender?	Gender Categorical 1-Male 2-Female	Interest Continuous	*t*-test effect size
6. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia based on participation in high school computer science courses?	Participation Categorical 1 – Any CS course 2 – No CS courses	Interest Continuous	*t*-test effect size

CHAPTER 4

Results and Findings

The purpose of this survey study was to examine the effects of gender and participation in computer science courses on high school seniors' (18 years old or older) computer self-efficacy and interest in computer science careers. In this study, computer self-efficacy and interest were determined through the Computer Science Interest Survey (Appendix A) given to a group of high school seniors. The survey contained statements about the students' beliefs regarding their perceived competence when working with computers as well as their perceived enjoyment when working with computers. In addition, the survey provided an opportunity for students to express their level of interest in a series of computer science career-related tasks. Independent variables included gender and participation. Dependent variables were computer self-efficacy and interest.

This chapter presents the analysis of the data and findings obtained for the research objectives. Specifically, the data were used to examine the relationships between gender and computer self-efficacy, participation and computer self-efficacy, gender and interest, and participation and interest. Data analysis included descriptive statistics and t-tests. An alpha level of .05 was used to determine the effect of each independent variable on the dependent variables.

Analysis of Research Questions

Research Question 1

What is the computer self-efficacy score of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

Table 2 presents the descriptive statistics for high school seniors' computer self-efficacy. Computer self-efficacy was determined by totaling responses to 15 statements on the Computer Science Interest Survey (Appendix A) relating to students' beliefs about their computer skills. The overall self-efficacy score had a possible range of 15-60. Scores closer to 60 indicated less computer self-efficacy. Self-efficacy was analyzed in conjunction with both gender and participation. Gender was an independent variable with two values, male and female. The mean computer self-efficacy score for male students was 23.60 and for female students the mean computer self-efficacy score was 25.42. Participation, a second independent variable, also had two categories, "yes" or "no." A "yes" answer was used if a student indicated he or she had taken any one of six CS courses listed on the Computer Science Interest Survey (Appendix A). A "no" value was used if a student indicated that he or she had not taken any of the six CS courses listed on the Computer Science Interest Survey (Appendix A). The mean score for students who indicated "yes" for participation was 22.80 and the mean score for students who indicated "no" for participation was 25.82.

Table 2

Descriptive Statistics for Computer Self-Efficacy

	Mean	SD	Variance	Minimum	Maximum
Male students (n = 107)	23.60	6.70	44.92	15	40
Female students (n = 110)	25.42	7.61	57.84	15	57
Participation "Yes" (n = 93)	22.80	5.82	33.88	15	40
Participation "No" (n = 124)	25.82	7.88	62.15	15	57

Research Question 2

What is the computer science career interest score of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

Table 3 presents the descriptive statistics for high school senior's interest. Interest was determined by totaling responses to 13 statements relating to CS job-related tasks listed on the Computer Science Interest Survey (Appendix A). The overall interest score had a possible range of 13-52. Scores closer to 52 indicated more interest in CS job-related tasks. Interest was analyzed in conjunction with both gender and participation. Gender was an independent variable with two values, male and female. The mean interest score for male students was 30.84 and for female students the mean score was 26.05. Participation, a second independent variable, also had two categories, "yes" or "no." A "yes" answer was used if a student indicated he or she had taken any one of six CS courses listed on the Computer Science Interest Survey (Appendix A). A "no" value was used if a student indicated that he or she had not taken any of the six CS courses listed on the Computer Science Interest Survey (Appendix A). The mean score for students who indicated "yes" for participation was 31.70 and the mean score for students who selected "no" for participation was 25.94.

Table 3

Descriptive Statistics for Interest

	Mean	SD	Variance	Minimum	Maximum
Male students (n = 107)	30.84	10.62	112.76	13	52
Female students (n = 110)	26.05	10.36	107.42	13	52
Participation "Yes" (n = 93)	31.70	11.15	124.39	13	52
Participation "No" (n = 124)	25.94	9.75	95.16	13	52

Research Question 3

Is there a significant difference in computer self-efficacy scores of seniors, 18 years old or older, at a large, suburban high school in Georgia based on gender?

An independent samples *t*-test was conducted to evaluate the relationship between gender and computer self-efficacy. The independent variable, gender, was a categorical variable consisting of the values male or female. The students self-reported their gender as either male or female. The dependent variable, computer self-efficacy, was a continuous variable with possible values ranging from 15-60. The computer self-efficacy total score for each respondent was determined by calculating the sum of responses on 15 statements relating to computer skills listed on the Computer Science Interest Survey (Appendix A). The *t*-test results indicate there is no statistically significant difference between males (N = 107, M = 23.60, SD = 6.70) and females (N = 110, M = 25.42, SD = 7.61) with regard to computer self-efficacy ($t = -1.868$, df = 215, p = .063) at alpha = .05. A Type II error should be considered when no statistically significant different is found. A Type II error is the concern that the null hypothesis was not rejected when in fact is was actually false (Hinkle et al., 1998).

Research Question 4

Is there a significant difference in computer self-efficacy scores of seniors, 18 years old or older, at a large, suburban high school in Georgia based on participation in high school computer science courses?

An independent samples *t*-test was conducted to evaluate the relationship between participation and computer self-efficacy. The independent variable, participation, was a categorical variable consisting of the values "yes" or "no." The "yes" value indicated a student had taken at least one CS course of the six listed on the Computer Science Interest Survey (Appendix A) while a "no" value indicated that a student had not taken any of the six CS courses listed on the Computer Science Interest Survey (Appendix A). The students self-reported their response as either "yes" or "no." The dependent variable, computer self-efficacy, was a continuous variable with possible values ranging from 15-60. The computer self-efficacy total score for each respondent was determined by calculating the sum of responses on 15 statements relating to computer skills listed on the Computer Science Interest Survey (Appendix A). The *t*-test results indicate there is a statistically significant difference between "yes" (N = 93, M = 22.80, SD = 5.82) and "no" (N = 124, M = 25.81, SD = 7.88) with regard to computer self-efficacy (*t* = -3.245, df = 215, p = .001) at alpha = .05. The practical significance of Cohen's *d* = 0.44 indicates a medium effect.

Research Question 5

Is there a significant difference in computer science career interest scores of seniors, 18 years old or older, at a large, suburban high school in Georgia based on gender?

