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Comparisons of Attitudes Toward Computer Use and Computer Technology Based on Gender and Race/Ethnicity Among Eighth Graders

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COMPARISONS OF ATTITUDES TOWARD COMPUTER USE AND COMPUTER TECHNOLOGY BASED ON GENDER AND RACE/ETHNICITY AMONG EIGHTH GRADERS

A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Table of Contents

List of Tables

Page

Abstract

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The purpose of this study is to determine whether or not having a laptop computer for individual use 24-hours-a-day, seven-days-a-week lessens differences between how eighth grade girls and eighth grade boys in 10 middle schools in Henrico County, Virginia perceive computer use and computer technology. Having a laptop computer to use at any time of the day or night eliminates the issue of competition between boys and girls for computer use. It also eliminates the need for either girls or boys to perform in front of other students while learning, thus lessening to some degree, feelings of computer anxiety. Competition for computer access and computer anxiety are two theories that have been offered to explain why many young women in previous studies have chosen not to use computers to the same extent that young men do, as well

as why many young women generally do not consider computer-related careers as career options in their futures.

A modified Computer Attitude Questionnaire, based upon the CAQ, Version 5.14 was used to survey eighth grade girls and boys in 10 Henrico County middle schools. Data collected from the surveys were analyzed using the statistical package, SPSS 14 for Windows. Comparisons were based on gender and on the self-reported race/ethnicity of the participants. A comparison of attitudes related to the number of computers already in the home in addition to the school-issued laptop was also conducted. A variety of statistical analyses were used in order to determine differences in attitudes between the boys and girls surveyed and the interactions between the attitudes of the respondents and their race/ethnicity. This was a non-experimental, quantitative, comparative research study.

CHAPTER 1 INTRODUCTION

Young women are not pursuing careers in computer-related fields at the same rate as their male counterparts. In 1996, only 4% of female college freshmen indicated an interest in computer science as a possible career alternative (Cooper & Weaver, 2003). The number of women entering information technology professions has actually declined since 1984 (Panteli, Stack, & Ramsay, 2001). In 1998, the American Association of University Women (AAUW) reported that computer science courses attract relatively few girls, noting that females comprised only 17% of Advanced Placement (AP) computer science test takers in 1996. During that same time, fewer than one in 10 of the higher-level computer science test takers were women (AAUW, 1998). Women received less than 28% of the computer science bachelor's degrees, which is down from 37% in 1984. Computer science is, in fact, the only field in which women's participation has decreased over time (AAUW, 1998).

Girls make up only a small percentage of students in computer science and computer design courses, and the gender gap seems to widen from grade eight to grade eleven (AAUW, 1998). An analysis of a survey from the Higher Education Research Institute at the University of California at Los Angeles indicates that the popularity of computer science (CS) as a major among incoming freshmen at all undergraduate institutions has dropped significantly since 2001. The proportion of women who

thought they might major in computer science (CS) has fallen to levels unseen since the early 1970s (Vegso, 2005).

The AAUW report reveals that girls are more likely than boys to enroll in clerical and data-entry classes (the 1990s version of typing) and less likely to enroll in advanced computer science and graphics courses (AAUW, 1998). Indeed, only one in four of computer/information science bachelor's degrees were conferred on women in 1995, and only 11% of the doctorates in engineering-related technologies went to women. Overall, women occupy only 20% of the jobs currently available in information technology (IT) professions (AAUW, 1998).

The primary concern about these statistics is that, unless the situation changes, women will not fully participate in the "new economy" that is expected to accompany the future growth of the IT industry. Failure to enter this growing field will result in women being precluded from earning the high salaries that advanced computer skills can generate. For economic, if not for social and political reasons, women would gain from being prepared to participate more fully in information technology (IT) fields.

Statement of the Problem

In recent years, a variety of studies have found that girls tend to display negative or neutral attitudes toward computers as compared to the more enthusiastic attitudes of boys. Additional studies indicate that girls' attitudes toward computer use and computer technology deteriorate during the middle school years (Cooper & Weaver, 2003). Psychological factors that researchers have used to explain these attitudes include computer anxiety, the social context of the classroom, and the gender composition of

groupings in class. Computer anxiety is the term used to refer to "feelings of discomfort, stress, or anxiety that people experience when responding to computers" (Cooper and Weaver, 2003). Researchers refer to the "social context of the classroom" and the "gender composition of groupings in class" as the characteristics they observe with regard to certain classroom dynamics when heterogeneous groups of boys and girls are given a cooperative learning assignment involving the use of a classroom computer. In most of the cases observed, in groupings involving both boys and girls, the boys enthusiastically took charge of the computers while the girls became passive onlookers. When the groups were homogenously designed to include either all boys or all girls, the girls' groups became more collaborative, with the girls working together to complete the project while the boys vied with each to see which one in the group would take charge. Especially as students reach middle school—for what may be primarily social reasons—girls tend to concede to boys their places at the classroom computers rather than to compete with them and risk open confrontation (Cooper & Weaver, 2003).

In a study related to computer gaming, Agosto (2004) found that boys and girls are equally skilled as far as their ability to use computers, but boys are far more likely than girls to choose computers for gaming. As a result, boys may be spending more individual time on computers and, as a result, grow to feel more comfortable with them than girls. Agosto also found that boys and girls may receive unintended and inadvertent messages from adults conveying the idea that computers are really "more for boys" than for girls (2004).

A confounding factor is that in the past, computer games tended to be written with boys more in mind than girls, thus exacerbating the problem of boys dominating computer time (Inkpen, 1993). The Inkpen study indicates that with regard to computer gaming, it plays a "major role in the lives of boys," while it serves as merely a "passing interest for girls." The study also argues that gender differences begin to emerge as early as kindergarten, and the chasm between boys' and girls' interest in computer gaming grows as students reach middle and high school (1993).

There is relatively little disagreement over whether or not there is a gender divide in computer technology. Indeed, the major debate hangs not on whether a gender gap exists but on the various possible explanations for its existence. While Cooper and Weaver (2003) contend that the problem stems from what they refer to as girls' "computer anxiety" and inequitable access to computers at home and in the classroom, the authors of the AAUW report, *Tech-Savvy,* maintain that the primary problem is that girls are opting not to pursue computers and information technology (IT) the way boys do as a matter of choice (AAUW, 2000).

In interviews with girls who participated in focus groups commissioned by the AAUW Educational Foundation, girls rarely reported that they felt victimized or had been subject to overt discrimination with relation to computers in the classroom or at home. What they did report, however, was that they did not generally enjoy the games that most of the boys liked to play, and they were, in fact, turned off by the computer stereotype of a "computer person:" one who is seen as generally male and anti-social (AAUW, 2000). In addition, girls described what they viewed as information

technology-related careers as not too difficult for them but rather as too isolated, materialistic, and shortsighted (AAUW, 2000).

Whether or not the primary reason for girls' perceived lack of interest in computers is computer anxiety, lack of access, or disdain for those closely identified with computers, computer initiatives that place laptop computers with individual students may make a difference in girls' attitudes toward computer use and computer technology. This may be especially true if they don't have to compete for equal time and are able to work on their computers at their leisure and in private. That possibility, then, leads to a broader question. What difference (if any) does one-on-one access to computers make in girls' interest in computer use, computer technology, or in computer-related careers as compared to their male counterparts who also have one-on-one access to computers?

Purpose of the Study

This study is based on the assumption that eighth grade girls in the Henrico County Public School system are more or less typical of eighth grade girls around the country with the exception that they have had the benefit of school-issued laptop computers for their personal and school use on a 24-hours-a-day, seven-days-a week basis since the sixth grade. Around the country—indeed, in other countries around the world—in most of the studies that have been conducted to date with regard to attitudes and computer use, by the eighth grade, girls have consistently demonstrated significantly less interest in computer use and computer technology than their eighth grade male counterparts. Indeed, in studies conducted by Christensen and Knezek (2000

& 2001), while no consistent differences were apparent between boys and girls and their attitudes toward computers in grades one through five, from grade six through grade twelve, males appeared to be consistently more positive than females in their attitudes toward a number of things, including computers. The changes begin to be noticeable during the sixth grade year, and girls' attitudes toward computer use and computer technology seem to decline into the ninth grade before they level off in high school (Christensen *et al.*, 2005).

This study will determine whether or not having a laptop computer for individual use 24-hours-a-day, seven-days-a-week lessens differences between how eighth grade girls and eighth grade boys in 10 middle schools in Henrico County, Virginia perceive computer use and computer technology. Having a laptop computer to use at any time of the day or night eliminates the issue of competition between boys and girls for computer use, for example. It also eliminates the need for either girls or boys to perform in front of other students, thus lessening to some degree, feelings of computer anxiety. If this study reveals that there is no statistically significant difference between the attitudes of the girls and boys surveyed, that may indicate that the use of laptop computers on a one-on-one basis is at least one way to address issues that have negatively impacted middle school girls' attitudes in other settings.

A number of school systems have initiated laptop computer programs in recent years. In 2001, Henrico County Public Schools joined with Apple, Inc. to initiate a technology program that placed an Apple iBook in the hands of every high school (and in 2003, every middle school) student. Students signed the district's "Acceptable Use

Policy" and students and parents accepted responsibility for the computer. The laptops became the students' primary instructional tool, and teachers were trained to integrate the new laptops into their overall instructional program across the curriculum.

Henrico County Public Schools near Richmond, Virginia was the first public school district to undertake a laptop initiative on such a large scale. Perhaps not surprisingly, the first year of implementation was marred by a variety of missteps and false starts including a number of networking problems. In addition, individual students occasionally abused their privileges and violated the district's "Acceptable Use Policy" by downloading pirated music and pornography. In spite of these problems, however, the program has been considered an overall success, and other districts around the country have followed Henrico's program with great interest. Indeed, after observing Henrico County's early successes and setbacks, several other districts around the country initiated similar programs of their own.

A significant gap in the current research surrounds the issue of whether or not one-on-one laptop initiatives have increased girls' interest in computer technology or had a positive impact on girls' attitudes regarding computers in relation to their male counterparts. Likewise, no studies have been done to indicate whether or not having one-on-one access to a computer positively impacts whether girls consider computer technology as a serious career possibility. This study will examine those issues.

Rationale and Significance of the Study

This study could have major implications for educators and policymakers as they seek to provide effective programs for those who are interested in the various

information technology (IT) professions. There is general agreement that women should be encouraged to pursue information-related careers in greater numbers, and schools and colleges are the logical places where that encouragement can be developed and offered (AAUW, 2000; Cooper & Weaver, 2003). Indeed, more people—both men and women—need to be in the pipeline for both technical and managerial IT jobs (Cooper & Weaver, 2003).

While much has been written about the so-called "gender divide" in an effort to call attention to and educate people about the different ways boys and girls approach computing, no one has yet studied the Henrico County Public School system's laptop computer initiative in an effort to determine if one-on-one access to a laptop computer has had a significant impact specifically on girls' attitudes and/or how girls perceive or use computers compared to boys. Likewise, no studies to date have attempted to determine whether or not girls with one-on-one access to a computer have considered pursuing computer-related careers as a result of having a laptop computer of their own to use.

Literature/Research Background

In *The Gendered Society,* Kimmel (2004) asserts that virtually every society in the world differentiates people on the basis of gender. Furthermore, every known society exhibits specific gender differences based upon the premise of male dominance over female (Kimmel, 2004). A gender scholar and social scientist, Kimmel looks at the question of whether the difference in the way society deals with gender issues is based more upon nature or nurture. More specifically, he looks at whether men are

psychologically different from women because they are hardwired to be different or because they have been taught to be different through socialization (Kimmel, 2004).

In *Women Don't Ask: Negotiation and the Gender Divide*, Babcock and Laschever (2003) argue that many of the differences between men and women in today's society are the result of socialization. They point to research in the areas of sociology and psychology that supports the notion that society expects men and women to behave differently and to exhibit different traits in almost every social context. Men are considered assertive, dominant, decisive, ambitious and self-oriented. Women are considered friendly, emotional, nurturing, expressive and warm and are expected to shy away from competition, while men are expected to thrive on it. Indeed, they contend that peers often hold a negative opinion of females who appear to be competitive. Women who are very confident and sure of their abilities are often perceived as arrogant, cold, and condescending (Babcock and Laschever, 2003).

From early on in their lives, children observe those around them and begin to distinguish the different roles that men and women perform in society. Indeed, according to Babcock and Laschever (2003) children begin formulating their gender "schemas" by age two. By that time, they have not only begun to distinguish the gender of the adults around them, they have also begun to distinguish between boys' toys and toys for girls (Babcock and Laschever, 2003).

In *Schoolgirls: Young Women, Self-Esteem and the Confidence Gap*, Orenstein (1994) describes her observation of a class in which a teacher asked her sixth graders to imagine, for the purpose of discussion, what their lives would be like had they been

born the opposite sex. Almost without exception, the lists the boys compiled were, to some degree, unpleasant: "I'd have to help my mom cook;" "I'd have to stand around at recess instead of getting to play basketball;" "I'd worry about getting pregnant." The girls' lists, on the other hand, consisted of a sort of regretful wish list: "I could stay out later;" "I'd get to play more sports;" "I wouldn't care how I look or if my clothes matched." Orenstein notes that, "Almost all of the boys' observations about gender swapping involve disparaging "have to's," whereas the girls seem somewhat wistful with longing. By sixth grade, it is clear that both girls and boys have learned to equate maleness with opportunity and femininity with constraint" (Orenstein, 1994, p. xviii).

Cooper and Weaver (2003) contend that in addition to the social issues surrounding gender, academic achievement issues arise and emerge as boys and girls enter middle school. Even when girls do better than boys in class and make better grades, the perception is that it is not as easy for them as it is for boys and it takes more effort to do well—especially in math and science. There is a prevailing paradigm in our culture that assumes that boys are inherently better in the sciences and math while girls have a more natural aptitude for languages and literature. Cooper and Weaver (2003) observe that in some cases, teachers attribute boys' lack of achievement to laziness rather than to a lack of ability, while they attribute girls' lack of achievement to a lack of aptitude rather than a lack of trying.

Concern about the subliminal—as well as the overt—messages that parents and teachers send girls and boys with regard to their innate aptitude for science and math has been raised in a number of studies; but the American Association of University

Women (AAUW) published the seminal report in 1992. In *How Schools Shortchange Girls—the AAUW Report: A Study of Major Findings on Girls and Education*, concern is raised about the finding that starting in middle school, girls demonstrate a significant decline in both self-esteem and academic achievement, especially in the areas of science and math. In her subsequent study, Orenstein (1994) discovered that even girls who had a healthy self-esteem and were confident of their abilities in elementary school suffered a decline in self-confidence and exhibited an acceptance of a negative body image by the age of twelve. The decline in confidence seems to permeate much of what girls do as they try to find their way through their middle school and high school years, and it takes a serious toll on their academic achievement as well as their aspirations for adult life (Orenstein, 1994).

One result of the lack of confidence in their academic ability is that starting in middle school, girls are less likely to choose the more challenging elective courses in math and science. This is particularly noticeable among girls from disadvantaged or low-income backgrounds, girls with learning disabilities, and girls learning English as a second language (Orenstein, 1994). Ironically, the AAUW report indicates that while girls may indicate that they "like math," significantly fewer indicate that they believe they are "good" at it by their middle school years. This ultimately results in the fact that girls and women are less likely to pursue math-related careers because of a fear of failure. It is an example of what Babcock and Laschever (2003) refer to as a tendency among women to set low goals and safe targets.

With regard to differences in how boys and girls approach computers, it is possible that many computer programs are just not as attractive to girls as they are to boys because they have been written mostly by men with boys primarily in mind (Cooper & Weaver, 2003). Boys generally like the game format of many learning programs, and if the games are competitive, that is even better (Cooper & Weaver, 2003). Girls, on the other hand, are somewhat turned off by the competitive nature of many computer games. Cooper and Weaver (2003) also contend that the girls may have trouble gaining access to the computers in their classrooms and school computer labs because the boys tend to monopolize the machines.

Gorriz and Medina (2000) point out that the more popular computer games are designed with boys as the intended market. Not only are computer games designed primarily for boys, Agosto believes that they potentially have a negative impact on girls (2004). For example, warring games tend to be too loud and violent to appeal to many girls. Additionally, girls are often portrayed in computer games in terms of negative stereotypes. Agosto (2004) points out that in many computer games, females are depicted as passive bystanders. They may even be portrayed in sexist terms, i.e., they may be large-breasted, too thin, and/or scantily dressed. Indeed, the females of computer games often represent the clichéd image of the "damsel in distress" (Agosto, 2004).

While boys tend to use computers for gaming more than girls, the most recent Pew Internet & American Life Project report points to changes that are occurring with regard to how teenagers—both boys and girls—use their computers. Many teenagers

use social networking sites like MySpace and Facebook and employ a variety of tools and techniques to manage online identities (Lenhart & Madden, 2007). Most of the teens using the networks do so in order to stay in touch with people they already know, but 49% of them say they use networks to make new friends.

It should be noted that there are those who question the premise that girls are disadvantaged when it comes to school and academic performance. Indeed, there are those who argue that school environments and classroom expectations actually favor the learning styles of girls over those of boys.

In "The Myth that Schools Shortchange Girls: Social Science in the Service of Deception," Kleinfeld (1998), argues that the findings reported by the 1992 AAUW report were based on a selective review of the research. She contends that girls generally receive higher grades than boys and obtain higher class rankings. Girls, in fact, receive more honors in every field except science and sports. Kleinfeld also points out that girls enter and graduate from college more frequently than young men. She does concede, however, that females lag behind males in mathematics and science achievement, and they also lag slightly behind males in attaining professional, business, and doctoral degrees. Regardless of the debate over who might be favored or who might be at a disadvantage in our schools' classrooms, what has been determined without a lot of debate is that there is a real and documented concern about the relatively small number of women who are entering computer-related, information technology (IT) fields, and research needs to be continued if that trend is to be reversed.

Research Questions

This study will determine if one-on-one access to a laptop computer reduces the differences between eighth grade girls' attitudes as compared to eighth grade boys' attitudes toward computer use and computer technology. In order to make that determination, this study will focus on the following research questions:

1. Is there a difference between the surveyed eighth grade girls' attitudes and surveyed eighth grade boys' attitudes with regard to computer use and computer technology?

2. Is there a difference between the surveyed girls' and the surveyed boys' thoughts regarding computer technology as a possible career option in their future?

3. Is there a difference in the attitudes of the surveyed girls' and the surveyed boys' attitudes regarding computer use and computer technology based on the respondents' race/ethnicity?

4. Is there a difference between the surveyed girls' and the surveyed boys' attitudes regarding computer technology as a possible career option in their future based on the respondents' race/ethnicity?

5. Does the level of support in the form of the number of computers already in the home make a difference in the attitudes of the surveyed girls' and the surveyed boys' attitudes toward computer use, computer technology, and their attitudes regarding computer technology as a possible career option?

Research Methodology

This is a non-experimental, comparative research study. Comparative studies involve the investigation of the relationship between one variable to another. This relationship is determined by examining whether the value of the dependent variable in one group is the same or different from the value of the dependent variable of the other group. In this case, the research is based upon a technology program that has been in place since 2001, and the researcher strove to ascertain and compare attitudes and/or prevailing attitudes (dispositions) toward computer use and computer technology that may be driven by differences in gender and/or by race/ethnicity.

A questionnaire in the form of paper and pencil surveys was used in collecting data. The questionnaires were distributed to eighth grade boys and girls in 10 middle schools in Henrico County, Virginia. The surveys were distributed and collected by Henrico County teachers during a homeroom or study hall period during a one-week period starting November 15 and ending November 22, 2006. The study compared attitudes among the surveyed girls and the surveyed boys with regard to their current computer use as well as their attitudes regarding the possibility of pursuing careers in a computer-related field in the future.