An independent samples *t*-test was conducted to evaluate the relationship between interest and computer self-efficacy. The independent variable, gender, was a categorical variable

consisting of the values male or female. The students self-reported their gender as either male or female. The dependent variable, interest, was a continuous variable with possible values ranging from 13-52. The total interest score for each respondent was determined by calculating the sum of responses on 13 statements relating to interest for specific CS job-related tasks listed on the Computer Science Interest Survey (Appendix A). The *t*-test results indicate there is a statistically significant difference between males (N = 107, M = 30.84, SD = 10.62) and females (N = 110, M = 26.05, SD = 10.36) with regard to interest (*t* = 3.367, df = 215, p = .001) at alpha = .05. The practical significance of Cohen's *d* = 0.46 indicates a medium effect.

Research Question 6

Is there a significant difference in computer science career interest scores of seniors, 18 years old or older, at a large, suburban high school in Georgia based on participation in high school computer science courses?

An independent samples *t*-test was conducted to evaluate the relationship between participation and interest. The independent variable, participation, was a categorical variable consisting of the values "yes" or "no." The "yes" value indicated a student had taken at least one CS course of the six courses listed on the Computer Science Interest Survey (Appendix A) while a "no" value indicated that a student had not taken any of the six CS courses listed on the Computer Science Interest Survey (Appendix A). The students self-reported their response as either "yes" or "no." The dependent variable, participation, was a continuous variable with possible values ranging from 13-52. The total participation score for each respondent was determined by calculating the sum of responses on 13 statements relating to interest in CS job-related tasks listed on the Computer Science Interest Survey (Appendix A). The *t*-test results indicate there is a statistically significant difference between "yes" (N = 93, M = 31.70, SD =

11.15) and "no" (N = 124, M = 25.94, SD = 9.75) with regard to computer self-efficacy (t = 4.043, df = 215, p = .000) at alpha = .05. The practical significance of Cohen's d = 0.55 indicates a medium effect.

Summary

The results of this study revealed no statistically significant difference between gender and computer self-efficacy.   While research has indicated that males and females do not feel the same about their computer skills (Birol, Bekirogullari, Etci & Dagli, 2009; Harris et al., 2009), the results of this study would indicate that is not the case—both males and females feel about the same concerning their computer abilities. Statistically significant differences were found between gender and interest, participation and computer self-efficacy and participation and interest. These are important aspects to look at in relation to the concern over the lack of students selecting CS as a major (Foster, 2005; Frauenheim, 2005; Klawe & Schneiderman, 2005).

CHAPTER 5

Conclusions and Recommendations

This chapter restates the rationale, purpose, and research questions for this study. A summary of the findings and conclusions drawn from the analysis of the data is discussed. The chapter concludes with recommendations for further research.

Rationale

An ongoing problem that exists in the computer science (CS) area is that there is a shortage of college CS graduates (Foster, 2005; Frauenheim, 2005; Klawe & Schneiderman, 2005). While the number of CS graduates has declined over the last ten years, the number of CS jobs has continued to grow, leaving many CS jobs without qualified candidates to fill them (Becerra-Fernandez et al., 2010; Cahalan, 2007; Denning & McGettrick, 2005; Gates, 2007; Raines, 2011b). The United States Department of Labor, Bureau of Labor Statistics, has predicted that computer-related occupations will be one of the areas to show the most growth through 2018 (Lacey & Wright, 2009; Raines, 2011b). Technology itself continues to evolve and has begun to permeate almost every area of business which adds to the need for more qualified CS graduates (Anthes, 2006; Arora & Chazelle, 2005; Association for Computing Machinery, 2003; Association for Computing Machinery et al., 2006; Klawe & Schneiderman, 2005; Marsan, 2010, 2009; McGregory, 1990; Rashid, 2008; Victory, 2009).

In order to meet the continuing CS demands, colleges need to produce more CS graduates (Foster, 2005; Frauenheim, 2005; Klawe & Schneiderman, 2005). However, colleges alone cannot cure the problem of the reduced number of college students selecting CS as a major. Rather than waiting for students to come to them and then attempting to attract students into CS,

efforts need to be made to attract students earlier, in middle and high school (Anthes, 2006;

Denning & McGettrick, 2005; Goode, 2008; Phillips, 2006; Stephenson, 2009; Vardi, 2009;

Wilson & Harsha, 2009). There is a concern that high school students do not know what CS

actually involves and therefore do not opt to participate in CS courses or select CS as a career

option (Carter, 2006; Denning et al., 1989; Foster, 2005; Goode, 2008; Locher, 2007).

<div align="center">**Purpose and Research Questions**</div>

The purpose of this survey study was to examine the effect of gender and participation in

computer science courses on high school seniors' computer self-efficacy and interest in computer

science careers. In this study, computer self-efficacy and interest were measured using the

Computer Science Interest Survey (Appendix A).

Gender and participation were selected as factors based on the Social Cognitive Career

Theory (SCCT) of Lent et al. (1999) which suggests that a person's environment influences

career decisions. SCCT consists of four basic elements which are self-efficacy, outcome

expectations, goals, and contextual supports and barriers (Lent & Brown, 2006). The first

element, self-efficacy, which is one's belief as to whether one has the ability to demonstrate

specific talents (Lent & Brown, 2006), was studied in conjunction with gender and participation.

Participation was considered "yes" if a student had taken any one of six CS courses listed on the

Computer Science Interest Survey (Appendix A). A "no" was used if a student had not taken

any of the six CS courses listed. Outcome expectations, or what one believes will be the result of

a specific action (Lent & Brown, 2006), and goals, those factors that are used to determine

whether a particular task is worth undertaking (Lent & Brown, 2006), were also studied in

conjunction with gender and self-efficacy. In this study contextual supports and barriers, or the

support and non-support one receives when completing a task (Lent & Brown, 2006), were

<div align="center">76</div>

considered to be gender and computer self-efficacy. The independent variables in this study were gender and participation. The dependent variables were computer-self-efficacy and interest. The results of this study may be used to inform school personnel, as well as parents, of the effects of participation in CS classes on a student's interest in pursuing CS careers. Schools may be able to create an environment where students have opportunities to participate in more CS classes which may in turn lead to more students becoming interested in CS careers. In addition, students could be encouraged to participate in Career Technical Student Organizations (CTSOs) as a method of creating interest in CS classes. The results of this study may also be used to inform school personnel about gender differences, if any, with regard to computer self-efficacy and participation in CS classes. The results may be used to create new policies or adjust current policies, and to provide resources for better marketing of programs in CS. This study addressed the following research questions:

1. What is the computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

2. What is the computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, as measured by the Computer Science Interest Survey?

3. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on gender?

4. Is there a significant difference in computer self-efficacy of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on participation in high school computer science courses?

5. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on gender?

6. Is there a significant difference in computer science career interest of seniors, 18 years old or older, at a large, suburban high school in Georgia, based on participation in high school computer science courses?

Summary of Findings

The Computer Science Interest Survey (Appendix A) was distributed and completed during a one-day time period at a large high school in the largest school system in Georgia. A total of 233 surveys were returned (52%) within three days of being distributed to the Guided Study teachers. There were 16 surveys that could not be used, leaving 217 useable surveys (48%). A variety of reasons were considered for the lack of useable surveys—some surveys were only completed on the front side, some surveys did not include the data regarding gender or participation, and some surveys were missing responses for individual statements within either the computer self-efficacy section or the interest section thereby rendering those surveys unusable because a total score was needed from these sections for assessment.

The results of this study indicated no statistically significant difference between male and female high school students and computer-self efficacy. Computer self-efficacy is an assessment of future possible actions and is associated with some type of performance, such as how one uses a computer (Bandura, as cited in Betz & Hackett, 2006).   Based on the mean scores of both male and female high school students, male students were slightly more confident in their computer skills than female high school students. Other findings of this study indicated a statistically significant difference between students who have participated in a CS class and those who have not. Participation was defined as either "yes" (had taken any one of six CS courses listed on the Computer Science Interest Survey (Appendix A)) or "no" (had not taken any CS courses while in high school).   A statistically significant difference was also found between gender and interest.

Interest was whether or not a student indicated he or she enjoyed completing tasks relating to CS jobs. A total interest score was calculated by adding together responses from 13 statements relating to CS job tasks listed on the Computer Science Interest Survey (Appendix A). The results of the study also indicated a statistically significant difference between participation and interest. There were no open-ended questions included in the survey and no oral interviews were conducted.

Conclusions

The following conclusions were made based on the findings of this study:

1. Male and female high school students do not differ in their computer self-efficacy. The percent of male and female respondents was basically equal—49% of the respondents were male and 51% were female. Both male and female respondents reported they were confident in their computers skills. This is contradictory to previous research which has found that female students were perceived to have less computer skill, to build up interest in computers later than males, and to have less self-assurance in their general ability with computers (Harris et al., 2009).

2. Students who have participated in at least one CS class while in high school differ in computer self-efficacy from those who have not taken any CS classes while in high school. Of the 217 respondents whose survey responses were analyzed, 43% had participated in at least one CS class and 57% had not participated in any CS class. The computer self-efficacy mean score for those students who had taken at least one CS class indicated that those students were more confident in their computer skills than the students who had not taken any CS classes. This finding is consistent with the findings in

a previous study conducted by Karsten & Schmidt (2008) which found that there is an influence on computer self-efficacy by participation.

3. Male and female high school students differ in their level of interest to pursue a CS career. The mean interest score for males was greater than the mean interest score for females. This is consistent with previous studies which have indicated women do not enter the field because of negative perceptions such as thinking CS jobs are "nerdy" or having to sit in front of a computer all day (Denning & McGettrick, 2005; Harris et al., 2009) and the general lack of understanding as to what computer science careers actually entail (Gupta & Houtz, 2000; Kastrul, 2008; Rashid, 2008).

4. Previous participation in a CS class might be a factor in whether a student is interested in pursuing a CS career. The results of the study indicated that the mean "yes" interest score was greater than the mean "no" interest score, but a bias may exist in that the collection of students comprising the "yes" group might all have had similar interests in computer science before enrolling in a CS class. The results align with previous research regarding career issues that indicate interest usually develops as a bi-product of experience (ACT, 2005).

Discussion and Implications

This study sought to determine if the computer self-efficacy of high school students was influenced by gender. Computer self-efficacy is a student's opinion of his or her competence to successfully perform in a CS major (Akbulut & Looney, 2007). Previous studies have indicated that gender affects how a student feels about his or her computer self-efficacy. The primary concerns in the past have been that male students are more likely to believe they are good with computers while female students are less likely (Harris et al., 2009). In addition, male students

80

were previously found to use computers for more technical activities while female students frequently just used computers for word processing and similar activities (Bleeker, 2005, Jackson et al., 2008). Two studies conducted ten years apart relating to computer self-efficacy indicated that although more core high school courses incorporated the use of computers in 2006 than in 1996, the increased computer use did not translate into significantly increased computer self-efficacy scores for female students (Karsten & Schmidt, 2008).

> Males have traditionally dominated the use of computers and their applications in technological fields. Many researchers have attributed this gender gap in computer use to anxiety about using computers. Computer anxiety among females does not lessen with age or with experience using computers, and females have held a more negative attitude toward using computers than males (Birol et al., 2009, p. 185).

The findings of the study conducted by Birol, Bekirogullari, Etci and Dagli (2009) were that there was a significant difference between females and males in computer self-confidence—females' scores were much less than males' scores. Both had scores which expressed confidence in using computers but mens' scores were greater with regard to self-efficacy. A study conducted by He and Freeman (2010) also indicated that females are less confident in their computer skills because they have used computers less and are more nervous about using computers when compared to male students. The findings from this study are important because they contradict previous studies which have indicated that high school girls did not enter the CS field because of low confidence in their skills to use computers—in other words, they had low computer self-efficacy (Harris et al., 2009). While most of the previous research has indicated a difference in computer self-efficacy with regard to gender, not all research has found the same results. A study conducted in 2002 by Beyer, Chaves and Rynes looked at gender and

stereotypes with regard to computer self-efficacy in first-year college CS students and found no gender difference for first-year students. The results of this study add to the existing body of literature regarding gender and computer self-efficacy.

The current study looked at the association between participation and computer self-efficacy. Participation was considered to be "yes" if a student had taken any one of six CS courses offered at the target high school. The "no" response for participation indicated that a student had not taken any CS courses while in high school. Deniz and Ulas (2008) believe that academic success and career options have been limited for people having computer anxiety (as cited in Birol et al., 2009). "Self-efficacy, outcome expectations, and interest constitute important factors that independently and cumulatively shape student aspirations to choose a computing major" (Akbulut & Looney, 2007, p. 69). With computer technology changing rapidly and the rising popularity of computers, most students entering college have a great amount of prior computer experience (Shiue, 2002). The low numbers of students majoring in CS cannot be totally attributed to a lack of knowledge with computers (Harris et al., 2009). "Studies have shown that college students' prior computer course experiences are positively correlated to computer competency and performance in entry level computer science" (Shiue, 2002). One way for college students to garner prior computer experience is by taking CS classes in high school. However, the number of CS classes currently being taught in America is on the decline (Communications of the ACM, 2009). In order to know success, students need to enjoy the learning experience while at the same time have an opportunity to explore interesting, inventive and challenging topics. They need to have the opportunity to build up expectations that their efforts will be rewarded (Akbulut & Looney, 2007). Several studies have been conducted that examined the relationship between prior computer experience and students'

perceptions of their abilities. These studies found that computer competencies were perceived to be greater if they had participated in a wide variety of computer experiences (Hill, Smith & Mann, 1986; Karsten & Roth, 1998; Shiue, 2002). Students are more likely to develop interests in CS when they feel secure about the capabilities to be successful and believe that good things will happen as a result of majoring in CS (Akbulut & Looney, 2007). The current study adds to the existing body of literature suggesting that participation has an effect on computer self-efficacy.