The potential number of eighth graders to be surveyed in the 10 middle schools was 3,428. The researcher's goal was to achieve a 60 % return. This goal was achieved with the return of 2,077 usable surveys—a 60.6 % return. The survey used was a modified form of the Computer Attitude Questionnaire (CAQ), Version 5.14, developed by Knezek and Christensen from the University of North Texas.

Summary

While there may be little consensus to date regarding the reasons that women are in relative short supply in computer science (CS) and information technology (IT) careers, the fact is that they are. As of the 2000 study conducted by AAUW, women represented only roughly 20% of IT professionals. As of 1996, girls represented only 17% of the computer science AP test takers, and less than one in 10 of the higher-level computer science test takers. Additionally, women received less than 28% of the computer science bachelor's degrees, which was actually down from 37% in 1984. Computer science is, in fact, the only field in which women's participation has actually decreased over time (AAUW, 1998); and the trend continues as demonstrated by the Computing Research Association as recently as 2006.

There are a number of possible explanations for why girls seem to be underrepresented in the computer technology industry. They may find computer-programming classes dull or tedious; they may find computer games boring or violent; or they may consider computer career options uninspiring. For whatever reason, the fact is that unless something is done to address the shortage of females in computer science (CS) and information technology (IT) programs, women will not be able to take advantage of the higher-paying computer-related careers that are available for the taking now and into the foreseeable future, and jobs will go unfilled—or to another country—because of an insufficient pipeline of American workers.

More research needs to be done in this area, and this important issue needs to be discussed at length by parents, educators, administrators, business leaders, and policy

makers at the local, state, and national levels. Computer technology is certainly here to stay, and our global society has undoubtedly entered the Information Age. We owe it to our young people—both boys *and* girls—to help them maximize their full potential as users of the available technology as well as to facilitate their development as innovators and inventors of new technologies, some of which are yet to be imagined.

CHAPTER 2 LITERATURE REVIEW

Introduction

This literature review focuses on issues that relate to girls' and young women's attitudes toward computer use, computer science (CS) and information technology (IT). The first section examines theories surrounding evidence that gender gaps may create significant differences in how boys and girls experience various aspects of their education and how their respective experiences may ultimately impact their approach to math, science, and computer technology. The second section examines the shortage of women preparing for technology-related careers and professions. This same section addresses why this shortage is cause for concern. The third section explores theories that try to explain the shortage of women in the computer technology pipeline. The fourth section examines the psychology of gender. The fifth section describes various theories that attempt to explain why there is a shortage of women in computer technology careers; and the sixth section describes a variety of laptop initiatives and looks at whether these initiatives are likely to significantly alter girls' attitudes toward technology and/or whether they may improve the likelihood that girls will begin to consider computer technology and information-related careers in larger numbers.

Gender Gap Research

Gender gap research first gained attention during the late 1980s and early 1990s. The purpose of the research was to explain the differences in achievement between men and women, particularly in math and science. Later in the 1990s, computer science (CS) was added to the list of academic areas in which there seems to be a serious discrepancy in interest and achievement among men and women.

The Association of American University Women (AAUW) conducted one of the earliest studies that pointed to the possible existence of gender bias in education. The landmark study, *How Schools Shortchange Girls—the AAUW Report: A Study of Major Findings on Girls and Education,* was published in 1992. That study was quickly followed by research conducted by the Sadkers. In 1994, they published a book entitled *Failing at Fairness: How Our Schools Cheat Girls*. The Sadkers and their team of classroom observers discovered that, in general, boys received more of their teachers' attention than girls, girls were more often praised for neatness and conformity than for originality or creativity, and in spite of the fact that girls often started school testing higher in academic subjects than their male classmates, they consistently scored lower on SAT tests than boys by an average of 30 to 40 points (Sadker & Sadker, 1994) as they finished their high school years. In spite of supposed gains in eliminating gender bias in math and science classes in the last decade, in 2005, the gap between girls and boys on the math section of their 2005 SAT was still 34 points (*College Board offers glimpse of new SAT with writing for upcoming class of '06*, 2005).

Owens, Smothers, and Love (2003) theorize that early differences in the

treatment of girls and boys result in enduring learning patterns. Since children spend more time with their teachers than any other adult except their parents, teachers' expectations and actions can profoundly impact both student achievement and self-esteem. The sexism in the classroom is very subtle and is most often completely unconscious. Certainly no one believes that it is intentional. Yet, its effects are no less apparent by the time girls enter high school. Beginning during their middle school years, girls' self-esteem and confidence in their competence—especially with regard to math and science—drop dramatically. As a result, girls begin to make choices that later impact their high school and college coursework and their future career options. Unlike the confidence and competence that many boys feel in their abilities—whether really warranted or not—girls tend to underestimate their abilities even when they are actually quite capable (Hargittai & Shafer, 2006).

By way of exacerbating what goes on during adolescence, many girls become over-socialized to contemporary stereotypical definitions of "femininity." The messages they receive from the popular culture and media—movies, television, magazines, etc.—conspire to cause them to become overly preoccupied with their physical appearance and the ideal of perfection as opposed to their academic performance and future career goals (Owens, Smothers, & Love, 2003).

In the AAUW Educational Foundation report, *Girls in the Middle; Working to Succeed in School*, Cohen, et al., (1996) report that middle school girls are expected to successfully negotiate their middle school years while also adopting their new female roles. First, there are changes that are demanded by the rapidly changing employment

pictures for females in today's world, but at the same time, girls must also come to terms with their emerging sexuality and all of the varying messages that society sends them regarding their place in the world in the context of being a woman. "Adolescent girls are to be sexy and flirtatious but at the same time to remain 'good girls'"(Cohen, et al., 1996, p. 1).

Indeed, the cultural messages that bombard girls in our society often involve unrealistic physical attributes to which many believe they must aspire in order to be accepted, happy, and successful in today's world. For example, many of the models that appear in leading fashion magazines today are as much as 23% below normal weight. Eating disorders, once considered prevalent among young women on college campuses, are now common among high school girls. It has been estimated that as many as 66% of high school girls are engaged in dieting. The stress of constantly dieting and concentrating on appearance almost certainly takes energy that might otherwise be used for learning and academic achievement (Owens, Love, & Smothers, 2003).

Cultural messages about computers are also used to convince girls that it is not feminine—and therefore not "okay"—to demonstrate too much interest in computers. In *Does Jane Compute?* Furger (1998) discovered that among preteen and teenage girls, there is an "unwritten yet incredibly powerful rule about computers: girls could use them for school, they could send e-mail, chat, or play games now and then, but only guys could be *into* computers, only guys could be really good at them. No one has to explain the rules...they've grown up learning them through the subtle, and not-so-subtle, ways in which society encourages boys to explore all things technical, while guiding

girls away from these activities" (Furger, 1998, p. 3).

Shortage of Women Seeking Computer-Related Careers and Professions

In 1998, the American Association of University Women (AAUW) issued an Educational Foundation Technology Commission report entitled, *Gender Gaps: Where Schools Still Fail Our Children,* as a follow-up to the 1992 watershed report entitled *How Schools Shortchange Girls.* According to the 1998 report, while girls had made some gains in the areas of math and science since the earlier report, as of 1996, only 17% of high school students taking the AP (Advanced Placement) exam in computer science were female. From 1978 to 1985, computer science undergraduates had approached nearly 50%, but by 1998, women held only 28% of bachelor's degrees and 24% of master's degrees in computer science. From the 1980s to the mid-1990s, the percentage of female undergraduate degrees in computer science actually went down from 37% to 28% (*Gender gaps: Where schools still fail our children: executive summary*, 1998; King, 2000).

Some gains have been made in getting women more interested in pursuing math and science related occupations. From 1993 until 1998, for example, the percentages of B.A. and B. S. degrees awarded to women increased significantly in every science and math related field *except* computer science. Statistics from the National Center for Education Statistics (NCES) indicate that the number of women who received B. S. degrees in computer science was at a high during the 1985-86 academic year. Since then, the number of women receiving B. S. degrees in computer science has steadily declined (Gürer & Camp, 2002).

On the other hand, young men are pursuing computer related careers at a healthy rate. Indeed, according to the NCES, males accounted for 86% of the students who took the Advanced Placement (AP) examination in computer science in 2002. Males also made higher average scores on the examination than females who took the same exam (NCES, 2004). The number of men receiving college degrees in computer and information sciences was 34,248 compared to 13,051 women in the same year. Master's degrees in the same areas were awarded to 10,753 men and 5,360 women. Doctorates were awarded to 579 men and 171 women in computer and information sciences (NCES, 2004).

In spite of the fact that computers and Internet access have been in an increasing number of homes and in most schools to a greater or lesser degree for the better part of the last 25 years, young women and girls still seem to lag behind men and boys with regard to their interest in and pursuit of computer-related careers. While the women's movement has attempted to equalize opportunities for girls and women in educational and career options, women still seem to be losing ground in the world of computing (Margolis & Fisher, 2002). This is occurring just as there is a great need for more people—regardless of gender—to enter the pipeline of computer programmers, technicians, and engineers as well as other fields that rely heavily on computer technology as part of their overall work. According to the AAUW report, *Tech-Savvy* (2000), computer programming is expected to see a faster than average rate of growth—up from 21% to 35%—over the next 10 years.

Indeed, according to the Bureau of Labor Statistics report, *Occupational Outlook*

Handbook, 2006-07, published by the U. S. Department of Labor, despite recent job losses in certain computer sectors, the computer systems design and related services industry remains one of the 25 fastest growing industries in the nation. Wage-and-salary employment is expected to grow 40% by the year 2014, compared with only 14% growth projected for the entire economy. The best opportunities are predicted to be in the professional and related occupations reflecting a continuing demand for higher level skills to keep up with changes in technology (*Occupational outlook handbook, 2006-07 edition*, 2005).

The Economic Impact of the Shortage of Women Seeking Computer-Related Careers: Why The Shortage Warrants Attention

The primary concern regarding the fact that women do not seem to be keeping up with men in the area of computer science is that unless this circumstance changes, women will not be able to take full advantage of the economic opportunities that are available to those with sophisticated computer expertise and training. According to Margolis & Fisher (2002) in *Unlocking the Clubhouse: Women in Computing*, the information technology (IT) profession is already in the midst of a workforce shortage, and that shortage is only expected to become more severe with time. For instance, it is estimated that more than 900,000 jobs are already going unfilled. The cost to the economy has been estimated to be between $3 billion and $4 billion per year in the Silicon Valley alone (Margolis & Fisher, 2002).

By self-selecting themselves out of careers in technology and computer-related fields, women are in danger of also self-selecting themselves out of a variety of highly

compensated jobs that accompany technology expertise. Indeed, many women may find themselves relegated to the lower level of computing as word processors and clerks—jobs that are low paying and offer little job security.

Beyond that personal and professional loss to individual women, however, society in general loses because women are not well represented in this very important field. Given that women represent about half of the population and almost half of the professional work force, it is important that they not shortchange themselves or society at large by avoiding careers in science, math, and technology.

Statistics indicate that this has already happened, however. Women computer professionals in the United States work force dropped during the 1990s from 35.4% to 29.1% (Mumtaz, 2000). And in recent years, more and more of the computer related occupations that might have been filled by American workers are now being outsourced to other countries where labor costs are lower.

Technology in its fullest, most modern sense entails more than just the operation and programming of computers, however. It is hard to think of any area of modern life that has not been impacted in some way by the invention of the microcomputer chip and the accompanying emergence of information technology (IT). Jobs in almost every occupational field are becoming more and more dependent upon an individual worker's computer skills and his/her grasp of information literacy. As long as women are underrepresented in the area of computer science (CS) and information technology (IT), they will be unable to take advantage of a wide variety of economic opportunities that

computer technology based careers provide (Cooper & Weaver, 2003; Furger, 1998; Margolis & Fisher, 2002; Whittenburg, 2005).

Psychology of Gender

An entire body of literature delves into the psychological differences that attempt to explain the way males and females approach many aspects of life. Freud, for example, believed that observed differences between women and men were traceable to their different experiences from infancy onward, especially in the ways they were treated by their families. Freud also believed that gender identity was a crucial part of personality development—perhaps even the most crucial part—and that gender identity was actually acquired mostly through interactions with family members and the expectations of the larger society (Kimmel, 2004).

Helgeson's study of gender is, at least in part, the result of her own experience as the mother of a daughter. After the birth of their daughter, Helgeson writes that she and her husband initially attempted to choose gender-neutral clothes and toys for her. While this was fairly easy to do during the early months of the child's infancy, it became an increasingly difficult task as the child approached age one. By the time a child is one, Helgeson came to realize, clothes and toys for children are more and more clearly gender-specific. Society makes the distinction between males and females visually salient because people feel uncomfortable when they cannot identify the gender of a person—including children—right away (Helgeson, 2005).

Helgeson and others who write about the psychology of gender make a clear distinction between what is meant by "sex" and "gender." "Sex," says Helgeson, refers

to the biological categories of male and female. One's sex is determined by his or her physical features, genes, chromosomes, and hormones. Neither culture nor social mores has any influence over what one's sex is. Gender, on the other hand, is much more fluid and is influenced to a great degree by behavior as opposed to physiology (Helgeson, 2005).

Gender is also influenced to a great extent by the expectations set by the culture of any specific society. For example, most cultures recognize two genders: male and female. Certain Native American cultures, however, recognize four genders, and within those specific cultures, gender is not so much dependent upon one's biological sex as it is based on the social roles that the individual takes on in the context of the society.

In Tahiti, the social roles of men and women tend to be very similar. Women enjoy the same status as men and have the same opportunities as men in domestic, occupational, and recreational spheres. Furthermore, not only do men and women enjoy similar roles in their society, they can share similar personalities. Men, for example, are not pressured to prove their masculinity, and the society is based more on cooperation than in competition (Helgeson, 2005).

Tahiti is an example of the exception rather than the rule, however, with regard to how gender is commonly viewed in most cultures. Indeed, virtually every other known society differentiates between women and men and exhibits patterns of gendered inequality and male domination (Kimmel, 2004). Most societies divide social, political, and economic resources unequally between genders, and with few exceptions, men get more (Kimmel, 2004).

In *The Psychology of Gender*, editors Eagly, Beall, and Sternberg contend that gender has considerable impact on people's lives in obvious ways. Citing 2002 statistics from the United Nations Development Programme, Eagly, Beall, and Sternberg point out the following facts about women from around the world:

- Women constitute 64% of illiterate adults.
- Women's income is 75% of that of men for comparable hours of paid employment.
- The proportion of men in national parliaments is 86%.
- Every year, approximately 500,000 women die in childbirth.

Through a series of chapters by a variety of authors writing from different points of view regarding the psychology of gender, the editors of *The Psychology of Gender* address the question of why the study of gender is important and how they believe that the discipline of psychology provides a major part of the answer. They contend that psychology provides a major part of the answer to the question of how gender permeates most aspects of human life and how it often manifests itself in terms of female disadvantage (Eagly, Beall, & Sternberg, 2004).

In *Reviving Ophelia: Saving the Selves of Adolescent Girls,* Pipher, a clinical psychologist, writes from her experience about her personal and professional view of the various kinds of trouble that many girls run into as they enter their adolescent years. Based on case studies of her own patients as opposed to any clinical study of large numbers of adolescent girls, Pipher writes about the various ways that adolescent girls tend to lose themselves:

> "Something dramatic happens to girls in early adolescence. Just as planes and ships disappear mysteriously into the Bermuda Triangle, so do the selves of girls go down in droves. They crash and burn in the social and developmental Bermuda triangle. In adolescence, studies show that girls' IQ scores drop and their math and science scores plummet" (Pipher, 1994, p. 19).

While preteen and teenaged girls try to negotiate the various landmines of adolescence, they experience conflicts between what Pipher refers to as their "autonomous selves and their need to be feminine, between their status as human beings and their vocation as females" (Pipher, 1994, pp. 21-22). These conflicts impact girls during perhaps the most critical stages of their development when they need to be considering their academic and career futures.

This is not to say that adolescent boys do not suffer problems of various kinds during their adolescent years. Certainly, the adolescent years are challenging for even the most secure young person—male *or* female. It would be fair to say, however, that the issues that adolescent boys deal with as opposed to those of adolescent girls are decidedly different, and for boys, there is not as great an emphasis on appearance, on being popular, on being considered by teachers and peers as "nice," or on developing healthy sexual attitudes while avoiding becoming sex objects.

Theories That Attempt to Explain Why There Is a Shortage of Women in Computer Technology Careers

The real problem goes much deeper than whether or not girls decide to become computer programmers or technicians, however. There may be serious social dynamics

at work that parents and teachers should note regarding what happens to adolescent girls as they enter middle school. Lanius (2005), a middle school math teacher who manages GirlTECH (math.rice.edu/~lanius/club/girls.html), a web site that is designed to assist parents and teachers who want to encourage girls in math and technology says that by middle school, girls are trying to figure out what it means to be a "desirable female." What they learn very quickly is that being technologically sophisticated is not high on that list (Jabs, 1998; Lanius, 2005.).

In the 1992 report, *How Schools Shortchange Girls*, released by the American Association of University Women (AAUW), concern was raised about the finding that starting in middle school, girls begin to demonstrate a significant decline in self-esteem, which ultimately has a negative effect upon their academic achievement, especially in the areas of math and science. Other studies have corroborated this finding (Orenstein, 1995, 2000; Sadker & Sadker, 1994). Girls at this stage of development start to question themselves in ways that boys do not seem to, and their flagging confidence negatively impacts their academic achievement, even when they had a healthy self-esteem and were academically successful in math and science in elementary school (Orenstein, 1995, 2000).

As a result of their declining self-confidence in matters related to the sciences, math, and computer technology, girls start to opt for electives that are less challenging than some of their male schoolmates. Babcock and Laschever (2003) refer to girls' tendency to avoid academic challenges as setting "low goals and safe targets." While it may be a strategy that leads to short term success, it undermines young women in the

long run because it limits their options as they later enter college and the work force. They simply cannot compete on the same level with men who opted for the higher-level science and math courses that they shied away from in middle and high school.

Cooper and Weaver (2003) have offered several explanations for why young girls tend to avoid computers. One explanation is the psychological factor known as computer anxiety. They argue that some girls tend to experience feelings of discomfort, stress, and anxiety when responding to computers. In an effort to avoid those uncomfortable feelings, girls tend to avoid computers altogether. Other explanations include the social contexts of the classroom, the gender compositions of the class, and the lack of access to computers (Cooper & Weaver, 2003).

For example, observation of a heterogeneous group of boys and girls assigned a project that involved group work at a single computer revealed that the boys tended to dominate the computer while the girls became passive onlookers. Rather than confront the boys and demand equal time at the computer, the girls wound up getting a second-rate learning experience. In other observations, when groups were homogenously designed to include all boys or all girls, the girls' groups were observed behaving more collaboratively. The girls worked together to complete the project at hand while the boys vied with one another to see who was going to be in charge of operating the computer (Cooper & Weaver, 2003).

Another theory that attempts to explain why young women are not pursuing computer-related activities at the same level as men is that most of the games that have been written for computers to date specifically target boys. The games are, in fact,

written "by boys for boys" (McLester, 1998). In addition, many of those games turn girls off when they are too loud and/or tend to have violent content.

Agosto (2004) argues that boys and girls are equally skilled as far as their ability to use computers, but boys tend to use the computers for gaming more frequently than girls. Until just recently, research indicated that boys spent more hours per week on computers at home and at school than girls. That trend is just now beginning to change, but girls are still not playing games as much as they are using e-mail, instant messaging, and creating their own websites (Hayes, 2002). Girls tend to see computers as tools that allow them to perform specific tasks as well as to be creative. They contend that they don't have to be able to take the computer apart like some of the boys in order to use it effectively, and their interest in the computer is of both a different quality and a different intensity than many boys (Melymuke, 1999).