Further results of the current study indicated that there is a difference between male and female high school students in their level of interest in pursuing a CS career. Women are underrepresented in the CS fields even though the job prospects and potential earnings remain positive (Harris et al., 2009). Studies have been conducted to determine why more women do not enter the CS field and frequent findings indicate that stereotypes of women being poor at math was frequently a reason for not entering science and technology fields (Cheryan et al., 2009; Denning & McGettrick, 2005; Foster, 2005). There has been much less research conducted regarding barriers that prevent women from developing an interest in computer science careers in the first place (Cheryan et al., 2009). Another area of concern is that women generally see the CS field as being a male-oriented environment with favoritism towards men (Harris et al., 2009). It is possible that some men also view the stereotypical computer setting as unappealing and might not select CS as a major because of additional stereotypes such as social awkwardness or unhealthy obsession with computers (Cheryan et al., 2009).

Lori Carter (2006) conducted a study to determine why more students with an obvious ability in CS did not consider it as a major and whether gender was a factor. In her study, she found that 40 percent of the men had taken at least one CS class previously but only 27 percent

of the women had taken a similar class (Carter, 2006). Female students need more motivation to take CS courses than males (Birol et al., 2009). One study sought to determine if there were specific high school courses that were taken by students who were interested in technology versus those not interested in technology. The results indicated that male and female students are taking CS courses at about the same rate, yet it does not lead to majoring in CS in college (Harris et al., 2009). Additional work needs to be completed that looks at the misconceptions about gender differences with regard to course selection in high school early in a student's educational career (Harris et al., 2009). "Environments can act like gatekeepers by preventing people who do not feel they fit into those environments from ever considering membership in the associated groups" (Cheryan et al., 2009, p. 1045). Making classroom settings more appealing to women can help indicate to women that they belong there and are imperative for future participation (Cheryan et al., 2009). "Altering a group's image by changing their environments can therefore inspire those who previously had little or no interest in pursuing the group to express a newfound interest in it" (Cheryan et al., 2009, p. 1058). Cheryan, Plaut, Davies and Steele (2009) found that small changes of a few items in a computer science classroom gave women an interest in considering CS. This study confirms the previous research that gender has an influence on participation in CS classes.

The results of the current study indicated that previous participation in a CS class by the target population might have had an effect on a student's interest in CS job-related tasks, thereby suggesting participation might have an effect on a student's interest in CS occupations as well. Finding interested students to major in CS is important because CS has an impact on almost every career area—there are CS majors working in a variety of fields other than strictly CS (Guzdial, 2009; Morris & Lee, 2010; Pandeya, 2010). Educational programs are under

continuing pressure to provide qualified graduates in order to meet the future needs in the CS areas (Akbulut & Looney, 2007). Rather than telling students they should be interested in CS because it will be helpful, we should work on actually helping students become interested in CS by showing them how CS can help with whatever their career interests are (Stephenson, 2010). Waiting until students are in college to interest them in CS careers is too late; the interest must be focused on high schools and middle schools (Morris & Lee, 2010). Students start thinking about their careers as early as eighth grade and the career aspirations become clearer as students continue through high school (ACT, 2005; Harris et al., 2009). Encouraging students to take part in a variety of activities as early as middle school is important because students who have researched all of their educational and career options make more knowledgeable career decisions (ACT, 2005). Students need to be encouraged to think about their interests as well as their skills (ACT, 2005).

Choice goals, according to SCCT, are a predecessor to actual choices. A student who selects a career in CS is more likely to ultimately pursue it (Akbulut & Looney, 2007). Choice goals are influenced by interest, self-efficacy and outcome expectations. Interest is the emotion that is created which in turn instigates a curiosity about a computing major. A student who is more interested in a major is more likely to set goals to choose it (Akbulut & Looney, 2007). Outcome expectations are a student's opinion about the belief that worthy rewards will be forthcoming by pursuing a CS major (Akbulut & Looney, 2007). In other words, they influence one's choice goals (Akbulut & Looney, 2007). Even though many students who enroll in CS in college have prior computing experience, they have had nominal exposure to computing within a vocational setting; therefore, they are more uncertain about their abilities to handle a beginning computing class (Akbulut & Looney, 2007), and the vocational environment of CS lowers its

appeal to many students (Morris & Lee, 2010). "When making educational and career decisions, students need to be encouraged to investigate careers that are consistent with their interests. They should also be encouraged to consider the current and projected availability of employment in those careers" (ACT, 2005, p. 2). Students should select high school classes that match their career interests and goals; however, many students seem to focus on everything except preparation for an intended major or career (Ayotte & Sevier, 2010). Without more robust counseling for high school students, they may continue to wander through high school without learning about all of the career opportunities available and without acquiring the skills to help them benefit from those opportunities (Reese, 2010). Students' ambitions can be influenced by a variety of sources, including parents, educators, and counselors (ACT, 2005; Womble, Adams & Stitt-Gohdes, 2000). This study adds to the body of existing literature and substantiates prior research findings that participation increases a student's interest.

Recommendations

These recommendations for additional research are based upon the findings and conclusions of the current study.

1. Additional studies should be conducted to determine if equality of computer self-efficacy among genders exists at all age levels. As computer technology has continued to evolve at an extremely rapid pace, students younger and younger are provided opportunities to use computers regularly. Has the development of new technology provided students with a comfort level to the extent that all students, male and female, feel confident in their overall computer self-efficacy?

2. A similar study should be conducted in an area of the state where the students do not have as much exposure to computer use on a daily basis to further test the findings

that participation affects self-efficacy. The sample in this consisted of students who had access to computers on a daily basis and throughout the school day in many of their classes. In addition, most students have access to computers outside of school and are expected to complete assignments on a regular basis through the use of a computer. A wide variety of courses are offered which provide students a multitude of opportunities to use computers regularly. The findings that computer self-efficacy is affected by participation could be tested to determine if there are advantages to having computers available on a daily basis or if all students have acquired more computer self-efficacy with the overall advancement of technology.

3. Prior research has confirmed that outside influences—counselors, parents, teachers, peers—can alter a person's decision about what career path to follow. With the passage of Georgia Senate Bill 387 in 2010, which provides counseling and advisement for students in grades six through 12, opportunities exist through counselors to influence more students into the areas of CS. Efforts need to be made to educate counselors about CS career options—and such efforts could be informed by a study (or studies) to determine where the deficiencies lie in counselors' personal knowledge of CS career options and the skills needed for those careers. The results of the study could lead to additional counseling suggestions and techniques to interest more students in CS careers.

4. Research continues to indicate a concern regarding gender differences and CS interest and why so few female students select CS as a viable major. Efforts have been implemented by CS professionals and organizations to improve female student participation in CS classes and additional studies need to be conducted to determine if

those efforts are making a difference in the number of female students selecting CS as a major.

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Final Survey Instrument

Computer Science Interest Survey

"Computing and computer technology are part of everything that touches our lives from the cars we drive, to the movies we watch, to the ways businesses and governments deal with us" (ACM, 2009). As this statement indicates, there is a need for skilled workers in all aspects of the computer science field. However, few students elect computer science as a career choice. The purpose of this survey is to look at several aspects of computer science. Your cooperation in completing the questionnaire is appreciated.

Do not put your name anywhere on this form. Your answers will be confidential and you will remain completely anonymous. You may decide not to take the survey without penalty.

For each of the following statements about your abilities when working with computers, indicate your level of agreement.

		Strongly Disagree			Strongly Agree
1.	I enjoy working with computers.	1	2	3	4
2.	I often have difficulties when trying to learn how to use a new computer package.	1	2	3	4
3.	I am very confident in my ability to use computers.	1	2	3	4
4.	Computers are far too complicated for me.	1	2	3	4
5.	I find working with computers very easy.	1	2	3	4
6.	As far as computers go, I feel less competent than my classmates.	1	2	3	4
7.	Using a computer makes me anxious.	1	2	3	4
8.	I consider myself a more skilled computer user than most of my classmates.	1	2	3	4
9.	I am very unsure of my ability to use computers.	1	2	3	4
10.	If given the opportunity to use a computer, I am afraid that I might damage it in some way.	1	2	3	4
11.	I hesitate to use a computer.	1	2	3	4
12.	I feel apprehensive about using a computer.	1	2	3	4
13.	Using a computer does not scare me at all.	1	2	3	4
14.	I hesitate to use a computer for fear of making mistakes I cannot correct.	1	2	3	4
15.	Computers make me feel uncomfortable.	1	2	3	4

For each of the following descriptions, indicate your level of interest.

		Not Interested At All			Very Interested
16.	Designing and constructing computers and computer-based systems	1	2	3	4
17.	Meeting the computer technology needs of healthcare organizations	1	2	3	4
18.	Devising new ways to use computers	1	2	3	4
19.	Developing and maintaining software systems that are affordable to develop and maintain	1	2	3	4
20.	Integrating information technology solutions to manage the information needs of businesses and other enterprises	1	2	3	4
21.	Meeting the computer technology needs of government agencies	1	2	3	4
22.	Designing and constructing computer-based systems	1	2	3	4
23.	Developing effective ways of solving computing problems	1	2	3	4
24.	Integrating business processes to manage the information needs of businesses and other enterprises	1	2	3	4
25.	Designing and implementing software	1	2	3	4
26.	Developing and maintaining software systems that behave reliably and efficiently	1	2	3	4
27.	Meeting the computer technology needs of schools	1	2	3	4
28.	Developing and maintaining software systems that satisfy all the requirements that customers define for them	1	2	3	4

29.   Have you taken any of the courses listed below?   _____ Yes   _____ No

AP Computer Science
Beginning Computer Programming
Business Communication and Presentation (previously called Multimedia)
Computer Applications
Computing in the Modern World
Fundamentals of Web Design

30.   What is your gender?   _____ Male   _____ Female

Thank you for taking the time to complete this questionnaire.

Appendix B

Permission to Use Survey

"Marina Papastergiou" <mpapas@pe.uth.gr

To <Janet_Blouin@gwinnett.k12.ga.us>
cc
01/24/2009 10:54 AM

Subject Re: About my article, Are CS and IT still masculine fields?

Dear Janet,

Please find attached the questionnaire used in my paper:

Papastergiou, M. (2008). Are Computer Science and Information Technology still masculine fields? High school students' perceptions and career choices. Computers & Education, 51(2), 594-608.

Please also note that this questionnaire is being sent to you under the understanding that it will be used only for the purposes of your research, that it will not be distributed to other persons and that the afore-mentioned paper will be referenced in your work.

I wish you good luck with your research efforts.

Best regards,

Marina Papastergiou, PhD, Lecturer
University of Thessaly
Department of Physical Education & Sport Science
42100 Karyes, Trikala, Greece

Appendix C

McKlin Suggested Revisions to Survey

Janet S. Blouin

Computer Science Interest Survey

"Computing and computer technology are part of everything that touches our lives from the cars we drive, to the movies we watch, to the ways businesses and governments deal with us" (ACM, 2009). As this statement indicates, there is a need for skilled workers in all aspects of the computer science field. However, enrollment in high school computer science courses is very low. The purpose of this questionnaire is to help determine ways to increase enrollment in computer science courses. Your cooperation in completing the questionnaire is appreciated.

Do not put your name anywhere on this form. Your answers will be confidential and you will remain completely anonymous. You may decide not to take the survey without penalty.

For each of the following statements about your abilities when working with computers, ~~indicate~~circle the number that most closely matches your level of agreement.

	Strongly Disagree				Strongly Agree
I enjoy working with computers.	1	2	3	4	5
I often have difficulties when trying to learn how to use a new computer package.	1	2	3	4	5
I am very confident in my ability to use computers.	1	2	3	4	5
Computers are far too complicated for me.	1	2	3	4	5
I find working with computers very easy.	1	2	3	4	5
As far as computers go, I feel less competent than my classmates.	1	2	3	4	5
Computers frighten me.	1	2	3	4	5
I consider myself a more skilled computer user than most of my classmates.	1	2	3	4	5
I am very unsure of my ability to use computers.	1	2	3	4	5
If given the opportunity to use a computer, I am afraid that I might damage it in some way.	1	2	3	4	5
I hesitate to use a computer in case I look stupid.	1	2	3	4	5
I feel apprehensive about using a computer.	1	2	3	4	5
Using a computer does not scare me at all.	1	2	3	4	5
I hesitate to use a computer for fear of making mistakes I cannot correct.	1	2	3	4	5
Computers make me feel uncomfortable.	1	2	3	4	5

Comment [TM1]: Include text descriptions for 2, 3, and 4.