Another possible explanation for girls' reluctance to pursue computer-related activity is that the school culture inadvertently encourages boys while subtly (yet ever so effectively) discouraging girls. Middle school and high school computer labs, for example, tend to be monopolized by boys during free periods, and the camaraderie and cliquishness of the boys tend to dissuade girls from invading what is seen as the boys' territory. Indeed, a number of researchers including Cooper and Harris (2003) contend that parents and teachers may inadvertently send girls mixed messages about computers being "more for boys" than for girls.

Margolis and Fisher (2002) find that girls who manage to run the gauntlet of challenges and hurdles that tend to turn girls of fainter heart away from computers in

middle and high school run into similar challenges in college. The book, *Unlocking the Clubhouse: Women in Computing*, is based upon interviews with young women who have beaten the odds and have been accepted by one of the premier computer training centers in the country, the Carnegie Mellon University. These young women have come to Carnegie Mellon from the tops of their respective high school classes, and upon entering their freshman year, are committed to earning degrees in computing because they believe that they have an aptitude for it and they enjoy it. Margolis and Fisher (2002) report that many of these same young women drop out or switch majors during their first and second years, however, because they begin to doubt their commitment to and their aptitude for the field of computing. They compare themselves to their male classmates who tend to be interested in little else besides computers. One female student, for example, complained that even when she and her classmates took a break together from an assignment, all her male classmates wanted to talk about were computers. She wanted to engage in conversation about music or movies or books—but the men always managed to steer the conversation back to some technical aspect of computers (Margolis and Fisher, 2002).

This single-minded focus on computing to the exclusion of all else may offer another possible explanation for why some girls seem to shun computers and computing. In fact, that is one of the things that the study, *Tech-Savvy* (2000), by the American Association of University Women (AAUW) revealed after interviewing middle and high school girls. The girls interviewed for this study reported that they did not feel that they had been the subject of overt discrimination with relation to computers

in the classroom or at home. What they did reveal, however, was a negative opinion of the games that boys liked to play and that they were turned off by the stereotype of the "computer person." They described such a person as a "male" who occurs as "single-focused and anti-social." Girls reported that computer-related careers were not too difficult for them to pursue but rather that working with computers seemed to be too isolated, materialistic, and shortsighted (*Tech-savvy*, 2000).

The young women interviewed in the Margolis and Fisher (2002) study also reported a negative view of their male classmates who had few if any interests beyond their computers; but they also reported a subtle (and sometimes not so subtle) discrimination that made them feel uncomfortable and out of place in the program. For example, their male classmates would sometimes tease them about being accepted at Carnegie Mellon as tokens in the university's effort to meet its quota of women. They would also "joke" with the women about the questions they asked in class, characterizing them as "dumb." While the women wanted to believe that the remarks were made mostly in jest, several reported that these suggestions regarding their competence and place in the program did nothing to bolster their confidence in their abilities (Margolis and Fisher, 2002).

Another complaint that was specific to the program at Carnegie Mellon was with regard to the teaching techniques that were used in some of the more basic, supposedly "beginner" courses. Girls reported that especially in the larger freshmen classes, assignments were handed out and students were told to complete them on their own without any instruction. The men tackled the assignments as challenges and at least

pretended to know what they were doing while some of the women felt that more instruction and more help from the instructor would make the assignment more manageable. This "sink or swim" approach tended to convince some of the young women that they were in the wrong discipline (Margolis & Fisher, 2002).

Other Possible Explanations

Other explanations for why girls don't pursue computer technology at the same rate as boys may go to the psychological differences in males and females. Much has been written about gender differences in both the academic realm and in the popular culture in recent years. In fact, the differences between the cognitive abilities of men and women became a hot topic in the national headlines in January 2005 when the president of Harvard University suggested the possibility of "intrinsic" differences in aptitude between the sexes that explain why men tend to dominate the science-and-engineering work force. The remarks sparked widespread protests, and the university president quickly apologized.

A growing body of research suggests that there may be at least some truth in the university president's observations, however. A spatial relationship test that has been administered for the last 25 years provides consistent evidence that there is at least one large cognitive difference between men and women. The test measures individuals' spatial abilities by asking them to rotate objects in their minds. The results of the test consistently indicate that, on average, women have more difficulty with this type of spatial orientation than men (Space, 2001).

This difference in performance on spatial orientation need not exclude women

from the world of computing, however. Linn (1999) reports that fifth grade girls improved their spatial relations skills after playing a game called "Marble Madness," and spatial relations skills improved with older girls who played the game, "Tetris."

Laptop Initiatives

In recent years, a growing number of school districts have launched one-on-one laptop programs in their effort to take full advantage of the various technologies that are currently available. Henrico County Public Schools near Richmond, Virginia, launched its Teaching and Learning Initiative in partnership with Apple Computers, Inc., in 2001. That laptop project was one of the first as well as one of the largest projects of its kind at that time. The program grew out of the school division's desire to help close the digital divide between the computer "haves" and "have-nots." The goal of the district's leaders was to close the achievement gap between students of color from economically depressed backgrounds and white students from more affluent backgrounds (Cook, 2002). By issuing a laptop to every student and making Internet access affordable to families who might not have it otherwise, Henrico County Public Schools leveled the field for students who were previously in danger of not being able to keep up with their more affluent classmates who had access to computers at home.

Henrico County's project quickly became the subject of great interest among educators and policy makers around the country who were considering laptop initiatives of their own. More than 20 districts sent visiting teams to Henrico County in order to observe first-hand how the program was working.

The program has not been free of difficulties. Critics point to problems that range

from the technical to the practical. Teachers complained about the lack of training that they received as the program was perhaps too quickly implemented, and there have been some problems with students opting out of the program because of the insurance fee, which means that not all students have had equal access after all. Additionally, a few students broke the "Acceptable Use Policy" by illegally downloading music and/or pornography. These infractions were limited to just a few students, however, and although the incidents generated a certain amount of negative press, the great majority of students complied with the rules and used their computers for their intended purposes. For the most part, in spite of some initial glitches in its technical implementation, many parents, teachers, and students consider the program a success (*Henrico County Public Schools iBook survey report*, 2005).

Another high-profile example of widespread use of laptop computers in schools has taken place in the state of Maine; and there have been similar initiatives in many areas around the country including Florida, California, Kansas, Michigan, Minnesota, North Carolina, Ohio and Pennsylvania. Many of these programs have taken a more conservative approach than the one taken by Henrico County. Most of the programs in other locations have taken the form of pilots that are being carried out in an effort to study the potential effectiveness of one-on-one access to computer technology. Some have selected single grade levels to start their programs, and unlike Henrico County where the initiative began in the high schools, many of the programs around the country are targeting middle schools first. (*Laptops for learning task force, 2004*).

For the most part, reviews of the laptop initiatives around the country have been

positive and promising. In Maine, for example, almost one and a half years after laptops were distributed to every seventh grader in the state, the news was positive. Teachers reported that students who were in danger of dropping out had become school leaders. The playing field was leveled for all students, and teachers reported feeling reinvigorated by learning new ways to teach (Curtis, 2003).

What has not yet surfaced in the course of this review of the literature is any indication that laptop initiatives have had a significant impact on girls and their attitudes toward computers and computing as compared to boys. *The iBook Survey Report* conducted by Henrico County Public Schools indicates in one brief sentence that there are "no differences" in iBook use by "gender or free/reduced lunch status" but there are small differences in use by "magisterial district and race/ethnicity." The focus of the study was to determine whether the district should proceed with a renewal of the initiative, however, and since the primary objective of the program was to level the playing field for the computer "haves" and "have-nots," the focus of the evaluation program was not on gender but more on economics and race/ethnicity. This circumstance lends support to the need for conducting this study.

Summary

The literature indicates that there is a shortage of women in the pipeline of future workers in computer-related and information technology (IT) careers and professions. Statistics from a variety of sources support the fact that more men than women by a significant percentage are pursuing computer science and IT as careers. This means that women will not be able to take advantage of the high-paying computer-

related careers that are now available and will continue to be available in even greater numbers in the future. Ultimately, then, women will not enjoy the economic security that they might otherwise enjoy; but additionally, and perhaps even more importantly, society will not benefit from the contributions that women might make in a variety of ways to the IT industry by virtue of their different experiences and different perspectives from their male counterparts. This study proposed to determine if having access to a computer on a one-on-one basis may provide some insight that could lead to effectively addressing the shortage of women in the information technology (IT) industry.

CHAPTER 3 METHODOLOGY

Overview

The purpose of this chapter is to discuss the steps taken to address the research questions. It contains a (1) restatement of the problem; (2) research questions; (3) the research design; (4) a discussion of the sample studied; (5) the nature of informed consent; (6) source and rationale for the instrumentation; (7) a description of the data collection procedures; (8) a review of the data analysis procedures; and (9) a summary of the limitations of the study.

Restatement of the Problem

A review of the literature with regard to gender differences and computer technology points out that the number of women who have pursued computer science (CS) and/or information technology (IT) as career goals has declined dramatically since the 1980s (AAUW, 1998; Panteli, Stack, & Ramsay, 2001; Margolis & Fisher, 2002; Cooper & Weaver, 2003; NCES, 2004). While a number of theories have been posed attempting to explain this fact, no one has yet identified concrete reasons for middle school girls' apparent disinterest in computers compared to the more enthusiastic interest of their adolescent male counterparts. Studies show, however, that while elementary girls and boys indicate about the same level of interest in computers through fifth grade, there is a definite decline in interest among girls from the sixth grade until

about the ninth grade. By the eleventh grade, interest between males and females seems to level off again (Christensen et al., 2005), but the studies have yet to identify reasons for the differences while they occur. Likewise, none of the studies done to date have identified specific reasons to explain why young women are apparently reluctant to actively pursue computer science as a viable career opportunity in this age of technology where computer related jobs are in abundance (Margolis & Fisher, 2002; Cooper & Weaver, 2003).

Cooper & Weaver (2003) argue that a contributing factor to girls' reluctance to embrace computer technology may be that girls have had to compete with boys for equal time and equal access to the computers that are available to them both in their homes and at school. Indeed, one study indicates that when families purchase a computer for home use, they think of the sons in the family more than the daughters (Knezek & Miyashita, 1994). Another theory is that girls' reluctance to actively pursue computer science may be attributed to a lack of confidence in their abilities in the math and science fields, including computer science. That lack of confidence generally develops and begins to manifest itself by the time girls enter middle school (Cooper & Weaver, 2003; Orenstein, 1995, 2000; Sadker & Sadker, 1994). A third theory is that parents, teachers, and society in general may unconsciously convey to both boys and girls that computers are really "more for boys than girls." Girls have simply conceded the point rather than to confront that paradigm or openly compete with boys (Cooper & Weaver, 2003; *Tech-savvy*, 2000).

If the problem can be attributed to equal computer access accompanied by a reluctance on the part of girls to intrude upon what is considered boys' "turf," then how might one-on-one access to a laptop computer on a full-time basis serve to help change girls' attitudes? That is the focus of this study.

Since the Henrico County Public School district has implemented a technology initiative allowing every secondary and middle school student to have a school-issued laptop for school and personal use on a 24-hours-a-day, seven-days-a-week basis, and since Henrico County is geographically convenient to the researcher, Henrico County Public Schools made an excellent choice for conducting a study that may help determine if one-on-one access to a computer on a full-time basis impacts girls' attitudes toward computer science (CS) and/or reduces differences in the attitudes of middle school girls as compared to middle school boys with regard to computer use and computer technology. The findings will, at the very least, add to the growing body of knowledge regarding gender differences and computer use.

Research Questions

This study explored whether or not one-on-one access to a laptop computer reduces differences in eighth grade girls' attitudes as compared to eighth grade boys' attitudes toward computer use and computer technology. The study was based on the assumption that eighth grade girls in the Henrico County Public Schools system are more or less typical of eighth grade girls around the country with the exception that they have had the benefit of school-issued laptop computers for their personal and school use on a 24-hours-a-day, seven-days-a-week basis since the sixth grade. If girls generally

tend to lose interest in computer technology during the middle school years because of lack of access, it seems logical that increased access might make a difference in girls' attitudes about computers compared to boys' attitudes.

This study, therefore, focused on the following research questions:

1. Is there a difference between the surveyed eighth grade girls' attitudes and the surveyed eighth grade boys' attitudes with regard to computer use and computer technology?

2. Is there a difference between the surveyed girls' and the surveyed boys' thoughts regarding computer technology as a possible career option in their future?

3. Is there a difference in the attitudes of the surveyed girls' and the surveyed boys' attitudes regarding computer use and computer technology based on the respondents' race/ethnicity?

4. Is there a difference between the surveyed girls' and the surveyed boys' attitudes regarding computer technology as a possible career option in their future based on the respondents' race/ethnicity?

5. Does the level of support in the form of the number of computers already in the home make a difference in the attitudes of the surveyed girls' and the surveyed boys' attitudes toward computer use, computer technology, and their attitudes regarding computer technology as a possible career option?

Research Design

This was a non-experimental, comparative research study. A comparative study involves the investigation of the relationship of one variable to another. This

relationship is determined by examining whether the value of the dependent variable in one group is the same or different from the value of the dependent variable(s) in the other group.

In this case, the research was based upon the laptop computer program that has been in place in Henrico County's secondary schools since 2001. There was no manipulation of the program or of the students' experience of the program in any way. The researcher ascertained attitudes and/or prevailing attitudes (dispositions) toward computer use and computer technology that may be driven by differences in gender and/or differences in race/ethnicity through a survey of students. This study was different from most of the research done to date regarding gender differences and computer technology because all of the boys and girls in the study have had equal access to school-issued laptop computers as a result of the Henrico County Public School laptop computer program.

The study used data collected from self-reporting surveys that were distributed to eighth grade boys and girls in 10 middle schools in Henrico County, Virginia. The surveys were distributed and collected by Henrico County teachers during a homeroom or study hall during a one-week period starting November 15 and ending November 22, 2006. The study compared attitudes among the eighth grade girls and the eighth grade boys with regard to their current computer use; their thoughts about pursuing a career in a computer technology field; and whether or not there is a relationship between the number of computers in the home (in addition to the school-issued laptop computer).

Sample

Participants in this study were eighth grade boys and girls from each of 10 middle schools in the Henrico County Public School district near Richmond, Virginia. The 10 middle schools selected for the study provided participants who are representative of the overall student population in Henrico County. Henrico County is a sprawling suburban district that includes a wide variety of neighborhoods and communities ranging from a more urban setting with a high minority population to a more affluent, mostly white, bedroom community that is in the farthest northwestern part of the district. The county also includes a large rural area in the eastern section of the county where there is a high concentration of manufacturing facilities and working class families. Students from the 10 middle schools were surveyed at the request of Henrico County Public Schools' Department of Research and Development. While the researcher had sought to gain permission to survey three of the middle schools in the district, the Leadership Team for the school division expressed an interest in gathering data from all of the eighth graders, and the school division offered the researcher assistance with the logistics of gathering the additional data. The nature of that assistance will be described in Chapter 4.

Eighth grade girls and boys were selected over sixth or seventh grade boys and girls because research indicates that there is a self-reported decline in girls' academic performance and interest in computers during the three-year middle school period. This pattern reflects a trend that girls enter middle grade schools with high levels of grades

and an overall sense of self-efficacy, but over time, the girls appear to decline more rapidly than boys on the same factors (Mulhall, Flowers, & Mertens, 2002).

Additionally, studies show that by the eighth grade, the reported use of computers reflects a decline from grade seven on the part of the girls. In those studies, the girls tend to decline in computer usage into the ninth grade and then appear to level out at a usage rate somewhat lower than boys for grades nine through eleven. By grade twelve, the boys' report a decline in hours of use per week to the level reported at grade twelve by the girls (Christensen, & Knezek, 2005).

By surveying eighth graders from the 10 middle schools for this study, the result was a convenience sampling of students in the eighth grade in Henrico County, Virginia. The number of students in the eighth grade during the 2006-07 school term provided a potential N of 3,428. The goal was to achieve a 60 % return. This goal was achieved with a return of 2,077 usable surveys, or a 60.6% return.

Informed Consent

A letter was sent to parents of the eighth grade students on October 30, 2006, outlining the focus of the research project, explaining the research questionnaire, and detailing the procedures for the study. The letter (Appendix B) offered parents and students assurance of confidentiality and provided the option of declining should they wish that their child not participate in the study. Parental consent was passively obtained when parents did not communicate their disapproval of their child's participation in the survey. Parents who objected to their child's participation in the survey returned the form to the respective schools by the specified deadline. This

procedure was followed in accordance with the school board policy adopted by Henrico County Schools with regard to how surveys are handled in order to make an effort to inform parents' of upcoming surveys of this type.

The information letters/opt-out forms were sent home with students on October 30, 2006. The deadline to return the letters to the appropriate school personnel if the parents objected to their child's participation in the survey was November 9, 2006. Those students who returned the form indicating their parents' wish that they not participate in the study were given an alternate activity (Appendix C) to work on while their classmates completed the survey. The survey took about fifteen minutes to complete.

A "Youth Assent Form" (Appendix D) was given to those students who did not return the opt-out form from their parents. Students who had passive parental consent to take the survey were given the "Youth Assent Form" which provided information regarding the purpose of the study and what students could expect to be asked if they chose to participate. If the student agreed to participate by taking the survey and had no questions, he/she was asked to sign the assent form. Witnesses and/or the persons conducting the informed assent discussion signed the forms. The homeroom or study hall teachers who served as survey administrators collected the "Youth Assent Forms" and returned them to the Research and Planning Department of Henrico County Public Schools and were then retrieved by the researcher. Any student who was not sure whether he/she wished to participate in the study was allowed to take the assent form home to discuss with a parent or responsible adult. Students were asked to return the

form by the next day if they decided to participate. Names of the students who brought back the signed opt-out form from their parents expressing a wish that their child not participate in the study and those students who did not sign the "Youth Assent Form" were compiled on a list of students not to be given a survey form at the time of the survey administration. That list remained confidential. Teachers were instructed not to discuss with anyone the names of those students who chose not to participate in the study. The only purpose of the list was to ensure that students who were not participating in the study were not given a survey form but were given the alternate activity instead.

Student identities were kept completely confidential throughout the study. No part of the study connected students' names to the results. An identifier was used to indicate the school that the student was from, and data regarding students' gender and race/ethnicity were collected. Descriptive statistics were used to provide general information about those students who participated in the survey.

Source and Rationale for Instrumentation

The questionnaire that was used for this study was a modified version of a Computer Attitude Questionnaire (CAQ) developed by Knezek and Christensen in 1993. The original CAQ is available in two versions. The CAQ, Version 5.14, is the version that served as the basis of the survey form that was used in this study. The CAQ, Version 5.14, is a 65-item, 4-point Likert-type self-report questionnaire designed to be used with students in the fourth through eighth grades. It has been used to measure attitudes (feelings toward a person or thing) and prevailing attitudes (dispositions),

rather than achievement. Students record their personal perceptions of the extent to which they agree or disagree with each item. The survey is intended to be administered under the supervision of a teacher in the classroom environment or a parent in the home.

The original CAQ, Version 5.14, includes seven separate indices or subscales taken from an earlier instrument known as the Young Children's Computer Inventory (YCCI). The YCCI was developed and refined during 1990-93 for use in a multinational study of the psychological impact of computer use on young children (Miyashita & Knezek, 1992; Knezek & Miyashita, 1993). The YCCI contains 48 items with child-like instructions and response descriptors. For the CAQ, Version 5.14, the title of the form, the instructions, and the response descriptors were changed to slightly more sophisticated wording. Also, the CAQ, Version 5.14 form was made longer than the YCCI with the addition of a new subscale related to Computer Anxiety. In addition, Krendl and Broihier's (1992) paired-comparisons instrument for computer attitudes was added to the CAQ, Version 5.14, in order to tie future results into a longitudinal research study based on Krendl and Broihier's form (Knezek & Miyashita, 1994).

A 1993 preliminary validation study indicated the CAQ's stable measurement qualities and its probable usefulness. A subsequent study conducted in 1995 used data from 588 junior high school students in a Texas public school. Results were used to validate the construct and criterion-related validity of the CAQ. A confirmatory factor analysis validated the psychological constructs carried over from the instrument's predecessor, the Young Children's Computer Inventory Questionnaire (YCCI), and high internal consistency reliability figures further reconfirmed the stability of the

newer subscales that were added for middle school students (Knezek & Christensen, 1996).

For the purpose of this study, a modified version of the CAQ, Version 5.14, was used with eighth graders in 10 Henrico County middle schools. The questionnaire consisted of a 4-point Likert-type self-report instrument without Krendl and Broihier's paired-comparison items and with additional questions added by the researcher.

The original CAQ, Version 5.14, measures attitudes (feelings toward a person or thing) and prevailing attitudes (dispositions) in the following areas: Computer Importance, Computer Enjoyment, Motivation and Persistence, Study Habits, Empathy, Creative Tendencies, Attitude Toward School, and Anxiety (Knezek & Christensen, 1997). This version of the CAQ has been used in a number of different studies over the last decade, and its internal consistency has been measured and is considered "high." The internal consistency reliability estimate for the entire document is .92 with reliabilities for individual subscales ranging from a low of .75 to a high of .84. (*CAQ Reliability*, n.d.). More specifically, the subscale on Computer Importance measured .82, the subscale on Computer Enjoyment measured .82, and the subscale on Computer Anxiety measured .84.

The Computer Attitude Questionnaire is one of five instruments developed at the Texas Center for Technology at the University of North Texas. The developers of the CAQ, (both Versions 5.14 and 5.22) Knezek and Christensen, agreed to allow the researcher to modify the CAQ, Version 5.14, by deleting and/or adding questions in order to narrow the focus for the purpose of this study. As a result, three of the

subscales from the CAQ, Version 5.14, were maintained (Computer Importance, Computer Enjoyment, and Computer Anxiety) while the remaining subscales were eliminated since they would have provided information superfluous to the needs of this study. The subscales to be deleted were those related to Computer Seclusion; Motivation/Persistence; Study Habits; Empathy; and Creative Tendencies.

In addition to the three subscales that were used from the original CAQ, Version 5.14, new questions designed by the researcher were included in the modified survey instrument in order to measure students' attitudes related to individual use of their school-issued laptop computers. Other questions (also designed by the researcher) were used to determine respondents' attitudes about perceived gender differences with regard to computers and student attitudes as they related to the possibility of pursuing computer-related jobs in the future.

These additions originally resulted in a questionnaire consisting of five pages with 44 questions including questions about the respondents' gender and race/ethnicity. The first 29 questions used the Likert-type scale, and these items were taken entirely from the original CAQ, Version 5.14. Six additional questions (items 30-35) using the Likert-type scale were to be added to the form by the researcher. Seven questions (items 36-42) were to be posed as closed, fixed-alternative questions for which respondents were asked to choose between two or more answers. Two of the questions (items 36-37) were to be asked in such a way that students would select either "yes" or "no" as their responses. The remaining questions (items 38-42) were to provide a list of possible responses in a closed-question format from which students were to select the answer

that most closely corresponded to his/her individual situation. All of the additional questions were designed to ascertain (1) the types of activities students engage in when using computers; (2) whether or not students think that boys and girls are treated differently with regard to computers; (3) whether or not students think that boys and girls have a different level of understanding of computers and computer technology; and (4) and whether or not students think males and females are better suited for certain occupations or careers based on gender.

Five of the questions (items 36-40) required students to select one response from a closed list of possible answers that most clearly indicated (1) the number of computers in the home in addition to their school-issued laptop computer; (2) the average amount of time in hours that respondents spend on the computer per day outside of school; (3) the type of software programs the respondents enjoy using most; (4) the type of activities that the respondents engage in most often using computers; and (5) how the respondents rate their interest in what makes a computer work.

At the recommendation of the researcher's dissertation committee combined with results of a pilot study which was conducted with a class of seventh graders from one of Henrico County's middle schools, changes were made in the originally proposed survey instrument. The instrument that was ultimately used (Appendix E) and the various changes that were made before its final implementation are described in more detail below.

The six subscales in this modified CAQ measured respondents' attitudes regarding Computer Importance (CI), Computer Enjoyment (CE), Computer Anxiety

(CA), Computer Usage (CU), Computer Careers (CC), and attitudes related to gender and computers (GA). The items of the various subscales were distributed throughout parts of the questionnaire as shown in Table 1. (Note that changes that were made in the subscales upon analysis of the reliability and validity of the survey instrument are reflected in Table 13 in Chapter 4 on page 73)

Table 1

Internal Consistency Reliability for Modified CAQ, Version 5.14 – Based on Previous Studies

Subscale	**Part**	**Item Numbers**	**Reliability**
Computer Importance	1	3, 6, 8, 9, 10, 11, 12 (7 items)	.82
Computer Enjoyment	1	1, 2*, 4, 10,13, 14*, 16*, 18,* 19* (9 items)	.82
Computer Anxiety	1	7*, 14*, 15, 16*, 17*, 18*, 19*, 20 (8 items)	.84
Computer Usage	2, 3, 4	21, 22, 26, 29, 33, 36, 37, 38, 39, 40, 41 (11 items)	TBD
Computer Careers	2	3, 17, 18, 23, 24, 25*, 32, 35, 36, 42 (10 items)	TBD
Gender Attitudes	2	27, 28, 30, 31, 33, 34, 35, (7 items)	TBD
Demographics	5	43, 44 (2 items)	TBD

Some of the items on the questionnaire were written in the negative (denoted in Table 1 with an asterisk*) and needed to be reversed before running the final data

analysis. The items that were reversed before analysis was conducted were 2, 7, 14, 16, 17, 18, 19 and 25.

The subscales of the original CAQ, Version 5.14, that were used for this study were intended to measure student attitudes denoted as Computer Importance (CI), Computer Enjoyment (CE), and Computer Anxiety (CA). Reliability of the original version of the CAQ, Version 5.14, has been established in several previous studies, and its overall reliability with regard to the total Likert-type scale was .94 utilizing 53 of the 62 Likert-type items contained in the original instrument. Subscale reliabilities ranged from a low of .80 to a high of .87. In addition, questions designed by the researcher were used to ascertain students' level of current Computer Use (CU); attitudes about Computer Careers (CC); and attitudes about gender (GA) and their possible impact on computer use and computer-related careers.

Scoring

The data that was collected from the survey instrument (Appendix E) was analyzed using the Statistical Package for the Social Sciences program (SPSS), Version 14 for Windows. The modified CAQ Code Sheet (Table 2) included codes for gender, race/ethnicity, items 1-33, items 34-35, items 36-40, and items 41-42. The scoring procedure for the Likert-type scale items (1-33) required the reversal of the items that were negatively worded in the survey form (items 2, 7, 14, 16, 17, 18, 19 and 25). This reversal was accomplished using a specific function provided by SPSS 14.

The scoring procedure involved entering all of the raw data from Scantron cards that were collected, run through a Scantron reader, converted into an Excel file and then

converted into a SPSS 14 data file. Upon completion of the conversion into SPSS, analysis of the data involved determining the average of the numeric values of the responses for related items listed in Table 2 in order to produce the appropriate subscale scores. The reason for producing the subscale scores was to provide insight into patterns that emerged with regard to the attitudes of the respondents. The statistical package, SPSS 14, computed the average of the mean scores and was used to produce a data listing and descriptive statistics including the mean, the standard deviation, the minimum and maximum scores provided by the respondents, along with the valid number of students (N) that responded to each set of questions. Table 2 below illustrates the code sheet that relates how the variables were coded in the SPSS 14 data file.

Table 2

Code Sheet for Modified CAQ, Version 5.14

Variable	Variable Name	Description
1	School	80 = Short Pump 100 = Wilder 130 = Rolfe 250 = Wilder 280 = Pocahontas 390 = Moody 500 = Brookland 510 = Fairfield 520 = Tuckahoe 690 = Byrd
2	Items 1-33	0 = Not Applicable 1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree

Table 2, continued

Code Sheet for Modified CAQ, Version 5.14

Variable	Variable Name	Description
3	Items 34-35	0 = Not Applicable 1 = No 2 = Yes
4	Item 36	0 = Not Applicable 1 = More than 2 computers 2 = 2 computers 3 = 1 computer 4 = 0 computers
5	Item 37	0 = Not Applicable 1 = 4 or more hours 2 = 3 hours 3 = 2 hours 1 = 1 hour
6	Item 38	0 = Not Applicable 1 = Word Processing 2 = Music Recording 3 = Web Page Design 4 = Games
7	Item 39	0 = Not Applicable 1 = Playing Games 2 = School Assignments 4 = Surfing the Internet
8	Item 40	0 = Not Applicable 2 = Interested 3 = Mildly Interested 4 = Very Interested
9	Gender	3 = Female 4 = Male

Table 2, continued

Code Sheet for Modified CAQ, Version 5.14

Variable	Variable Name	Description
10	Race/Ethnicity	0 = Not Applicable 4 = Other 3 = Hispanic 2 = African-American 1 = Caucasian

The statistical package, SPSS 14, was used to read the data, reverse the eight items that had been worded in the negative, average the subscale values, and produce descriptive statistics.

Data Analysis

The Likert-type scale items were used to produce six separate subscale scores: Computer Importance (CI), Computer Enjoyment (CE), Computer Anxiety (CA), Computer Usage (CU), Computer Careers (CC) and Gender Attitudes (GA). The statistical package, SPSS 14, was used to average the responses for each subscale, and descriptive statistics were generated for each for the purpose of comparison. Items 34-35 were asked as closed, dichotomous questions requiring a "yes" or "no" response. These items were converted to the numerical format parallel with the Likert-type items. For example, a "yes" answer was coded as a "3," and a "no" answer was coded as a "2"

in order to correspond with the "Disagree" and "Agree" responses on the Likert-type items.

The internal consistency of this survey was determined by having SPSS 14 calculate the Cronbach's alpha coefficient. A variety of statistical analyses were performed including descriptive statistics, frequencies, *t*-tests, a multivariate analysis of variance (MANOVA), and a 2 x 3 factorial analysis of variance (ANOVA). All of these various tests were used to determine attitudes between the boys and girls who were also of different racial/ethnic backgrounds. Since the students in the study could be grouped by both of the independent variables (gender and race/ethnicity) the researcher used the 2 x 3 ANOVA to determine if there was an interaction between the respondent's gender and his/her race or ethnic background.

Once the various tests had been run, it was also necessary to estimate the effect size of the study. The purpose of this step was to determine whether the study's results had any practical significance beyond their purported statistical significance. One popular measure of effect size is the calculation of Cohen's *d*. Another measurement calculated by SPSS which also computes effect size is the "partial Eta squared" measurement. These measurements were calculated in order to obtain information about the overall effect size of the comparisons of the variables used in the study.

Research Protocol

All research protocol conducted during this study was done in an effort to be in compliance with the Internal Review Board (IRB) at the Virginia Commonwealth University and with research protocol procedures and school board policies required by

Henrico County Public Schools. Upon receiving approval of the study from the IRB and upon receiving permission from the Department of Research and Planning of Henrico County Public Schools to conduct the survey, the researcher contacted the central office administrator in charge of Henrico County Public Schools' middle schools to discuss the study. The Director of Middle Schools for Henrico County Public Schools approved the survey and wrote an e-mail to the 10 middle school principals alerting them of the fact that they would be receiving instructions from the Research and Planning Department regarding arrangements that would need to be made in order to administer the surveys during either a homeroom or a study hall during a period of time in November 2006.

The researcher conducted training of the middle school technology trainers who agreed to serve as trainers of the eighth grade teachers in their respective buildings who would serve as the actual survey administrators. The training session for the technology trainers took place at one of their regular monthly training meetings at New Bridge Middle School on October 24, 2006.

Starting the week of October 30, 2006, informational letters with the opt-out form required by Henrico County Public Schools were sent home to parents of all the eighth graders in each of the 10 Henrico County middle schools that were to participate in the study. Upon the distribution of the letters, the teacher administrators conducted a brief but thorough information session with students regarding the nature of the upcoming survey. The teacher administrators described the general nature of the survey with students and described any and all benefits as well as any and all potential risks.

Students were asked to take the informational letters with the opt-out forms home to their parents. They were informed that they needed to return the letter with their parents' signatures only if their parents would prefer they NOT participate in the survey. By November 9, 2006, all letters that were returned to the school were collected by the homeroom or study hall teachers, and lists of those students who were not to receive a survey were compiled.

Starting November 9, 2006, the teacher administrators conducted a follow-up session with students. The "Youth Assent Forms" (Appendix D) were distributed, and students were given ample time to read the form carefully. Teacher administrators read the "Survey Administration Script Regarding the Youth Assent Form" (Appendix F) to students by way of explaining the pertinent details of the study and then inquired if students had any questions about their participation in the survey. After all questions were answered, students were asked to sign the "Youth Assent Form" (Appendix D) and turn it in. Teachers were asked to make note of any students who chose not to sign the "Youth Assent Form," and those names were added to the list of students who did not receive parental permission to participate in the survey.

During the period starting November 15 and ending November 22, 2006, students who had signed the "Youth Assent Form" and who had not returned the opt-out form from their parents were asked to complete the modified Computer Attitude Questionnaire (CAQ) under the supervision of a trained teacher during homeroom or study hall. Homeroom or study hall time was used in order avoid negatively impacting instructional time.

Students who participated in the study completed the modified Computer Attitude Questionnaire (CAQ). The survey instrument inquired about students' attitudes and dispositions regarding computers and computer use in general. Students were asked questions that indicated specific attitudes toward computers that reflected feelings of enjoyment and motivation. Students who participated in this study were asked to complete the two-page, 42-item questionnaire (Appendix B). The survey instrument took about fifteen minutes to complete. Homeroom or study hall teachers administered the surveys, collected them, placed them in pre-addressed envelopes, sealed them, and sent them directly to the Department of Research and Planning at the central office of Henrico County Public Schools. Students who chose not to participate in this study were given an alternate activity (Appendix C) to work on during the time that other students were completing the survey. A word search puzzle provided by the researcher was distributed to those students who brought back their opt-out forms indicating their parents' wish that they not participate in the study and/or for those students who chose not to sign the "Youth Assent Form."

All of the information collected from the questionnaires remained completely confidential. Names were not requested. Certain demographic information such as gender and race/ethnicity were requested for the purpose of comparison only. If any student placed his/her name on a questionnaire, it was removed. No student was identified with his or her results in the reporting of this study, and grades were not impacted by the student's participation or lack of participation in the study. No student was negatively impacted in any way by not participating in the study.

Piloting the Survey Instrument

The modified survey form was piloted with a group of 23 seventh grade students in order to attempt to validate the internal consistency and the reliability of the modified survey. The pilot test was also used to uncover any potential problems from which the modified questionnaire might suffer (Tuckman, 1994). Upon analysis of the pilot study, any changes that needed to be made were incorporated into the final version of the questionnaire (Appendix E) before being distributed to the study group.

Delimitations

This study did not attempt to generalize to other populations or conditions and was strictly limited to the eighth grade students in the 10 middle schools in the Henrico County Public Schools system who chose to voluntarily participate. This study did not attempt to incorporate teachers' attitudes toward computers; and the study did not attempt to generalize to any other populations or conditions. Findings were limited to the eighth grade students who participated in the survey in the 10 middle schools in Henrico County.

CHAPTER 4 FINDINGS

The purpose of this research is to compare eighth grade girls' attitudes to eighth grade boys' attitudes toward computer use and computer technology. The findings of this study are presented in this chapter in the following sections:

(1) description of the sample;

(2) description of the survey instrument;

(3) description of the pilot study;

(4) validating the internal consistency of the modified Computer Attitude Questionnaire;

(5) description of the research protocol and procedures used;

(6) findings;

(7) analysis of data related to research questions;

(8) differences in attitudes toward computer use and computer technology based on gender;

(9) differences in attitudes toward computer use and computer technology based on race/ethnicity;

(10) multivariate analysis of variance results;

(11) analysis of variance results;

(12) correlation between attitudes regarding computer use and computer technology and the number of computers in the home;

(13) summary.

Description of the Sample

The sample used in this study included eighth grade students from 10 middle schools in Henrico County, Virginia. The number of students included in the total sample equaled 3,428. The number of students who were opted out of the study by their parents equaled 16. The number of surveys that were ultimately returned and scanned equaled 2,077 for a 60.6% return. The remaining number of students (1,335) either did not sign or did not return the required "Youth Assent Form," or they were absent on the day that the survey was administered.

The number of females who responded to the survey equaled 1,122 (54%) and the number of males who responded to the survey equaled 955 (46%). Table 3 presents a breakdown of the response rates based on the self-reported racial/ethnic backgrounds of the students.

Table 3

Response Rates by Race/Ethnicity

Race/Ethnicity	Frequency	Valid Percent	Cumulative Percent
Not Applicable	63	3%	3%
Other	306	14.7%	17.8%
Hispanic	99	4.8%	22.5%
African-American	615	29.6%	52.1%
Caucasian	994	47.9%	100%
Total	2077		

Table 4 shows the number of students from each of the 10 middle schools who participated in the survey.

Table 4

Response Rates by School

School	Frequency	Valid Percent	Cumulative Percent
Short Pump Middle	212	10.2%	10.2%
Hungary Creek Middle	228	11%	21.2%
Rolfe Middle	170	8.2%	29.4%
Wilder Middle	177	8.5%	37.9%
Pocahontas Middle	223	10.7%	48.6%
Moody Middle	195	9.4%	58%
Brookland Middle	262	12.6%	70.6%
Fairfield Middle	138	6.6%	77.3%
Tuckahoe Middle	148	7.1%	84.4%
Byrd Middle	324	15.6%	100%
Total	2077		

Description of the Survey Instrument

The questionnaire that was used for this study was a modified version of the Computer Attitude Questionnaire (CAQ) developed by Knezek and Christensen in 1993. Although the CAQ is available online in two versions, one for older students and one for younger students, the version that was selected for this study was known as CAQ, Version 5.14. CAQ, Version 5.14 is a 65-item, 4-point Likert-type self-report

questionnaire designed to be used in grades four through eight. It was designed to measure attitudes (feelings toward a person or thing) and prevailing attitudes (dispositions) rather than achievement. Students are asked to record their personal perceptions of the extent to which they agree or disagree with each item on the survey. The survey is designed to be administered under the supervision of a teacher in a classroom environment or a parent in the home.

Dr. Gerald Knezek granted the researcher permission to modify the CAQ, Version 5.14 as needed in order to adjust it for the purpose of this study. As a result, three subscales from the CAQ, Version 5.14 were maintained (Computer Importance, Computer Enjoyment, and Computer Anxiety) while the remaining subscales were eliminated. The researcher added new questions in an effort to measure students' attitudes related to their individual use of their school-issued laptop computers. The subscales that were added related to computer usage and computer careers. One more section was added that was designed to measure students' attitudes toward gender differences as they relate to computer-related jobs.

Description of the Pilot of the Survey Instrument

At the recommendation of the Director of the Department of Research and Planning for Henrico County Public Schools, the researcher met with the principal of Brookland Middle School to request permission to conduct a pilot study of the survey instrument with a group of seventh graders. Seventh graders were used for the pilot study since eighth graders in most of the middle schools in the county were going to be part of the research study.

The meeting with the principal took place on September 22, 2006. The principal recommended the name of two seventh grade teachers that he thought might be willing to participate in a pilot study. The researcher contacted both teachers by e-mail and chose to work with the first teacher who responded positively to the request.