Also, what is your midpoint? "Neutral," "Neither Agree nor Disagree," "In Between," "No Opinion"?

Comment [TM2]: What do you mean by package? Programming environment? Application?

Comment [TM3]: Who is your audience? Will they understand "less competent?"

For each of the following statements about computer science careers, indicate your level of agreement.

	Strongly Disagree				Strongly Agree
Working with computers allows me to be creative.	1	2	3	4	5
The computer science field is competitive.	1	2	3	4	5
Computer science careers are interesting.	1	2	3	4	5
People who work in the computer science field are well-paid.	1	2	3	4	5
Careers in the computer science field are prestigious.	1	2	3	4	5
Working in the computer science industry offers opportunities to work in a variety of fields.	1	2	3	4	5
Computer science careers are difficult to acquire.	1	2	3	4	5
The ability to computer program is a requirement to work in the computer science field.	1	2	3	4	5
Most high-tech computer science jobs are moving overseas.	1	2	3	4	5
Opportunities in the Computer Science field disappeared when the dot-com bubble burst in 2000.	1	2	3	4	5
Computing jobs are solitary and boring.	1	2	3	4	5
Salaries for computing professionals will fall as companies turn to labor overseas.	1	2	3	4	5

Comment [TM4]: Not sure what you mean by that...do you mean the people who work in it compete with each other for jobs? The salary is competitive?

Comment [TM5]: Use first person

Comment [TM6]: How about, "Programming is a requirement for working in computer science."

For each of the following Computer Science careers, indicate your level of interest in each as an occupation.

	Not Interested At All				Very Interested
Computer Engineering - designing and constructing computers and computer-based systems	1	2	3	4	5
Computer Science - designing and implementing software; devising new ways to use computers; developing effective ways of solving computing problems	1	2	3	4	5
Information Systems - integrating information technology solutions and business processes to manage the information needs of businesses and other enterprises	1	2	3	4	5
Information Technology - meeting the computer technology needs of government, healthcare, schools, and other kinds of organizations	1	2	3	4	5
Software Engineering - developing and maintaining software systems that behave reliably and efficiently, are affordable to develop and maintain, and satisfy all the requirements that customers define for them	1	2	3	4	5

Comment [TM7]: Again, include descriptions for 2, 3, and 4

Comment [TM8]: I had a little trouble figuring out where you were going here. It's not clear at first that the text below each job is a description or definition for that job. Now that I get it, I'm not really sure how to fix it.

107

From the choices below, please mark the one that best represents your main reason for using a computer.

☐ Playing games
☐ Completing school work
☐ Blogging
☐ Other (describe) _____

☐ Sending email
☐ Searching the Internet
☐ Social networking

> **Comment [TM9]:** Ask your respondents to give a rating for each option. This could be a frequency rating for each one such as a scale like "never, seldom, often, all the time"

Have you taken any computer science courses at Brookwood High School?   ☐ Yes   ☐ No

If you marked "Yes" in the previous question, please mark which of the following computer courses you have taken. Please mark all that you have taken.

☐ AP Computer Science
☐ Beginning Computer Programming
☐ Fundamentals of Web Design

☐ Business Communication and Presentation (Multimedia)
☐ Computer Applications (Word Processing)
☐ Computing in the Modern World

If you have NOT taken any of the computer science courses listed above, which of the following was the main reason?

☐ Lack of interest
☐ People who use computers are nerds
☐ I didn't have room in my schedule
☐ My counselor told me to take an academic course instead

☐ I don't like using computers
☐ Computer Science courses don't count towards HOPE
☐ A friend took a course and said it was boring
☐ A friend took a course and said I would already know everything in the class

> **Comment [TM10]:** See item 11 on the attached survey

Do you plan on majoring in Computer Science in college?   ☐ Yes   ☐ No

Who in your home uses a computer? Check all that apply.

☐ Only me
☐ Mother
☐ Father

☐ Brother(s)
☐ Sister(s)
☐ Other _____

What is your gender?   ☐ Male   ☐ Female

Thank you for taking the time to complete this questionnaire.

Appendix D

IRB Approval

The University of Georgia

Office of The Vice President for Research
DHHS Assurance ID No. : FWA00003901

Institutional Review Board
Human Subjects Office
612 Boyd GSRC
Athens, Georgia 30602-7411
(706) 542-3199
Fax: (706) 542-3360
www.ovpr.uga.edu/hso

APPROVAL OF RENEWALS / CHANGES

Request Date: 2010-11-12   Project Number: 2011-10377-0

Name	Title	Dept,Phone	Address	Email
Dr. Elaine Adams	PI	Workforce Education 206 Rivers Crossing 4809 706-542-4284		adamsje@uga.edu
Ms. Janet S. Blouin	CO	WELSF 770-972-0115	1300 Blyth Walk Snellville, GA 30078	jsblouin@uga.edu

Title of Study: High School Student's Interest in Computer Science Careers.

48 CFR 46 Category: Expedite   Renew : No   Change(s) : Receipt of Recruitment Scripts;
Parameters: Revised Application;
Reviewed per Subpart D (46.404): Permission of   Revised Consent Document(s);
one parent may be sufficient;
Approved for Institutions with Authorization
Letters on File;

Approved : 2011-01-06   Begin date : 2011-01-06   Expiration date : 2012-01-05

NOTE: Any research conducted before the approval date or after the end data collection date shown above is not covered by IRB approval, and cannot be retrospectively approved.

Number Assigned by Sponsored Programs: Funding Agency:

Your request for approval of renewal and/or changes has been approved.

You must report any adverse events or unanticipated risk to the IRB within 24 to 72 hours. Refer to the IRB Guidelines for additional information.

Use the attached Researcher Request Form for requesting renewals, changes, or closures.
Keep this original approval form for your records.

Chairperson or Designee,
Institutional Review Board

Appendix E

Gwinnett County Approval

!

December 1, 2010

Janet S. Blouin
1300 Blyth Walk
Snellville, GA 30078

Re: **File ID 2011-39**

Dear Ms. Blouin:

This is to advise you that your proposal, High School Students' Interest in Computer Science Careers," (File ID 2011-39), has been approved with the following comments and limitations:

- The first three sentences of the text preceding the items of the student questionnaire seem superfluous and potentially leading. Consider omitting them.

- Since the survey is designed to be anonymous, confidentiality of responses is not an issue, and need not be addressed in the text preceding the items.

- If the survey instrument has been adopted or adapted from previous research, a citation of the survey's origins should be included with the survey.

- If the survey has not been validated, consider creating more balance between positively-worded and negatively-worded items.