Between September 23, 2006 and October 6, 2006, the researcher was in e-mail contact with the seventh grade teacher who agreed to allow her class to be used in the pilot study. The researcher sent the parent letters (Appendix B) and "Youth Assent Forms" (Appendix D) along with a description of the research protocol to the teacher through the school system's inter-school mail system and answered all questions that the teacher posed through e-mail.

By mutual agreement, the researcher went to Brookland Middle School on October 6, 2006, and conducted a pilot study of the seventh grade English class offered by the teacher. The class consisted of 23 students. One of the students had returned the opt-out form signed by her parents, and one student elected not to sign the "Youth Assent Form." The two students who did not participate in the study were given the alternate activity (Appendix C) to complete while the remaining 21 students worked on the survey.

The researcher offered students two small incentives to participate in the pilot study. One incentive was the gift of an inexpensive mechanical pencil with a #2 lead. Students were told that they would be given the pencil for the purpose of taking the survey and they would be allowed to keep it if they participated in the pilot study.

Additionally, individually wrapped pieces of chocolate candy were offered to students who completed the survey.

Of the 21 students who participated in the pilot study, two students did not indicate whether they were male or female on the item requesting identification of sex. The frequency distribution for the remaining 19 students who indicated their sex broke down into 10 females and nine males. The breakdown of the students along racial/ethnic lines was as follows: one identified himself or herself as Hispanic; 15 identified themselves as African-American; four identified themselves as Caucasian; and one identified himself or herself as "other."

The pilot survey took a total of 13 minutes for the students to complete from the time they began to work on the instrument until the last survey was returned. The students who took the least amount of time to answer the questions returned the survey after just eight minutes.

As a result of the pilot study, the researcher realized that some sort of script would need to be sent out with the surveys so that survey administrators would be able to give uniform directions on how to fill out the survey instrument. That survey script is included in the Appendix (Appendix G).

After all of the students had returned their surveys, the researcher talked with them about their general impressions of the questions. A couple of the students commented that they didn't think some of the questions "made sense." In particular, they had had trouble understanding item 14 and item 16. They indicated that their problem with item 14 was that they did not understand the meaning of the phrase

"sinking feeling" in the context of the statement, "I get a sinking feeling when I think of a trying to use a computer." With regard to item 16, they complained that it also didn't make sense to them. (Item 16 stated, "Working with a computer makes me nervous.")

One student observed that on item 38, not enough choices were offered. When asked what he meant, he pointed out that the item asked for the respondent to indicate the number of computers in the home not counting the school-issued iBook. In his case, he said, there were *no* other computers besides his school-issued iBook, but "0" had not been offered as a choice.

With regard to items 27 and 28 ("I think boys understand and enjoy computers more than girls," and "I think girls understand and enjoy computers more than boys") students commented that they would have liked to be allowed to "write more." When asked what they meant, they indicated that they would have liked to explain their individual responses.

With regard to item 30 ("I think my family treats boys and girls differently when it comes to using computers") one student commented that it didn't apply to him or his family because he was an only child.

Following this discussion with the students in the pilot study, in addition to the changes in the survey instrument that had been recommended by the dissertation committee at the presentation of the prospectus proposal, the researcher made the following changes in the survey instrument:

- Item 14 was changed from "I get a sinking feeling when I think of trying to use a computer" to "I feel uneasy when I think of trying to use a computer."
- Item 30 ("I think my family treats boys and girls differently when it comes to using computers") was deleted.
- Item 35 ("I would consider pursuing a career that is considered nontraditional for my gender") was deleted.
- Two new items were added at the suggestion of the dissertation committee chair. Item 32 became "When I work full time for a living, I want to use the computer all the time."
- Item 33 became, "When I graduate, my dream job is to work with computers."
- Item 36 ("How many computers are in your home, not counting your school-issued iBook?") was adjusted to reflect "0" as an option.
- All of Part 4 of the survey was modified in order to make it more compatible with the use of the Scantron machine that was offered by the Henrico County Public Schools system in order to make surveying most of the eighth graders in the school division more practical. In effect, options for old items 39, 40, 41, and 42 were changed and became new items 36, 37, 38, 39, and 40 with four options each.

(Note that the original survey form used in the pilot study is included in the

Appendix as "Appendix H" for the purpose of comparison with the final version of the survey that was used, "Appendix B.")

The modified survey was reduced from a 44-item survey to a 42-item survey, and the school division reduced the print and adjusted the format in order to make it a two-page survey instead of three. Students who participated in the study were given the survey along with a Scantron card that corresponded with the options on the survey. Students filled in the bubbles on the Scantron card to correspond with their responses. The Scantron cards were then run through the school division's Scantron card reader. The results were converted to an Excel file, and that data was then converted into an SPSS file using the statistical package, SPSS 14.

When the data for the pilot study were analyzed for reliability, the sample proved to be too small to provide adequate data on reliability or validity. As a result, the changes that were made in the questionnaire were based upon the verbal input from the individual students who participated in the pilot study and the recommendations of the dissertation committee, and the Director of the Department of Research and Planning for the Henrico County Public Schools division.

Validity and Reliability Evidence for the Modified Computer Attitude Questionnaire

The modified Computer Attitude Questionnaire (CAQ) that was used as the survey instrument for this study was a Likert-type self-report instrument. In addition to using questions from the original Computer Attitude Questionnaire, Version 5.14, items requesting information about the number of computers in the homes of the students, the

amount of time students spend on their computers beyond the school day, and the types of activities that the students generally engage in when using their school-issued iBook computers were incorporated into the modified survey instrument.

The items from sections one and two of the survey instrument were taken directly from the Computer Attitude Questionnaire, Version 5.14, that was based on the 1992 questionnaire known as the "Young Children's Computer Inventory Questionnaire" (YCCI). That survey instrument was developed by Miyashita and Knezek (1992) in order to gather data from children in grades one-three. The CAQ which incorporated 48 items from the YCCI was developed by Knezek and Christensen and was used in a 1993 study. A later study used the CAQ in 1995.

The following table shows the internal consistency reliability for the modified CAQ. The reliability estimates were calculated using the statistical package, SPSS 14. The overall internal consistency reliability for all of the Likert-type items used in the survey instrument (items 1-33) indicate a Cronbach's alpha index of .85 which is generally considered to be in the "good" range according to guidelines regarding acceptable reliabilities for research instrument scales.

Table 5 shows the individual subscales indicating Cronbach's alpha indices for the following subscales: Computer Importance (CI), Computer Enjoyment (CE), Computer Anxiety (CA), Computer Usage (CU), Computer Careers (CC), and Gender Attitudes (GA). Cronbach's alpha indices for those subscales range from a low of .64 for the item attempting to measure attitudes toward gender to a high of .77 for the index on Computer Anxiety. The individual indices were calculated as follows: Computer

Importance = .71; Computer Enjoyment = .73; Computer Anxiety = .77; Computer Usage = .73; Computer Careers = .75; and Gender Attitudes = .64. In general, an index of .70 is used to say that a measure is internally consistent (Mitchell & Jolley, 2004).

Table 5

Internal Consistency Reliability for Modified CAQ, Version 5.14

Subscale	**Part**	**Item Numbers**	**Reliability**
Computer Importance	1	3, 6, 8, 9, 10, 11, 12 (7 items)	.71
Computer Enjoyment	1	1, 2*, 4, 10,13, 14*, 16*, 18,* 19* (9 items)	.73
Computer Anxiety	1	7*, 14*, 15, 16*, 17*, 18*, 19,* 20 (8 items)	.77
Computer Usage	1&2	6, 9, 10, 11, 12, 21, 22, 29 (8 items)	.73
Computer Careers	2	23, 24, 25*, 30, 32, 33 (6 items)	.75
Gender Attitudes	1&2	3, 23, 24, 25, 27 28, 31, 32, 33 (9 items)	.64
Overall	1&2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33	.85

The items with the asterisk (*) were written in the negative and were reversed before having the analysis run on the items. The items that were reversed were 2, 7, 14, 16, 17, 18, 19, and 25.

Description of Research Protocol

The researcher received approval from the VCU Institutional Review Board (IRB) after submitting requested changes and clarifications to the initial submission on August 25, 2006. On September 15, 2006, the researcher met with the head of the Department of Research and Planning and her assistant. At that meeting, the researcher was asked about the possibility of surveying all of the eighth graders in Henrico County rather than just the eighth graders in the three middle schools that had been part of the initial request. The researcher offered that the possibility of surveying all of the eighth graders in the school district was certainly intriguing, but it presented a number of logistical problems including (1) printing costs that could prove prohibitive for the researcher since there would be a need for more than three times the numbers of surveys, parent letters, assent forms, etc.; (2) the method used for gathering the raw data from the surveys; and (3) training of the teacher administrators in 10 schools as opposed to three schools.

The solutions offered to solve those problems were as follows:

(1) The school system absorbed the printing costs and the research department's assistant took over the logistical details which included printing and distributing parent letters, surveys, alternate activities, and "Youth Assent Forms" to each of the 10 middle schools to be part of the study.

(2) The school system offered use of Scantron cards that could be filled out by students and then scanned through the school division's Scantron card reader. This

would facilitate a faster and more efficient method for entering the raw data from the individual surveys.

(3) The researcher was advised to contact the head of the secondary Technology Department to inquire about the possibility of training the middle school technology trainers on the protocol to be used in the administration of the surveys. The technology trainers would then train the individual eighth grade teachers who would serve as survey administrators during the week designated by the researcher and the school division for the administration of the surveys to the students. That training would take place during a faculty meeting at a time that would be convenient for the individual school's schedule at some point between the time the researcher trained the technology trainers and the surveys were to be administered.

Training of Technology Trainers

On October 24, 2006, the researcher met with the middle school technology trainers at New Bridge Middle School during one of their regular monthly training sessions. The researcher distributed an outline (Appendix I), a copy of the survey (Appendix E), a copy of the parent letter (Appendix B), a copy of the "Youth Assent Form" (Appendix D), a copy of the scripts to be used by the survey administrators during both the youth assent conversation and as an introduction to the survey itself (Appendix J), and the alternate activity (Appendix C).

During this meeting, the researcher went over the important points that the technology trainers needed to emphasize with the eighth grade teachers who would be administering the surveys. The need for respecting the students' right to privacy and to

guard against making the students feel that they were to be pressured in any way to participate in the study were discussed. The researcher answered all questions posed by the technology trainers and left her contact information in case any one of them might have questions to arise between that date and the training that they would be conducting in their individual schools.

Survey Implementation Procedures

In the meantime, the researcher and the assistant from the Department of Research and Planning agreed upon a timeline during which all survey activities would be conducted. Ultimately, the following timeline was implemented:

(1) Parent information letters including an opt-out form required by Henrico County School Board policy were sent home with students on October 30, 2006. All opt-out forms were to be returned to the homeroom or study hall teacher of the student (depending upon how the surveys were going to be distributed in the individual school) no later than November 9, 2006.

(2) On November 9, 2006, discussion around the "Youth Assent Form" was conducted with students in order to assure their understanding that they could voluntarily choose to participate in the study or not. Teachers were given scripts (Appendix F) to read verbatim that explained the students' rights.

(3) Surveys were administered to students in 10 middle schools from November 15-22, 2006.

(4) All surveys and "Youth Assent Forms" (along with the 16 parent opt-out forms that were received) were returned to the Henrico County Schools' Office of

Research and Planning where the Scantron cards were run through the Scantron card reader, the raw data was dumped into an Excel file, and the data from the Excel file was converted to a SPSS 14 database.

The researcher picked up the surveys, the "Youth Assent Forms," and the parent opt-out forms and transported them to the Principal Investigator's office for secure storage. The SPSS 14 database of raw data from the surveys was transported via a flash drive from the computer in the office of the research assistant for Henrico County Schools' Department of Research and Planning to the computer owned by the researcher and secured in the researcher's home. The data has since been securely stored and backed up periodically while being analyzed.

Findings

Number of Computers in the Homes of Respondents

Students reported the number of computers in their homes in addition to their school-issued iBooks. The significance of this number is that it provides some indication of the level of technological support offered in the students' homes in addition to the Henrico County School division's iBook initiative. Table 6 shows the number of computers in the respondents' homes broken down by gender, and Table 7 shows the number of computers in the respondents' homes broken down by race/ethnicity.

It should be noted that the "N" for each group is slightly different because 63 of the respondents selected "not applicable" as their choice for the item asking that they identify their race/ethnicity. For the purpose of analysis for each of the questions related

to race/ethnicity, those 63 cases were eliminated in order to keep the racial/ethnic groups to four rather than five, providing an "N" of 2,014 for that particular group analysis.

Table 6

Response to Question 36: How Many Computers Are in Your Home, Not Counting Your School-Issued iBook? (Responses by Gender)

	Gender Female/Male	Percent within Gender	Total
Not Applicable	80/55	7.1%/5.8%	6.5%
More than 2 computers	244/222	21.7%/23.2%	22.4%
2 computers	283/252	25.2%/26.4%	25.8%
1 computer	447/364	39.8%/38.1%	39.0%
0 computers	68/62	6.1%/6.5%	6.3%
Total	1122/955	100%/100%	100%

Table 7

Response to Question 36: How Many Computers Are in Your Home, Not Counting Your School-Issued iBook? (Responses by Race/Ethnicity)

	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	23	7	42	56	128
More than 2	71	16	80	280	447
2 computers	90	24	118	291	523
1 computer	113	40	300	342	795
0 computers	9	12	75	25	121
Total	306	99	615	994	2014

Table 7, Continued

Response to Question 36: How Many Computers Are in Your Home, Not Counting Your School-Issued iBook? (Responses by Race/Ethnicity)

Percentage within Race/Ethnicity

	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	7.5%	7.1%	6.8%	5.6%	6.4%
More than 2	23.2%	16.2%	13.0%	28.2%	22.2%
2 computers	29.4%	24.2%	19.2%	29.3%	26.0%
1 computer	36.9%	40.4%	48.8%	34.4%	39.5%
0 computers	2.9%	12.1%	12.2%	2.5%	6%
Total	100%	100%	100%	100%	100%

Reported Use of Computers

Respondents reported that on average, they use computers 2.73 hours per day outside of school. Table 8 shows how many hours per day the students report that they use their computers outside of school by gender. Table 9 shows how many hours per day the students report that they use their computers outside of school by race/ethnicity.

Table 8

Response to Question 37: On Average, How Many Hours Per Day Do You Use Your Computer Outside of School? (Responses by Gender)

	Female/Male	Percent within Gender	Total
Not Applicable	22/31	2.0%/3.2%	2.6%
4 or more hours	254/152	22.6%/15.9%	19.5%
3 hours	184/139	16.4%/14.6%	15.6%
2 hours	299/267	26.6%/28.0%	27.3%
1 hour	363/366	32.4%/38.3%	35.1%
Total	1122/955	100%/100%	100%

Table 9

Response to Question 37: On Average, How Many Hours Per Day Do You Use Your Computer Outside of School? (Responses by Race/Ethnicity)

	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	6	4	11	28	49
4 or more hours	65	15	173	143	396
3 hours	53	13	98	151	315
2 hours	88	25	155	276	544
1 hour	94	42	178	396	710
Total	306	99	615	994	2014

Table 9, Continued

Response to Question 37: On Average, How Many Hours Per Day Do You Use Your Computer Outside of School? (Responses by Race/Ethnicity)

	Percent within Race/Ethnicity				
	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	2%	4%	1.8%	2.8%	2.4%
4 or more hours	21.2%	15.2%	28.1%	14.4%	19.7%
3 hours	17.3%	13.1%	15.9%	15.2%	15.6%
2 hours	28.8%	25.3%	25.2%	27.8%	27%
1 hour	30.7%	42.4%	28.9%	39.8%	35.3%
Total	100.0%	100%	100%	100%	100%

Software Programs That Respondents Report Enjoying

Respondents reported enjoying a variety of activities when using their iBooks, including different types of software programs. Overall, students reported that they enjoyed playing games more than other activities such as word processing, music recording, or web page design. Indeed, according to their responses, 41.2% of students reported enjoying playing games over the next highest most enjoyable activity which was music recording. The percentage of students reporting that music recording was their favorite activity was 31.4%. Web design came in as the students' third preference with 14.9% of students reporting that as their favorite activity, and 9.1% reported that they enjoyed word processing more than other activities.

Computer Activities that Respondents Report Enjoying

Students reported using their computers for different activities, and they reported on the types of software programs that they enjoyed using most. When asked to choose among four specific choices including word processing, music recording, web page design, and games, students of both sexes reported enjoying playing games more than the other three activities. Boys and girls reported enjoying different programs, however. Generally speaking, girls reported music recording as their first choice for enjoyment (35.6%) compared to playing games (26.8%). By contrast, the boys reported games as their favorite software choice (58.1%) with music recording coming in as their second choice (26.6%). Table 10 shows how students reported their favorite software activities by gender. Table 11 shows how students reported their favorite software activities by race/ethnicity.

Table 10

Response to Question 38: What Type of Software Do You Enjoy Using Most? (Responses by Gender)

	Female/Male	Percent within Gender	Total
Not Applicable	35/35	3.1%/3.7%	3.4%
Word Processing	152/36	13.5%/3.8%	9.1%
Music Recording	399/254	35.6%/26.6%	31.4%
Web Page Design	235/75	20.9%/7.9%	14.9%
Games	301/555	26.8%/58.1%	41.2%
Total	1122/955	100%/100%	100%

Table 11

Response to Question 38: What Type of Software Do You Enjoy Using Most? (Responses by Race/Ethnicity)

	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	8	3	24	27	62
Word Processing	32	8	38	108	186
Music Recording	82	37	255	263	637
Web Page Design	43	13	90	149	295
Games	141	38	208	447	834
Total	306	99	615	994	2014

Table 11, Continued

Response to Question 38: What Type of Software Do You Enjoy Using Most? (Responses by Race/Ethnicity)

	Percentage within Race/Ethnicity				
	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	2.6%	3.0%	3.9%	2.7%	3.1%
Word Processing	10.5%	8.1%	6.2%	10.9%	9.2%
Music Recording	26.8%	37.4%	41.5%	26.5%	31.6%
Web Page Design	14.1%	13.1%	14.6%	15.0%	14.6%
Games	46.1%	39.4%	33.8%	45.0%	41.4%
Total					100.0%

How Students Report Using Their Computers

Students reported using their computers for different activities including playing games, school assignments, e-mail, and surfing the Internet. In spite of the fact that students had responded that the software activity they enjoyed most was related to playing games, the number one activity reported by both boys and girls as what they use their computers for most was "surfing the Internet," with 44.3% of students reporting that as their first choice among the choices provided. Their next favorite activity involved using their computers for school assignments with 21.1% of students reporting that as their first choice of computer activity. Using e-mail came in as the students' third choice with 16.7% of respondents reporting that as their number one activity. Playing

games came in last with 14.4% of students reporting playing games as the activity that they use their computer for most.

Table 12 shows how students responded to the question compared by gender and Table 13 shows how students responded to the question compared by race/ethnicity.

Table 12

Response to Question 39: What Do You Use the Computer for the Most? (Compared by Gender)

	Female/Male	Percent within Gender	Total
Not Applicable	28/44	2.5%/4.6%	3.5%
Playing Games	86/214	7.7%/22.4%	14.4%
School Assignments	248/190	22.1%/19.9%	21.1%
E-Mail	258/89	23.0%/9.3%	16.7%
Surfing the Internet	502/418	44.7%/43.8%	44.3%
Total	1122/955	100%/100%	100%

Table 13

Response to Question 39: What Do You Use the Computer For Most? (Responses by Race/Ethnicity)

	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	10	5	21	29	65
Playing Games	54	15	63	161	293
School Assignments	67	27	117	212	423
E-Mail	42	17	93	185	337
Surfing the Internet	133	35	321	407	896
Total	306	99	615	994	2014

Table 13, Continued

Response to Question 39: What Do You Use the Computer For Most? (Responses by Race/Ethnicity)

	Percentage				
	Other	Hispanic	African-American	Caucasian	Total
Not Applicable	3.3%	5.1%	3.4%	2.9%	3.2%
Playing Games	17.6%	15.2%	10.2%	16.2%	14.5%
School Assignments	21.9%	27.3%	19.0%	21.3%	21.0%
E-Mail	13.7%	17.2%	15.1%	18.6%	16.7%
Surfing the Internet	43.5%	35.4%	52.2%	40.9%	44.5%
Total					100.0%

Students with Connections to the Internet

Most of the students surveyed have Internet access at home. Of the total sample, 82.8% of the students reported having access to the World Wide Web at home, compared to only 13.4% who do not. (Those who chose "not applicable" as their response to item 37 constituted 3.9% of the responses.) Access to the Internet varies somewhat across racial/ethnic lines. For example, while a majority of the Hispanic students reported having Internet access at home, the percentage was only 65.7% compared to 72.7% of the African-Americans, and 90.4% of the Caucasian students.

Students Enjoy Lessons Using Computers

Students indicated that they enjoy class lessons that are done on the computer. Overall, 82% of students, both boys and girls, reported that they enjoy "lessons that are done on the computer." They tend to enjoy lessons slightly less if the teachers are using the computers as opposed to the students using them, however. In response to the item, "I believe that the more often teachers use computers, the more I will enjoy school," the percentage of students who agreed dropped from 82% to 63.9%.

Differences in Attitudes Toward Computer Use and Computer Technology Based on Gender

Overall, 82.3% of students reported that they either agreed or strongly agreed that computers are important. Only 17.5% disagreed. With regard to their enjoyment of computers, 59.6% of students reported that they either agreed or strongly agreed that they "enjoyed" computers, while 40.2% disagreed.

With regard to feeling anxiety when using computers, students of both sexes reported feeling little if any anxiety when using computers. In fact, 89.8% of the respondents either disagreed or strongly disagreed with the idea that they felt any anxiety with regard to computer use. In contrast, only 9.7% reported feeling some level of anxiety.

Gender Differences

Independent samples *t*-tests were conducted to compare scores for Computer Importance (CI), Computer Enjoyment (CE) and Computer Anxiety (CA) based on

gender. There was a significant statistical difference ($p < .05$) between the mean scores of the females ($M = 2.929$, $SD = .589$) and the mean scores of the males [$M = 3.059$, $SD = .598$; $t(2075) = -4.995$, $p = .000$] with regard to attitudes toward computer importance. The mean of the scores for the males was higher than the females, indicating that males think computers are more important than the girls. The magnitude of the differences in the means with regard to effect size, however, was in the small range (Cohen's $d = -0.219$; partial Eta squared = .012); and there were no significant statistical differences in the scores for the males and females when comparing attitudes toward computer enjoyment or in student attitudes toward computer anxiety.

With regard to the students' attitude toward Computer Usage (CU), there was a statistically significant difference between the females ($M = 2.945$, $SD = .582$) and males [$M = 3.0398$; $SD = .591$; $t(2075) = -3.662$; $p = .000$] to $p < .05$. The mean score for the males was higher than the females. The magnitude of the differences in the means with regard to effect size, however, was in the small range with regard to Cohen's $d = -0.161$, and the value of partial Eta squared was .006.

In response to questions regarding students' attitudes about Computer Careers (CC), the difference between males and females was also significantly different. The mean for females was ($M = 1.899$; $SD = .582$; $t(2075) = -11.033$; $p = .000$) and the mean for males was [$M = 2.242$; $SD = .755$; $t(2075) = -10.913$; $p = .000$]. The magnitude of the differences in the means with regard to effect size was moderate to large (Cohen's $d = -0.483$ and partial Eta squared = .055).

Boys and girls indicated differing views with regard to the idea that working with a computer in a job all day sounds interesting and/or fun. For example, item 23 stated, "I think working with a computer in a job all day would be an interesting and fun way to make a living." In response to that item, 50.7% of the boys agreed or strongly agreed compared to 37% of the girls who agreed or strongly agreed. By contrast, 55.8% of the girls either disagreed or strongly disagreed compared to 42.4% of the boys who either disagreed or strongly disagreed.

Girls indicated more interest in how computers work than boys, however. This may be because the boys believe they already know what they need to know about how computers work, or it may point to the fact that girls feel that they would somehow benefit from understanding more about how computers work. Either way, item 24 stated, "I would like to know more about what makes computers work." In response to that item, 58.1% of the girls either strongly agreed or agreed, while in comparison, 40.5% of the boys reported holding the same opinion. The percentage of girls who disagreed or strongly disagreed came to 33.3% while 52.7% of the boys either disagreed or strongly disagreed with that statement.

The girls' response to item 24 did not seem to affect their response to item 25, however, which stated, "I don't care what makes computers work as long as they do what I want them to do." Of the girls who responded in the affirmative, 69.7% indicated that they either agreed or strongly agreed with that statement. Of the boys who responded in the affirmative, 54% indicated that they either agreed or strongly agreed. Of the girls who responded negatively (indicating that they did care about how the

computer works) 25.3% of them disagreed or strongly disagreed with the item while 40.2% of the boys disagreed or strongly disagreed.

In response to item 30 which stated, "I have considered taking courses that might lead to a computer-related career, boys and girls seem to have differing thoughts. Specifically, 44.9% of the boys agreed or strongly agreed compared to only 24.9% of the girls. The percentage of girls who indicated that they either disagreed or strongly disagreed came to 65.9% compared to 47.8% of the boys who responded that they either disagreed or strongly disagreed with that item.

In response to item 32, "When I work full time for a living, I want to use the computer all the time," 72.3% of the girls either strongly disagreed or disagreed compared to 60.9% of the boys who reported disagreement or strong disagreement. Only 20.6% of the girls agreed or strongly agreed that working with a computer all the time was something they would want to do full time for a living compared to 32.1% of the boys.

In response to item 33, "When I graduate, my dream job is to work with computers," 24.7% of the boys agreed or strongly agreed with the statement. Among the boys, 66.1% responded in the negative to that item. The number of girls who responded in the negative was even greater; however, with 81.5% of the girls reporting that they either strongly disagreed or disagreed with the statement. Only 11% of the girls agreed or strongly agreed with the idea that their "dream job" would be to work with computers.

Differences in Attitudes Toward Computer Use and Computer Technology Based on Race/Ethnicity

A one-way between-groups analysis of variance was conducted to explore the impact of race/ethnicity on attitudes toward Computer Importance (CI), Computer Enjoyment (CE), Computer Anxiety (CA), Computer Usage (CU), and Computer Careers (CC). Subjects were divided into four groups based on their self-reported characterization of race/ethnicity: Caucasian, African-American, Hispanic, and Other. Subjects who had selected "Not Applicable" with regard to race/ethnicity were deleted from the data set used in this particular analysis. The number of cases deleted equaled 63, which brought the total N for this particular data file to 2,014.

There were no statistically significant differences in the mean scores for the four groups with regard to the variables for Computer Importance (CI), Computer Anxiety (CA), or Computer Usage (CU); but there were statistically significant differences in the mean scores of the four groups with regard to Computer Enjoyment (CE) and Computer Careers (CC).

A one-way between-groups analysis of variance (ANOVA) was conducted to measure computer enjoyment against students' reported race/ethnicity as measured by the modified Computer Attitude Questionnaire. There was a statistically significant difference at the $p < .05$ level in Computer Enjoyment (CE) for the four racial/ethnic groups [$F(3, 2010) = 2.676$, $p = .046$]. The effect size was measured using partial Eta squared and was .004, which would be considered small.

A one-way between groups analysis of variance (ANOVA) was also conducted to measure attitudes regarding computer careers against students' reported race/ethnicity. There was a statistically significant difference at the $p < .05$ level in Computer Careers (CC) for the four racial/ethnic groups [$F(3, 2010) = 5.426, p = .001$]. The effect size was measured using partial Eta squared and was .008, which would also be considered small.

Table 14 shows how the means and standard deviations were reported by SPSS 14, broken down by gender and by race/ethnicity using designations for Caucasian, and African-American, and Hispanic.

Table 14

Comparisons of Attitudes of Eighth Graders Toward Computer Use and Computer Technology Based on Gender and Race/Ethnicity

	Female Mean/S.D.	Male Mean/S.D.	Total Mean/S.D.
Computer Importance			
Caucasian	2.88/.55	3.07/.59	2.97/.58
African American	3.02/.59	3.04/.62	3.03/.60
Hispanic	2.88/.57	3.09/.52	2.97/.55
Computer Enjoyment			
Caucasian	3.14/.52	3.23/.58	3.18/.55
African American	3.16/.58	3.16/.62	3.16/.60
Hispanic	3.01/.67	3.02/.62	3.01/.64
Computer Anxiety			
Caucasian	3.14/.62	3.19/.70	3.16/.66
African American	3.11/.72	3.11/.72	3.11/.72
Hispanic	2.96/.84	2.99/.70	2.97/.78
Computer Usage			
Caucasian	2.91/.54	3.05/.59	2.98/.57
African American	3.03/.56	3.01/.60	3.02/.58
Hispanic	2.86/.63	3.08/.53	2.96/.60
Computer Careers			
Caucasian	1.80/.61	2.22/.75	1.99/.71
African American	2.00/.67	2.28/.72	2.13/.71
Hispanic	1.93/.67	2.13/.80	2.02/.73
Gender Attitudes			
Caucasian	1.95/.48	2.23/.57	2.08/.54
African American	2.13/.54	2.28/.60	2.20/.58
Hispanic	2.04/.58	2.12/.70	2.08/.63

Multivariate Analysis of Variance Results

A one-way between groups multivariate analysis of variance (MANOVA) was performed to investigate the interaction of Gender Attitudes (GA) with regard to attitudes toward computer use and computer technology. Five dependent variables were used: attitudes toward Computer Importance (CI), Computer Enjoyment (CE), Computer Anxiety (CA), Computer Usage (CU), and Computer Careers (CC). The independent variable that was used was based on the mean score of the combined items for the subscale on Gender Attitudes (GA). Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices and multicollinearity.

The Kolmogorov-Smirnov statistic which assesses the normality of the distribution of scores indicated a significance of .000 which is less than .05, indicating a violation of the assumption of normality. However, given the large sample size, this was not actually a violation.

With a Sig. value of .000, the Box's Test of Equality of Covariance Matrix also indicated a violation of the assumption of homogeneity of variance-covariance matrices. It should be noted, however, that the Box's M statistic can be too strict when a large sample size is used. Likewise, the Levene's Test of Equality of Error Variances indicated that there was a violation of the assumption of equality of variance for each of the dependent variables. When this assumption is violated, it is sometimes recommended that a more conservative alpha level may be chosen for determining

significance for the variables used. In this case, the alpha of .01 was selected rather than the conventional .05 level for the MANOVA tests.

Multivariate tests of significance are used to indicate whether there are statistically significant differences among the groups on a linear combination of the dependent variables. One of the more commonly reported statistics is Wilk's Lambda. In this instance, there was a statistically significant difference to a $p < .01$ when a multivariate test was performed on the five combined dependent variables (Computer Importance, Computer Enjoyment, Computer Anxiety, Computer Usage, and Computer Careers) and the independent variable for Gender Attitudes. The result was $F(170, 10107.505) = 19.768$, $p = .000$; Wilks' Lambda = .241; partial Eta squared = .248. Tests of between-subjects effects also indicated significant differences between the mean for Gender Attitudes (GA) and each one of the dependent variables to a $p < .01$.

When the results for the dependent variables were considered separately, the differences to reach statistical significance using ANOVA to $p < .05$ were for the independent variable for gender and the dependent variables for Computer Importance (CI), Computer Usage (CU), and Computer Careers (CC). The results for Computer Importance (CI) and gender were $F(1, 2075) = 24.947$; $p = .000$; partial Eta squared .012. The results for Computer Usage (CU) and gender were $F(1, 2075) = 13.410$; p. = .000; partial Eta squared = .006; and the results for Computer Careers (CC) and gender were $F(1, 2075)$ 121.721; p = .000; partial Eta squared = .055. In all three of these instances, even though statistical differences were indicated, the effect size for each

would be considered small to moderate based on Cohen's *d* effect size recommendations.

When the results for the independent variable race/ethnicity and the five dependent variables (Computer Importance, Computer Enjoyment, Computer Anxiety, Computer Usage, and Computer Careers) were analyzed using ANOVA, the statistical differences occurred to $p < .05$ for Computer Enjoyment (CE) and Computer Careers (CC). The result for Computer Enjoyment (CE) was $F(3, 2010) = 2.676$; $p = .046$; partial Eta squared .046; and the result for Computer Careers (CC) and race/ethnicity was $F(4, 2010) = 5.426$; $p = .001$; partial Eta squared = .001. Again, even though the differences appear to be statistically significant, the effect size would be considered small based on Cohen's *d* effect size recommendations.

When the results for the independent variables for gender and race/ethnicity and the five dependent variables (Computer Importance, Computer Enjoyment, Computer Anxiety, Computer Usage, and Computer Careers) were analyzed using a multivariate analysis of variance (MANOVA) in an attempt to find an interaction between race and gender, no statistically significant differences were found. In spite of the fact that the means for the boys' responses in the different racial/ethnic groups were consistently higher than the girls' in every category, the Wilks' Lambda statistic for gender * ethnicity failed to meet the $p < .01$ level or the $p < .05$ level.

Correlation Between Attitudes Regarding Computer Use and Computer Technology and the Number of Computers in the Home

The fifth research question asked by this study was, "Does the level of support in the form of the number of computers already in the home make a difference in the attitudes of the surveyed girls' and the surveyed boys' attitudes toward computer use, computer technology, and their attitudes regarding computer technology as a possible career option?" The relationship between the subsets for Computer Importance, Computer Usage and Computer Careers and the number of computers in the homes of the respondents not counting their school-issued iBook was investigated using a Pearson product-moment correlation coefficient. There were strong positive correlations between the variables as illustrated in Table 15.

Table 15

Correlations Between Mean Computer Importance, Mean Computer Usage, Mean Computer Careers, and the Mean of Respondents' Responses to the Question, "How Many Computers Are in Your Home, Not Counting Your School-Issued iBook?"

		Mean Computer Importance	Mean Computer Usage	Mean Computer Careers
Mean Computer Importance	Pearson Correlation			
	Sig. (2-tailed)			
	N	2014		
Mean Computer Usage	Pearson Correlation	.894**		
	Sig. (2-tailed)			
	N	2014		
Mean Computer Careers	Pearson Correlation	.440**	.407**	
	Sig. (2-tailed)			
	N	2014		
How many computers are in your home, not counting your school-issued iBook?	Pearson Correlation	-.003	-.004	.035
	Sig. (2-tailed)	.884	.864	.114
		2014	2014	2014

** Correlation is significant at the 0.01 level (2-tailed).

The results of the correlation statistics in Table 15 indicate medium to large positive correlations between the variables related to Computer Importance, Computer Usage, and Computer Careers but not with the variable for the number of computers in the home in addition to the respondent's school-issued iBook.

Summary

A sample of eighth grade students in the Henrico County Public Schools division participated in this study. Findings were presented that indicate the attitudes of students as they relate to perceptions of Computer Importance (CI), Computer Enjoyment (CE), Computer Anxiety (CA), Computer Usage (CU), and Computer Careers (CC). A total of 2,077 students participated in the study which represents a 60.6% return. When analyses based upon race/ethnicity were run, the 63 cases that indicated "not applicable" as their selection were deleted from that data set, resulting in an "N" of 2,014 when the independent variable for race/ethnicity was being considered.

Findings were presented that indicate students' attitudes regarding computer use and computer technology. Descriptive statistics were used to illustrate how students responded to a variety of questions pertaining to their use of computers and the time spent on computers beyond the school day.

The survey instrument was described in detail along with a description of the pilot study that was conducted prior to the primary study. Changes that were made in the survey instrument as a result of the pilot study were described, and the procedure for how the survey instrument was validated is also described in detail.

The research protocol used by the researcher was described including changes that were required after the school system made certain requests of the researcher in order for the study to take place. Training of the technology trainers who trained the survey administrators and the survey implementation procedures were also described.

Findings were presented that indicate that students generally agree that computers are important, that they enjoy using computers, and that they feel very little anxiety when using computers. Findings did indicate, however, that there was a significant statistical difference to a $p < .05$ between girls and boys with regard to their attitudes toward computer importance, and additional findings were presented that indicate that there were statistically significant differences between girls and boys with regard to their attitudes about computer usage and computer careers. There were no statistical differences between boys and girls in their attitudes regarding computer enjoyment or anxiety, however.

Findings indicated that there were no statistically significant differences to a $p < .05$ between the racial/ethnic groups that participated in the study regarding attitudes toward computer importance, but that there was a statistically significant difference to a $p < .05$ with regard to attitudes toward computer enjoyment. There was a statistically significant difference to a $p < .05$ with regard to computer anxiety, but no statistically significant difference to a $p < .05$ with regard to computer usage. There was a statistically significant difference to a $p < .05$, however, with regard to computer careers.

Findings suggest that there are differences between the surveyed girls' and the surveyed boys' attitudes when gender is the only fixed variable taken into account with regard to computer use and computer technology. In addition, there are statistically significant differences between students when race/ethnicity is the only fixed variable taken into account with regard to computer use and computer technology. While there

were no statistically significant differences in the mean scores of the four racial/ethnic groups surveyed with regard to computer importance, computer anxiety, or computer usage, there were statistically significant differences in the mean scores of the four groups with regard to computer enjoyment and computer careers.

In addition, a correlation between attitudes regarding computer use and computer technology and the number of computers in the home indicate that there are strong positive correlations between the means for computer importance, computer usage, and computer careers, but not with the mean of how many computers are in the home not counting the respondent's school-issued iBook.

CHAPTER 5 DISCUSSION AND CONCLUSIONS

Over the past decade, jobs requiring high level computer skills have grown substantially, and the U. S. Department of Labor Statistics predicts that computer occupations are expected to grow faster than other occupations (except health care) between 2004 and 2014. Within the computer field, the occupations predicted to grow the fastest include network systems and data communication analysts; computer software engineers; network and computer systems administrators; and database administrators (*Tomorrow's jobs*, 2003).

Additionally, employment in the information supersector is expected to increase by 11.6%, adding 364,000 jobs by 2014. Information technology contains some of the fast-growing computer-related industries such as software publishers; Internet publishing and broadcasting; Internet service providers; Web search portals; and data processing services. Employment in these industries is expected to grow by 67.6%, 43.5%, and 27.8% respectively (*Tomorrow's jobs*, 2003).

The U. S. Department of Labor statistics also predicts that while the numbers of men and women in the labor force will grow, the number of women will grow at a faster rate than men. The male labor force has been projected to grow by 9.1% from 2004-

2014 compared to 10.9% of women (*Tomorrow's jobs*, 2003). Total employment was expected to increase to 164.5 million in 2014 compared to 145.6 million in 2004. This is an increase of 13%. The 18.9 million jobs that will be added to the economy by 2014 will not be evenly distributed across major industrial and occupational groups, however. Changes in consumer demand, technology, and other factors will no doubt contribute to the changing employment structure in the United States' economy (*Tomorrow's jobs,* 2003).

Because of the projected growth in high-tech jobs, women will be in greater demand. These jobs are key in the changing economy of the 21st century; therefore women should give serious consideration to information technology (IT) as possible career choices. Use of the Internet and wireless technologies has exploded, creating growth as well as challenges for manufacturers of the equipment (*Facts on working women*, 2002).

According to a 2001 Current Population Survey, three out of ten computer analysts, engineers, and scientists were women. In addition, one out of four computer programmers was a woman. Between 2000-2010, the Women's Bureau within the U. S. Department of Labor projected that computer engineers would experience the fastest growth among all occupations. Indeed, 664,000 jobs will be added, nearly doubling the 2000 figure. In addition, the number of computer scientists and systems analysts is expected to increase by nearly 60% or by 269,000 jobs (*Facts on working women*, 2002).