- It seems that the completion of the courses listed might provide different relationships to the survey questions as would the end grade received in these classes. Consider revision to account for these potential differences.

Important: When contacting schools regarding this research, it is your responsibility to provide a copy of this approval letter to the principal. In addition, it is your responsibility to provide your sponsors and project officers or managers with a copy of this approval letter. **Be sure to use the file ID number issued above when contacting schools or district level personnel regarding this research study.**

Please note that schools and teachers may elect not to participate in your research study, even though the district has granted permission.

Please forward a copy of your results to me when they are completed. Also, we would appreciate you providing us with feedback on the research approval process by completing the enclosed survey and returning it in the enclosed postage-paid envelope.

Best wishes for a successful research project. Please call me at (678) 301-7090 if I may be of further assistance.

Sincerely,

Colin Martin

Digitally signed by Colin Martin
DN: cn=Colin Martin, o=Gwinnett County Public Schools, ou=Research & Evaluation,
email=Colin_Martin@Gwinnett.K12.GA.US, c=US
Date: 2010.12.07 09:01:39 -05'00'

Colin Martin, Ph.D., Executive Director
Research and Evaluation

cc: Janet Blouin, janet_blouin@gwinnett.k12.ga.us
     Dr. Elaine Adams, adamsje@uga.edu

Appendix F

Pilot Study – Parental Permission Letter

Date

Dear Parent/Guardian:

I am a doctoral candidate at the University of Georgia in the department of Workforce Education. My study is examining high school students' interest in computer science careers.

As part of my doctoral studies I am conducting a survey study on high school students' interest in computer science careers, their belief about their computer self-efficacy, their interest in specific tasks associated with computer science careers and whether or not they have taken any computer science courses while at Parkview High School.

If you decide to let your child participate, I will collect information from a survey that students will complete during their Guided Study period. At the end of the collection of data from the surveys I will look at the relationships between high school students' interest in computer science careers and their understanding of the tasks associated with computer science careers and their own computer self-efficacy. The results of this pilot study will be analyzed to determine the validity of the survey instrument in preparation for the final study to be conducted at a different high school later in the spring.

Please note that participation in this study is voluntary and no data will be collected for use within this study unless permission is granted. The actual survey responses will be totally anonymous with the only specific identifying information being gender. No student names or other personal information will be used during this study. The only time the students' names will be used will be to determine who has returned permission forms.

Please read over the attached parental permission form that explains this research study. If you agree to allow me to survey your child for use within this study, please sign the bottom of the permission form and have your child return the form to me when I revisit his/her Guided Study on Thursday, February 10. Thank you for your assistance.

Sincerely,

Janet S. Blouin
Department and Workforce Education,
   Leadership and Social Foundations
janet_blouin@gwinnett.k12.ga.us
678-344-9023

Appendix G

Parental Permission Form

The University of Georgia
Department of Workforce Education, Leadership and Social Foundations

Title: High School Students' Interest in Computer Science Careers

Student Investigator: Janet S. Blouin

Principal Investigator/Faculty Advisor: J. Elaine Adams, Ph.D.

1.   The purpose of this study will be to examine the effect of computer self-efficacy, gender, and participation in computer science courses on high school students' interest in computer science careers.

2.   Your child is invited to participate in a research study that focuses on student interest in computer science classes and computer science career tasks. The survey will ask questions pertaining to computer self-efficacy and interest in specific tasks associated with computer science careers.

Procedure—Students will participate through their Guided Study classes, during the week of February 7-11. Those students who have returned signed permission forms will be asked to complete a paper and pencil survey. Other than determining which students have returned permission forms, no student identifying characteristics will be garnered as a result of this survey. Students will only be identified by gender. The survey will take approximately 10 minutes to complete and will be completed during one Guided Study period.

Risks—Participation in this study does not pose a risk or discomfort greater than a regular school day.

Benefits—Participants in this study will help educators determine the extent to which computer science careers need to be addressed in order to continue to provide qualified candidates to fill the increasing needs in computer science.

Voluntary Participation—Participation in this study is voluntary. If you decide not to let your child participate, your decision will not affect your students' well being at Parkview High School. Your child can refuse to take part or drop out of the study at any time without penalty or loss of benefits to which he/she is otherwise entitled.

Confidentiality—Any data that will be collected will be compiled anonymously in an Excel spreadsheet to be used for statistical purposes only. There will be no identifying indicators used in the compilation of the data. Data will be compiled in a manner that will not allow identification of any individual students. Surveys will be randomly numbered from 1-60 for data entry purposes only—no identifying information other than gender will be used.

Contact Persons—You may call Dr. Elaine Adams at The University of Georgia, Department of Workforce Education, Leadership and Social Foundations, 706-542-4204, or adamsje@uga.edu, if you have questions.

Copy of Permission Form—Please sign both copies, keep one and return one to the Guided Study teacher.

_____   _____
Child's Name   Guided Study Teacher

_____
Parent Name (Please Print)

_____   _____
Parent Signature   Date

Additional questions or problems regarding your child's rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 629 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone 706- 542-3199; E-Mail Address IRB@uga.edu

Appendix H

Pilot Study - 18 Year Old Consent Letter

Date

Dear Student:

I am a doctoral candidate at the University of Georgia in the Department of Workforce Education. My study is examining high school students' interest in computer science careers.

As part of my doctoral studies I am conducting a survey study on high school students' interest in computer science careers, their belief about their computer self-efficacy, their interest in specific tasks associated with computer science careers and whether or not they have taken any computer science courses while at Parkview High School.

If you decide to participate, I will collect information from a survey that you will complete during one of your Guided Study periods. At the end of the collection of data from the surveys I will look at the relationships between high school students' interest in computer science careers and their understanding of the tasks associated with computer science careers and their own computer self-efficacy. The results of this pilot study will be analyzed to determine the validity of the survey instrument in preparation for the final study to be conducted at a different high school later in the spring.

Please note that participation in this study is voluntary and no data will be collected for use within this study unless your permission is granted. The actual survey responses will be totally anonymous with the only specific identifying information being gender. No student names or other personal information will be used during this study. The only time students' names will be used will be to determine who has returned consent forms.

Please read over the attached consent form that explains this research study. If you agree to participate in this study, please sign the bottom of the consent form and return the form to me today or Thursday, February 10. Thank you for your assistance.

Sincerely,

Janet S. Blouin
Department and Workforce Education,
   Leadership and Social Foundations
janet_blouin@gwinnett.k12.ga.us
678-344-9023

Pilot Study – 18 Year Old Consent Form

The University of Georgia
Department of Workforce Education, Leadership and Social Foundations

Title: High School Students' Interest in Computer Science Careers

Student Investigator: Janet S. Blouin

Principal Investigator/Faculty Advisor: J. Elaine Adams, Ph.D.