If women continue to make up just three out of 10 computer systems analysts and scientists, then an estimated 219,000 more women could be employed as computer software engineers, computer scientists, and systems analysts by 2010. Computer support specialists are expected to increase by 97% or by about 490,000 workers (*Facts on working women*, 2002).

In spite of this phenomenal growth in high-tech jobs, the numbers of women who are embracing technology as a lifelong career are still very much in the minority. According to *InfoWorld*, women held only 26.7% of the computer and mathematical positions in the United States in 2006, and the percentage of women in those jobs has been on the decline. For example, the number of women in network and computer systems administrator positions accounted for 16.6% of the workforce in 2006—down from 23.4% in 2000 (Nobel, 2007).

Gender Bias

A study released by Reuters in September 2006 indicates that there is a bias in the United States against women in science, but the committee of experts expressed an inability to explain it. Looking at all the possible excuses—biological differences in ability, hormonal influences, childbearing demands, and even differences in ambition—the committee could come up with no good explanation for the fact that women are seemingly systematically locked out of high-level science, math, and engineering jobs in the United States (Reuters, 2006).

Furthermore, the committee found that compared to men, women faculty members are generally paid less and promoted more slowly, receive fewer honors, and

hold fewer leadership positions. None of these discrepancies seem to be because of a lack of productivity, the significance of their work, or any other performance measures, however (Reuters, 2006).

While the committee was at a loss for finding objective evidence for the discrepancies, they did acknowledge that both men and women seem to hold certain implicit biases that seem to stem from issues that are firmly rooted in our society's traditions and culture. Women's perceived lack of success in math and science, for example, and the belief that women are not as good as men in mathematical ability has long been accepted as truth in spite of the fact that female performance in high school mathematics now matches that of males (Reuters, 2006).

The fact is that information technology (IT) is here to stay, and both men *and* women need to prepare themselves for the jobs of the present and future that will fuel the economic growth necessary for the nation's continued economic success. If more than one million new IT jobs are going to be created by 2014, steps need to be taken toward preparing a workforce that can handle those jobs—if the country plans to stay globally competitive, that is.

The purpose of this research was to compare eighth grade girls' attitudes to eighth grade boys' attitudes toward computer use and computer technology. The research provided information related to how students view computers in general; how they view and use their school-issued laptop computers in particular; whether they feel anxiety when using computers; how they report using their computers; and whether or not they are considering computer-related careers.

The findings contribute to the professional literature in the areas of information technology and computer use comparisons based on gender and race/ethnicity.

Discussion

Attitudes of Eighth Grade Girls vs. Eighth Grade Boys with Regard to Computers

The results of this study indicate that boys and girls generally agree that computers are important in today's world, but boys tend to see computers as slightly more important than the girls. While there were statistically significant differences between the girls and boys with regard to their attitudes toward computer importance, the effect size was small, and there were no significant differences between how boys and girls view computers with regard to their reported computer enjoyment or feelings of anxiety when using computers.

The finding that there is no significant difference between boys and girls with regard to their reported computer enjoyment in addition to the finding that both boys and girls report feeling virtually no anxiety when using their computers are both important since previous studies have shown that girls have reported not enjoying computers as much as boys and that they have also reported experiencing heightened anxiety when using computers (Christensen et al., 2005; Enochsson, 2005; Hargittai and Shafer, 2006). The fact that the girls who participated in this study do not seem to feel any heightened sense of anxiety compared to boys, coupled with the fact that they report feeling similar levels of enjoyment when using their computers, may be positive indications that the one-on-one iBook initiative has helped girls to feel more at ease and

to enjoy their computers more than girls of previous studies who have not had the benefit of one-on-one access to a computer 24-hours-a-day, seven-days-a-week.

Students reported that they use computers an average of 2.73 hours per day outside of school. Indeed, girls outnumbered the boys when reporting that they use their computers four or more hours a day. Specifically, 62.6% of the girls reported using their computers four or more hours a day beyond the school day compared to 37.4% of the boys. Since the girls also indicate that they use their computers more for e-mail than for games or other computer activities, this finding is an indication that the girls may be using their computers more for its social networking function than the boys.

Students of both sexes reported enjoying a variety of activities when using their school-issued iBooks. Seventy-one percent of the boys chose "playing games" as the activity they enjoy most when using their computers. By comparison, only 28.7% of the girls reported playing games as the activity they enjoy most. On the other hand, 74.4% of the girls reported enjoying using e-mail as their activity of choice compared to 25.6% of the boys who reported using e-mail as their favorite activity.

Other findings indicate differences between boys and girls with regard to their use of computers as well as their thoughts regarding the possibility of pursuing computer-related jobs in the future. It is ironic that in spite of the fact that girls reported greater interest in how computers work than boys, fewer girls indicated an interest in working in a job that would require using a computer all day. Girls also indicated less interest in taking courses that might lead to a computer-related career than boys. It is something of a puzzle that girls would express more interest in how computers work

and yet not express greater interest in taking advanced courses or in pursuing computer-related employment. One explanation is that the girls' curiosity about how computers work is idler in nature; or it may point to the possibility that boys expressed less interest in how computers work because they believe that they already have an adequate understanding of them. Regardless of the reason for the apparent differences, these findings suggest that even though girls reported feeling virtually no anxiety and enjoying their computers about as much as boys, they are still not finding computer-related careers interesting as possible careers for their futures.

Attitudes Toward Computers Based on Race/Ethnicity

The results of this study indicate that there are no differences between ethnic/racial groups (Caucasian, African-American, Hispanic, and Other) with regard to attitudes toward computer importance, computer anxiety, or computer usage. There were differences between the ethnic/racial groups with regard to computer enjoyment and computer careers, but the effect sizes for both of those variables were very small.

The findings related to the differences (and lack of differences) in how the ethnic/racial groups reported attitudes regarding computers and computer technology would suggest that the Teaching and Learning Initiative that was launched in Henrico County in 2001 has been successful in addressing the digital divide that was occurring between the computer haves and the computer have-nots prior to the initiative. The "playing field" has been leveled somewhat by virtue of the fact that all the students surveyed have had access to laptop computers on a seven-days-a-week, 24-hours-a-day basis since the middle of their sixth grade year.

These findings cannot be used to state definitively that the distribution of laptops has been the only leveling factor, however. Additional research comparing a school district that has not yet initiated a one-on-one laptop program that is similar in size and demographics to Henrico County Public Schools would provide more information about the effectiveness of one-on-one laptop programs.

Correlations Between Attitudes toward Computer Importance, Computer Usage, Computer Careers, and the Number of Computers in the Home Not Counting the School-Issued iBook

The fifth research question asked by this study was, "Does the level of support in the form of the number of computers already in the home make a difference in the attitudes of the surveyed girls' and the surveyed boys' attitudes toward computer use, computer technology, and their attitudes regarding computer technology as a possible career option?" The results indicate a strong positive correlation between the number of computers in the home besides the school-issued iBook and the students' perception of computer importance. There was a weaker correlation between the number of computers in the home and the students' attitude toward computer careers.

Limitations

Although the sample used in this study was relatively large with 2,077 respondents, it was not a random sampling of eighth grade students, and therefore might possibly suffer from the effects of threats inherent in a convenience sampling. There was also no possibility for the researcher to be directly involved in the survey administration in each of the 10 middle schools where the surveys were administered.

As a result, there are no assurances that the surveys were administered uniformly from school to school or that the students had equal understanding of the purpose of their participation in the study from one school—or even from one classroom—to another.

Another limitation inherent in the study lies in the fact that the researcher did not question respondents about the number of school-issued laptops that might be in the home in addition to the individual respondent's laptop. This oversight means that it is possible that some portion of the 48.2% of homes with two or more computers in addition to the school-issued laptop are the result of siblings in Henrico County secondary schools who each have school-issued laptops of their own. The researcher's failure to ascertain the number of school-issued laptops in the respondents' homes may have skewed that statistic upward.

An additional limitation of this study is the lack of attention given to the growing phenomenon of social networking sites. A recently released study by the Pew Internet & American Life Project indicates that more than half (55%) of American teenagers ages 12-17 are participating in online social networks that allow users to create profiles and connect to others through a network of profiles created and managed by other teen users (Lenhart & Madden, 2007). The survey instrument used in this study did not include any questions that might have aided the researcher in determining the level of social networking currently being done by respondents.

Implications

Previous research over the course of the past 20 years has indicated that in spite of the fact that computer technology has become more widely available to a larger

proportion of the population in the United States, young women have been reluctant to pursue computer related careers. In spite of the growing number of well paying jobs that are currently available and will reportedly continue to be available into the foreseeable future, males continue to dominate computer-related fields across the board.

The theory that computer anxiety may account for the lack of women in the information technology (IT) fields (Harris & Cooper, 2003) seems to be debunked to a certain extent by this study. Girls who participated in this particular study clearly feel no sense of heightened anxiety when using their computers, yet they do report less interest in taking advanced computer courses and/or pursuing computer-related careers for their future than boys.

If computer anxiety is not a reason for girls' lack of interest in computer-related jobs for their future, then there must be others, but this study does not provide clear-cut answers to what they may be. This means that further study in this area needs to be done.

One implication of previous studies has been that women may not be drawn to information technology (IT) jobs because there has been a shortage of women role models and mentors in the area of computer science (Margolis, Fisher, & Miller, 1999). The stereotype of the computer "geek" as a personality type that is drawn to computers and/or is "really good at computers" may be turning girls off before they have had a chance to give computer-related careers serious consideration (*Tech-savvy*, 2000). If they are not giving the possibility of pursuing careers in computers serious thought, it is possible that they are also not preparing themselves academically for that possibility in

the future. As a result, even if they should decide that they would like to enter the IT field at a later time, they are under prepared to do so. Going back and making up classes would cause them to lose valuable time. As a result, they may opt for careers that offer easier entry in spite of the possibilities for growth and economic security in the IT industry.

Another consideration for girls of this (indeed, of every) generation is how to prepare for a balanced life of career vs. motherhood and/or homemaker for at least some portion of their reproductive years. Whether there is phenomenal growth in the IT industry or not, the fact of the matter is that women are still the only group who are capable of reproducing and assuring the survival of the human species. As young women consider their desires for a balanced home life with a satisfying career, high level IT jobs may seem more rigorous and may be more intimidating, thus causing them to opt for "softer" career options that may seem to offer more flexibility in work schedules and work loads.

In a study of women leaving IT jobs, women reported that keeping up with their male colleagues with regard to their skill level is difficult as a result of "certain facts of women's lives" (Hill, 2005). Even a short maternity leave of a few months, for example, causes some women in the IT industry to fall behind their colleagues in skill level, especially if a major software update has occurred in their absence. In addition, fast-paced projects tend to change so rapidly and are often so intense in nature that women with children on the project teams find it difficult to stay late and/or work overtime when they have the demands of child-rearing and home management to tend

to in addition to their jobs. These stressors have caused a number of women to leave IT jobs in large numbers in recent years.

Another possible explanation for the differences between men and women with regard to computers is that men and women may simply have very different views about how technology impacts them individually and how it impacts their world collectively. According to findings of the Center for Children & Technology (cited in *The Girl difference*," 2001), the bottleneck caused by the shortage of women in the sciences may well be the result of real differences between how women and girls approach technology and the sciences versus men and boys. Women and girls, says the Center for Children & Technology (CCT), tend to view technology as a tool for communication, companionship and social utility, often focusing on what technology can do to improve conditions in the everyday world. In contrast, men and boys tend to view technology as an object that will help them transcend various barriers. In spite of recent strides in understanding the differences, the CCT notes that there is much to be done to develop strategies for including women and girls more fully in the arenas that include math, science, and technology education with regard to career paths (cited in *The Girl difference*, 2001).

Margolis, Fisher, and Miller (1999) also note that women seem to approach computer science differently from men based on the qualitative study of the students that they conducted at Carnegie Mellon in preparation for writing *Unlocking the Clubhouse* (Margolis & Fisher, 2002). The men that they interviewed seemed to have a fascination with the computer itself as a machine. Learning about the computer was

described as a "pleasurable end in itself." For many of them, the computer is the ultimate toy (Margolis, Fisher, & Miller, 1999).

For women, on the other hand, the desire is to connect the technology with something other—something bigger—than just the computer itself. Forty-four percent of the women who were interviewed as compared to 9% of the men students linked their interest in computers to other arenas. The women in the study emphasized the importance of having computing and their programs "do something." They wanted their computer work to do something "useful" for society at large (Margolis, Fisher, & Miller, 1999). Perhaps one way to attract women to the IT fields that are rife with jobs is to find the key for unlocking their interest in other areas and helping them make the connections needed in order to accomplish their computing goals.

In order for this to happen, it may be necessary to break down the current barriers and to change the paradigm that one must be a "computer geek" with a single-minded focus on computers in order to be successful in the IT world. Perhaps what is called for is what Margolis, Fisher, and Miller (1999) refer to as "re-visioning computer science" so that it becomes a more engaging field and attracts more women to it. Perhaps what is needed is to focus more on young women's different capabilities and various interests in technology as assets as opposed to framing them as deficiencies in order to attract women to these important jobs of the future (*The Girl difference*, 2001).

Another implication of the Margolis, Fisher, and Miller study (1999) is related to curriculum design. They explain that curriculum helps to set the tone, but in the program at Carnegie Mellon, at least, the focus has been narrow and has been more on

the highly technical aspects of the field. A remedy might be to offer courses that have a more interdisciplinary approach that would ultimately bring students of differing and diverse backgrounds together to work on multifaceted problems. This approach has also been recommended by the AAUW (2000) study.

As is the case with many problems that seem simple enough upon first glance, the problem of a shortage of women in technology is more complex than one might think. One of the great distractions for girls during the time when they might otherwise be planning for their professional futures, for example, is the onset of puberty and the myriad of issues that accompany it in modern society. Studies show that during their adolescent years, girls begin to question themselves and doubt their abilities more than boys of the same age (Cohen, et al, 1996; Hargitti & Shafer, 2006; Orenstein, 1995, 2000; Owens, Smothers, & Love, 2003; Pipher, 1994). They express a tendency to doubt themselves even when they are performing, for all intents and purposes, as well or better than their male classmates; but they don't believe in themselves or their abilities the way they might have when they were in elementary school (Orenstein, 1995, 2000; Pipher, 1994). Even for those who succeed in math, science, and computer science and make it into IT programs such as the one at Carnegie Mellon, once there, they run the risk of being driven out of the program by a seemingly hostile environment and/or a curriculum that fails to account for the differences in learning styles and interests between men and women (Margolis & Fisher, 2002).

Implications of Providing an iBook to Every Student

The findings in this study suggest that the students surveyed have benefited from the circumstance of having an iBook given to them to use on a one-on-one basis during their middle school years. Certainly the respondents reported enjoying their computers and enjoying lessons that incorporate use of the computers in class. They also report using their computers for several hours beyond their school day for a variety of different activities, including schoolwork.

Students also reported feeling virtually no anxiety when using their computers which is an important finding in light of earlier studies that suggested that computer anxiety might be at least one reason why females are not entering computer science (CS) or information technology (IT) fields of work. This study would seem to indicate that the girls in this sample feel no more anxiety related to using computers than their male classmates, and furthermore, both groups report feeling virtually no anxiety at all when using computers. Likewise, students from different racial and ethnic backgrounds report feeling virtually no anxiety when using computers.

It is quite possible that the students surveyed in this study are members of the generation that Prensky refers to as "digital natives"—those who have grown up around computers and digital technology all their lives—thus explaining their ease of use of computers and computer technology. It is just natural for them to use computers; therefore they feel no anxiety because computers are an integral part of their environment both at home and in school (Prensky, 2001). It seems possible, however,

that the one-on-one access to a laptop computer on full-time basis has had some impact on students' lack of anxiety as well as their reported enjoyment of their computers.

Implications for Future Research

Findings in this study showed that some of the differences that have been reported in previous studies regarding the differences in attitudes of girls and boys toward computers and computer technology have been lessened to some degree. One possible explanation for these findings is that the boys and girls in this study have had one-on-one access to laptop computers through the school system's Teaching and Learning Initiative since the sixth grade. It is possible, however, that some of the attitude changes are also the result of computer technology being more and more available in the homes of many of the students surveyed. Only 6.3% of the students in the study reported that there were no other computers in their homes besides the school-issued iBook; and only 13.4% of the students reported not having access to the Internet at home.

Additional research needs to be done comparing Henrico County's laptop program findings with a school district of comparable size and demographics that has not yet initiated a one-on-one laptop program. This sort of comparative study would give policymakers more information about the real and perceived effectiveness of one-on-one laptop programs.

Further research also needs to be done regarding the growing use of social networks that are currently being used by teens ages 12-17. Since much of the literature points to differences between the perspectives that boys and girls have with regard to

computer usage, research into the significance of social networking could help shed additional light on how those differences specifically manifest themselves.

The findings in this study did not get to the heart of the issue that would help explain why girls do not seem to be as interested in pursuing computer-related jobs and careers as boys in spite of the fact that the girls use their computers about as much as the boys and report enjoying computers as much as boys. Further research needs to be done in that area.

Further study regarding the influence of social expectations, varying cultural values, and the impact (both positive and negative) on adolescent girls as they are making important educational and career choices also seems to be called for. Additionally, studies that may help to identify and explain the declining sense of self-efficacy that seems to impact adolescent girls are needed in order to help parents, teachers, guidance counselors, and others with direction on how to avert the crisis of confidence that seems all too prevalent among middle school girls.

Conclusions

Our modern society has entered the Information Age, and it is imperative that the supply of workers that are needed in order to fill the growing number of jobs be increased if the country is to stay competitive in a global economy. In *The World is Flat*, Friedman describes his view of a world that is being "flattened" by a variety of factors, not the least of which is the impact of the Internet, the ability to connect almost instantaneously with people all around the world, and the ability to transfer wealth and to create jobs that have heretofore never existed. It is imperative that Americans wake

up to the fact that other nations and their workers are learning fast how to make the most of the opportunities afforded them through the arenas of computer science and information technology.

"On such a flat earth, the most important attribute [one] can have is creative imagination—the ability to be the first on your block to figure ways to create products, communities, opportunities, and profits. That has always been America's strength, because America was, and for now still is, the world's greatest dream machine" (Friedman, 2005, p. 469). In order to stay competitive—to maintain its place as an economic and business leader, however—America needs to be able to fill the pipeline of qualified workers who can take on the jobs that are being created by the information industry. This means encouraging men *and* women to consider the benefits of learning about the opportunities that can be afforded them by pursuing computer-related jobs and careers. It also means learning more about why women seem to be avoiding these career opportunities and addressing their reluctance in ways that will clear the way for them to enter the IT world in far greater numbers than they are doing currently.

The purpose of this study was to explore computer use and attitudes of students who have access to a school-issued computer 24-hours-a-day, seven-days-a-week. The focus of the study was to determine if one-on-one access to a laptop computer makes a difference in the attitudes of the eighth grade girls compared to the eighth grade boys in the Henrico County Public Schools system. With regard to a leveling of the playing field as far as enjoying computers and eliminating any gap between the anxiety felt by boys or girls when using computers, this study seems to indicate that a one-on-one

approach to computers has been successful. The findings that in spite of the one-on-one laptop initiative, girls are still not as interested as boys in the possibility of pursuing computer-related jobs, that they differ with regard to their attitude toward the importance of computers, and they clearly use their computers differently for different functions, all point to the possibility that other factors are at play that go beyond easy, one-on-one access to computers.