1.   The purpose of this study will be to examine the effect of computer self-efficacy, gender, and participation in computer science courses on high school students' interest in computer science careers.

2.   You are invited to participate in a research study that focuses on student interest in computer science classes and computer science career tasks. The survey will ask questions pertaining to computer self-efficacy and interest in specific tasks associated with computer science careers.

Procedure—Students will participate through their Guided Study classes, during the week of February 7-11. Those students who have returned signed consent forms will be asked to complete a paper and pencil survey. Other than determining which students have returned consent forms, no student identifying characteristics will be gathered as a result of this survey. Students will only be identified by gender. The survey will take approximately 10 minutes to complete and will be completed during one Guided Study period.

Risks—Participation in this study does not pose a risk or discomfort greater than a regular school day.

Benefits—Participants in this study will help educators determine the extent to which computer science careers need to be addressed in order to continue to provide qualified candidates to fill the increasing needs in computer science.

Voluntary Participation—Participation in this study is voluntary. If you decide not to participate, your decision will not affect your well being at Parkview High School. You can refuse to take part or drop out of the study at any time without penalty or loss of benefits to which you are otherwise entitled.

Confidentiality—Any data that will be collected will be compiled anonymously in an Excel spreadsheet to be used for statistical purposes only. There will be no identifying indicators used in the compilation of the data. Data will be compiled in a manner that will not allow identification of any individual students.

Contact Persons—You may call Dr. Elaine Adams at The University of Georgia, Department of Workforce Education, Leadership and Social Foundations, 706-542-4204, or adamsje@uga.edu, if you have questions.

Copy of Consent Form—Please sign both copies, keep one and return one to me.

_____   _____
Your Name   Guided Study Teacher

_____   _____
Signature   Date

Pilot Study - Student Assent Letter

Date

Dear Student:

You are invited to participate in my research project titled, "High School Students' Interest in Pursuing Computer Science Careers." Through this project I am learning about whether high school students understand the specific tasks associated with computer science careers.

If you decide to be part of this, you will spend one Guided Study period (approximately 27 minutes) with me completing a brief survey about your interest in computer tasks, your beliefs about your abilities with computers and whether or not you have taken any computer science courses while attending Parkview High School. The survey itself will take approximately 10 minutes to complete.

Your participation in this project will not affect your grades in school. I will not use your name on any papers that I write about this project. I hope to learn about connections between high school students' interest in pursuing computer science careers and their computer abilities and understanding of particular tasks. If you want to stop participating in this project, you are free to do so at any time. You can also choose not to answer questions that you don't want to answer.

If you have any questions or concerns you can always ask me or call my major professor, Dr. Elaine Adams, at The University of Georgia, Department of Workforce Education, Leadership and Social Foundations, 706-542-4204.

Sincerely,

Janet S. Blouin
Department and Workforce Education,
   Leadership and Social Foundations
janet_blouin@gwinnett.k12.ga.us
770-979-4723

I understand the project described above. My questions have been answered and I agree to participate in this project. I have received a copy of this form.

_____   _____
Signature of the Participant   Date

Please sign both copies, keep one and return one to the researcher.

Appendix K

Final Study – 18 Year Old Consent Letter

March 2, 2011

Dear Student:

I am a doctoral candidate at the University of Georgia in the department of Workforce Education. My study is examining high school students' interest in pursuing computer science careers.

As part of my doctoral studies I am conducting a survey study on high school students' interest in computer science careers, their belief about their computer self-efficacy, their interest in specific tasks associated with computer science careers and whether or not they have taken any computer science courses while at Brookwood High School.

If you decide to participate, I will collect information from a survey that you will complete during Guided Study today. At the end of the collection of data from the surveys I will look at the relationships between high school students' interest in pursuing computer science careers and their understanding of the tasks associated with computer science careers and their own computer self-efficacy.

Please note that participation in this study is voluntary and no data will be collected for use within this study unless your permission is granted. The actual survey responses will be totally anonymous with the only specific identifying information being gender. No student names or other personal information will be used during this study. The only time students' names will be used will be to determine who has returned consent forms.

Please read over the attached consent form that explains this research study. If you agree to participate in this study, please sign the bottom of the consent form and return the form to me today. Thank you for your assistance.

Sincerely,

Janet S. Blouin
Department and Workforce Education,
   Leadership and Social Foundations
janet_blouin@gwinnett.k12.ga.us
678-344-9023

Appendix L

Final Study – 18 Year Old Consent Form

The University of Georgia
Department of Workforce Education, Leadership and Social Foundations

Title: High School Students' Interest in Pursuing Computer Science Careers

Student Investigator: Janet S. Blouin

Principal Investigator/Faculty Advisor: J. Elaine Adams, Ph.D.

1.   The purpose of this study will be to examine the effect of computer self-efficacy, gender, and participation in computer science courses on high school students' interest in computer science careers.

2.   You are invited to participate in a research study that focuses on student interest in computer science classes and computer science career tasks. The survey will ask questions pertaining to computer self-efficacy and interest in specific tasks associated with computer science careers.

Procedure—Students will participate through their Guided Study classes, during the week of February 28-March 4, 2011. Those students who have returned signed consent forms will be asked complete a paper and pencil survey. Other than determining which students have returned consent forms, no student identifying characteristics will be gathered as a result of this survey. Students will only be identified by gender. The survey will take approximately 10 minutes to complete and will be completed during one Guided Study period.

Risks—Participation in this study does not pose a risk or discomfort greater than a regular school day.

Benefits—Participants in this study will help educators determine the extent to which computer science careers need to be addressed in order to continue to provide qualified candidates to fill the increasing needs in computer science.

Voluntary Participation—Participation in this study is voluntary. If you decide not to participate, your decision will not affect your well being at Brookwood High School. You can refuse to take part or drop out of the study at any time without penalty or loss of benefits to which you are otherwise entitled.

Confidentiality—Any data that will be collected will be compiled anonymously in an Excel spreadsheet to be used for statistical purposes only. There will be no identifying indicators used in the compilation of the data. Data will be compiled in a manner that will not allow identification of any individual students.

Contact Persons—You may call Dr. Elaine Adams at The University of Georgia, Department of Workforce Education, Leadership and Social Foundations, 706-542-4204, or adamsje@uga.edu, if you have questions.

Copy of Consent Form—Please sign both copies, keep one and return one to me.

_____   _____
Your Name   Guided Study Teacher

_____   _____
Signature   Date

Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 629 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone 706- 542-3199; E-Mail Address IRB@uga.edu