As with any study, the findings in this one simply point to the need for further study. The findings here do conclude, however, that if girls ever avoided computers because of a lack of access and/or feelings of anxiety when using computers, the eighth grade girls who participated in this study do not share those feelings, perhaps as a result of having one-on-one access to their school-issued iBooks, perhaps as a result of having computers more accessible to them at home or in their classrooms. For whatever reason, girls in this study report that they enjoy having their own computers for school and personal use, and they report feeling no more anxiety with regard to using computers than their male classmates. The next challenge is to find the key to unlocking their resistance to joining the IT world so that they can take advantage of the economic benefits of the jobs that are waiting for them.

List of References

List of References

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APPENDICES

APPENDIX A

Definitions

Achievement gap. Differences in achievement between white students and minority groups, especially African-Americans and Hispanics as indicated by scores on standardized tests, grades, and other data.

Advanced Placement (AP) program. College-level courses offered by high schools to students who are above average in academic standing.

Gender. The (psychological) state of being male or female.

Gender bias. The idea that one gender or the other is short-changed by school practices and expectations.

Information literacy. The ability to use a variety of sources, including computers, to locate desired information.

Information technology (IT). Includes all matters concerned with the furtherance of computer science and technology and with the design, development, installation, and implementation of information systems and applications.

Scholastic Achievement Tests (SAT II; formerly ACH). Subject-matter tests required for college entrance by many institutions of higher education.

Scholastic Assessment Test (SAT I). Formerly called the Scholastic Aptitude Test, the SAT was introduced in the 1950s and renamed in 1994. The SAT I is one of the two alternative standardized tests commonly used by institutions of higher education as a primary basis for evaluating a student's application for admission (the other is the ACT).

School culture. The sum of the values, cultures, safety practices, and organizational structures within a school that cause it to function and react in particular ways. Teaching practices, diversity, and the relationships among administrators, teachers, parents, and students contribute to school culture. The terms, "school culture" and "school climate" are often discussed interchangeably.

APPENDIX B

Parent Letter and Consent Form

P. O. Box 23120
3820 Nine Mile Road
Richmond, Virginia 23223-0420
(804) 652-3700

October 30, 2006

Dear Parent or Guardian:

Henrico County Public Schools (HCPS) along with a doctoral student from Virginia Commonwealth University is conducting a study to provide the school system with information on the attitudes of eighth grade students toward computers and computer technology The study is intended to explore attitude differences between genders associated with computer importance, computer enjoyment, and computer anxiety. The study will also look at attitudes regarding the possibility of pursuing careers in a computer-related field.

The students who participate in this study will be asked to complete a 15 minute questionnaire during homeroom or study hall. The results of the study will be reported only in combined form and your student's name will never be associated with his/her response. Results of the study will help HCPS with future program planning.

Prior to survey administration students will be asked to sign a "Youth Assent Form" in compliance with regulations of the Virginia Commonwealth University's Institutional Review Board. If any student wishes to bring that form home to discuss it with a parent, they will be allowed to do so. Students will be informed as to the nature and purpose of the study, and their participation is to be totally voluntary. No one will pressure them to participate if they prefer not to for any reason.

If you have any questions, please feel free to contact either Kitty Boitnott, VCU Doctoral Student, at , or Helen Whitehurst, Research Analyst at HCPS, at

Participation in the study is totally voluntary. If you do **NOT** wish your child to participate in this study, please sign and return the bottom portion of this letter to your child's homeroom teacher no later than Thursday, November 9, 2006. The survey will be administered during the week of November 13 – 17, 2006.

Sincerely,

Kitty Boitnott, Doctoral Student
Virginia Commonwealth University

---------- **Cut Here & Return to School**----------

Please sign and return this form if you prefer that you child **not** participate in this research study.

I,_____, **DO NOT** give permission for

Parent Name (Please Print Clearly)

_____

Name of Child (Please Print Clearly)

_____ to participate in this research study

Name of School (Please Print Clearly)

_____

Signature of Parent or Guardian

APPENDIX C

Alternate Activity

Computer Terms

O G N I S S E C O R P D R O W

B P T V M H P W T Q O C U D G

I Y E E L P O W E R P O I N T

X G H R E T Z B I H Q K T Z X

R O I V A H E B L A C I H T E

E L H K C T S N K W X K F B C

S O S A E H I D R V G Y O M O

A N Q Q R Y P N A E I C N S P

B H H P G D N P G E T S T F Y

A C X H A N D O T S R N S Y R

T E L Y T S T R T P Y P I X I

A T O Y G O X I I E Z S S X G

D D R A O B Y E K V P D T C H

P R I N T E R L P P E K H E T

E L E C T R O N I C M A I L M

COPYRIGHT
DATABASE
ELECTRONICMAIL
ETHICALBEHAVIOR
FONTS
HARDDRIVE
INTERNET
KEYBOARD
KEYNOTE
OPERATINGSYSTEM
POWERPOINT
PRINTER
SPREADSHEET
STYLE
TECHNOLOGY
WORDPROCESSING

APPENDIX D

Youth Assent Form

YOUTH ASSENT FORM

TITLE: Comparisons of Attitudes of Eighth Graders Toward Computer Use and Computer Technology Based on Gender and Race/Ethnicity

VCU IRB NO.: HM10445

This form may have some words that you do not know. Please ask someone to explain any words that you do not know. You may take home a copy of this form to think about and talk to your parents about before you decide if you want to be in this study.

What is this study about?

This study is intended to measure the attitudes of eighth grade boys and girls toward computers and their one-on-one access to computers through the laptop program that Henrico County Public Schools offers its middle and high school students. The purpose of the study is to determine if there is a difference between the attitudes of eighth grade boys and girls when both the boys and girls have equal access to computer technology through their laptops.

What will happen to me if I choose to be in this study?

In this study you will be asked to fill out a short survey form that will ask you questions about how your feel about computers and how you use them.

If you decide to be in this research study, you will be asked to sign this form. Do not sign the form until you have all your questions answered, and understand the purpose of the study.

What might happen if I am in this study?

If you choose to participate in this study, you will fill out a short questionnaire indicating your current feelings and attitudes toward computers. You will be asked questions about how you use your computers and whether you have considered computer technology as a possible career.

Your name will not be used in any reporting of the study, and your participation will remain totally confidential. Your decision to participate in this study should be totally voluntary. Your answers will not be shared with any of your teachers or administrators. Your grades will not be affected in any way whether you choose to participate in the study or not.

Will you tell anyone what I say?
We will not tell anyone the answers you give us. We will not share your answers with your teachers or parents or friends.

Do I have to be in this study?

You do not have to be in this study. If you choose to be in the study you may stop at any time. No one will blame you or criticize if you drop out of the survey.

Questions

If you have questions about being in this study, you can talk to your teacher or your principal, or you can have your parent or another adult call:

Kitty J. Boitnott
Henrico County Public Schools
Doctoral Candidate
Virginia Commonwealth University

Do not sign this form if you have any questions. Be sure someone answers your questions.

Assent:
I have read this form. I understand the information about this study. I am willing to be in this study.

Youth name printed	Youth signature	Date

Name of Person Conducting Informed Assent Discussion/Witness, printed

Signature of Person Conducting Informed Assent Discussion/Witness	Date

Investigator signature (if different from above)	Date

APPENDIX E

Computer Attitude Questionnaire

Computer Attitude Questionnaire

This survey consists of 5 parts. Within each part, please read each statement and then bubble in the response that best reflects how you feel at this point in time on the answer document.

Part 1

A = Strongly Agree	B = Agree	C = Disagree	D = Strongly Disagree	E = Not Applicable

(1) I enjoy doing things on a computer.

(2) I am tired of using a computer.

(3) I will be able to get a good job if I learn how to use a computer.

(4) I concentrate on a computer when I use one.

(5) I enjoy computer games very much.

(6) I would work harder if I could use computers more often.

(7) I think that it takes a long time to finish when I use a computer.

(8) I know that computers give me opportunities to learn many new things.

(9) I can learn many things when I use a computer.

(10) I enjoy class lessons that are done on the computer.

(11) I believe that the more often teachers use computers, the more I will enjoy school.

(12) I believe that it is very important for me to learn how to use a computer.

(13) I feel comfortable working with a computer.

(14) I feel uneasy when I think of trying to use a computer.

(15) Computers do not scare me at all.

(16) Working with a computer makes me feel nervous.

(17) Using a computer is very frustrating.

(18) I will do as little work with computers as possible.

(19) Computers are difficult to use.

(20) I think computers are very easy to use.

Part 2

A = Strongly Agree	B = Agree	C = Disagree	D = Strongly Disagree	E = Not Applicable

(21) I feel very comfortable with the current level of my skill when using my iBook.

(22) I use my iBook more for schoolwork.

(23) I think working with a computer in a job all day would be an interesting and fun way to make a living.

(24) I would like to know more about what makes computers work.

(25) I don't care what makes computers work as long as they do what I want them to do.

(26) I have created (or I have thought about creating) my own web site and posted (or plan to post) it on the Internet.

(27) I think boys understand and enjoy computers more than girls.

(28) I think girls understand and enjoy computers more than boys.

(29) I like having my own iBook computer so I can use it any time I want.

(30) I have considered taking courses that might lead to a computer-related career.

(31) I believe that men and women are better suited for different careers.

(32) When I work full time for a living, I want to use the computer all the time.

(33) When I graduate, my dream job is to work with computers.

Part 3

Read the following questions and answer "yes" or "no" according to your experience.

A = Yes	B = No

(34) Do you use a desktop computer at home in addition to your school-issued laptop?

(35) Do you have Internet (World Wide Web / www) access at home?

Part 4

Read the following questions and bubble in the appropriate answer according to your specific experience and circumstances on the answer document.

(36) How many computers are in your home, not counting your school-issued iBook?
A = 0 computers **B** = 1 computer **C** = 2 computers **D** = More than 2 computers

(37) On average, how many hours per day do you use your computer outside of school?
A = 1 hour **B** = 2 hour **C** = 3 hours **D** = 4 or more hours

(38) What type of software to you enjoy using most?
A = games **B** = web page design **C** = music recording **D** = word processing

(39) What do you use the computer for the most?
A = surfing the Internet **B** = e-mail **C** = school assignments **D** = playing games

(40) How would you rate your interest in what makes a computer work?
A = Very interested. **B** = Mildly interested. **C** = Interested. **D** = Not interested.

Part 5

Please answer the following questions about yourself. Bubble the best or most appropriate answer on the answer document:

(41) I am a ... **A** = boy **B** = girl

(42) My race/ethnicity is considered...
A = Caucasian **B** = African-American **C** = Hispanic **D** = Other

END OF SURVEY

Thank you for your participation in this survey!
Please give the completed survey form to your teacher now.

APPENDIX F

Survey Administration Script Regarding the Youth Assent Form

Survey Administration Script Regarding the Youth Assent Form

The following script is to be read exactly as written to eighth grade students who are eligible to take the "Computer Attitude Survey."

The homeroom or study hall teacher who has agreed to administer the survey and who has been properly trained is the only individual who is authorized to read the script by way of providing students with important information about the purpose and contents of the survey instrument.

Please read the script carefully. Upon completion of the reading, please answer any and all questions that students may have as thoroughly and as thoughtfully as possible. If the homeroom or study hall teacher reading the script does not know the answer to a specific question, he/she is asked to please make a note and promise to get an answer to get back to the student(s) who asked the question as soon as possible.

START OF SCRIPT REGARDING THE YOUTH ASSENT FORM

Teacher (Please read verbatim): The form you are receiving may have some words that you do not know. Please ask me to explain any words or terms that you do not understand. After we have gone over this information, you may take a copy of the "Youth Assent Form" that you have been given home with you if you would like to discuss it with your parents before you decide whether you would like to participate in this study.

You are going to be asked to consider taking part in a research study that is being conducted by a student who is working on a doctorate (an advanced college degree) at the Virginia Commonwealth University (VCU). This research study is intended to measure the attitudes (feelings, thoughts, beliefs, or reflections) of eighth grade boys and girls in Henrico County middle schools toward computers and technology. The questions take into account students' one-on-one access to computers through the laptop program that Henrico County Public Schools offers its middle and high school students. The purpose of this study is to measure differences in the attitudes of eighth grade students who have equal access to computer technology through their laptop computers.

If you choose to take part in this research study, you will be asked to fill out a survey form called a "Computer Attitude Questionnaire." The questionnaire will contain questions about how you feel about computers in general and how you use them both at home and in school.

If you decide to take part in this study, you will be asked to sign the form that you have been given. This form is called a "Youth Assent Form," which means that you are assenting—that is, you are agreeing—to participate in this survey. Do *not* sign the form until you have all of your questions answered and you believe you fully understand the purpose of the study and your rights concerning the study.

If you choose to take part in this study, you will be given the survey questionnaire sometime in the next few days. The questions in the questionnaire are aimed at measuring your attitudes (feelings, thoughts, beliefs, or reflections) toward computers and computer use both at home and at school. You will be asked general questions about how you use your computer. You will also be asked whether you have considered computer science or computer technology as a possible career in your future.

Your name will NOT be used in any reporting of this study. In fact, you are not going to be asked to provide your name at all. Your participation in the study, should you decide to take part, will remain totally confidential. That means that no one will know anything about your answers to the questions on the survey. Please do NOT put your name anywhere on the questionnaire. Your participation in the study will be anonymous which means that no one will know who participated and who did not. All of your answers to the questions will be kept private and confidential.

Your decision to take part in this study should be totally voluntary. That means that no one should place any pressure on your to take part in the study. It is up to you alone to decide whether you wish to take part in the study or not. Your answers will NOT be shared with any of your teachers or your school's administrators. Your grades will NOT be affected in any way whether you choose to take part in the study or not.

No one will discuss any of the individual answers you provide on the survey. Your personal answers will not be shared with your teachers, parents, administrators, or friends. The results of the study will be based upon the answers of the students in all three selected middle schools. No one individual will have his or her answers reported in any way.

Please understand that you are not required to take part in the study. Your decision to take part in the study or not is completely voluntary.

If you choose to take part in this study, but you change your mind part way through the questionnaire, you may stop at any time. No one will blame you or criticize you if you change your mind and drop out of the study.

If you have any questions about this study, you may talk to your teacher or your principal. You may ask questions of general concern at the end of my reading this

information. You may ask questions of individual concern in private if you had rather not ask your questions in front of your classmates.

You may take the "Youth Assent Form" home tonight in order to discuss it with a parent or another responsible adult if you wish. You are asked to return the form on the day following this discussion if you wish to take part in the study. If you fail to return the form by the day following this discussion, you will be given a different activity rather than the survey instrument unless you request an additional "Youth Assent Form" and sign it on the day of the survey.

Parents received a letter regarding this research study a few weeks ago, so they are already aware of the upcoming study and the fact that you are being given an opportunity to take part in it. Your parents may have information from that letter that would help answer any questions you have if you wish to talk to them before signing the "Youth Assent Form" that you are being given.

If you care to talk about the study with the Research Coordinator, you may contact her individually as follows:

Ms. Kitty Boitnott

If all of your questions have been answered to your satisfaction, and you wish to take part in this study, please fill out the "Youth Assent Form" you have been given now. Signing this "Youth Assent Form" indicates that you have been given information about the nature and purpose of this research study and you volunteer to take part in it.

If you care to think about it before signing the "Youth Assent Form" today, please put the form in a place where you will not lose it and think about it or talk to your parents or another responsible adult tonight. If you choose to take part in the study, please return the signed "Youth Assent Form" to me tomorrow. If you choose not to take part in the study, do not sign the form. You may tell me of your decision so that I don't accidentally give you a form. I will give you an alternate activity to work on while your classmates work on the survey.

Now is the time for questions.

END OF SCRIPT

APPENDIX G

Script to be Used the Day of the Survey Administration

START OF SCRIPT TO BE USED THE DAY OF THE SURVEY ADMINISTRATION

Teacher (Please read verbatim): Students who did not return an opt out form from their parents and who signed the "Youth Assent Form" are going to be given the "Computer Attitude Questionnaire at this time." Students who returned an opt out form from their parents or who have not signed the "Youth Assent Form" will be given an alternate activity to work on while the survey is being administered.

For those taking the survey, please note that the choices for Parts 1 and 2 are enclosed in the boxes at the top if each section. You are asked to select the response that most closely reflects how you feel about the statement at this point in time. For example, in answer to question #1, if you enjoy doing things on a computer to a very great degree, you would select "A" as your answer. If you enjoy it to a degree but not to a "very great" degree, you would select "B" as your answer. If you do not enjoy doing things on a computer, you would select "C" as your answer. If you really do not enjoy doing things on a computer, you would select "D" as your answer. You would select "E" as your answer if you have no feelings about doing things on a computer or you feel completely neutral about using the computer or you do not have a computer and therefore the question does not apply to you.

In Part 3 of the survey, there are two questions, and the choices change to "A" for "yes" and "B" for "no." Select the answer that best describes your circumstance.

In Part 4, please note that the choices are under each statement and change with the question. Please select the answer that most closely reflects your circumstance.

Do the same for Part 5.

When you have completed the survey, please return it to the teacher's desk and return to your desk quietly.

Are there any questions?

You may begin.

END OF SCRIPT

APPENDIX H

Computer Attitude Questionnaire (Original Used in Pilot Study)

Computer Attitude Questionnaire

This survey consists of 4 parts. Within each part, please read each statement and then circle the number that best reflects how you feel.

Part 1

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly Agree

		SD	D	A	SA
(1)	I enjoy doing things on a computer.	1	2	3	4
(2)	I am tired of using a computer.	1	2	3	4
(3)	I will be able to get a good job if I learn how to use a computer.	1	2	3	4
(4)	I concentrate on a computer when I use one.	1	2	3	4
(5)	I enjoy computer games very much.	1	2	3	4
(6)	I would work harder if I could use computers more often.	1	2	3	4
(7)	I think that it takes a long time to finish when I use a computer.	1	2	3	4
(8)	I know that computers give me opportunities to learn many new things.	1	2	3	4
(9)	I can learn many things when I use a computer.	1	2	3	4
(10)	I enjoy lessons on the computer.	1	2	3	4
(11)	I believe that the more often teachers use computers, the more I will enjoy school.	1	2	3	4
(12)	I believe that it is very important for me to learn how to use a computer.	1	2	3	4
(13)	I feel comfortable working with a computer.	1	2	3	4
(14)	I get a sinking feeling when I think of trying to use a computer.	1	2	3	4

Please continue to the next page

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly Agree

		SD	D	A	SA
(15)	Computers do not scare me at all.	1	2	3	4
(16)	Working with a computer makes me nervous.	1	2	3	4
(17)	Using a computer is very frustrating.	1	2	3	4
(18)	I will do as little work with computers as possible.	1	2	3	4
(19)	Computers are difficult to use.	1	2	3	4
(20)	I think computer are very easy to use.	1	2	3	4

Part 2

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly

		SD	D	A	SA
(21)	I feel very comfortable with the current level of my skill when using my iBook.	1	2	3	4
(22)	I use my iBook more for schoolwork than for playing games or music.	1	2	3	4
(23)	I think working with a computer in a job all day would be an interesting and fun way to make a living.	1	2	3	4
(24)	I would like to know more about what makes computers work.	1	2	3	4
(25)	I don't care what makes computers work as long as they do what I want them to do.	1	2	3	4
(26)	I have created my own web site and posted it on the Internet.	1	2	3	4
(27)	I think boys understand and enjoy computers more than girls.	1	2	3	4
(28)	I think girls understand and enjoy computers more than boys.	1	2	3	4
(29)	I like having my own iBook computer so I can us it any time I want.	1	2	3	4

Please continue to the next page

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly Agree

		SD	D	A	SA
(30)	I think my family treats boys and girls differently when it comes to using computers.	1	2	3	4
(31)	I think boys are better than girls at understanding and using computers.	1	2	3	4
(32)	I have considered taking courses that might lead to a computer-related career.	1	2	3	4
(33)	I think girls are better than boys at understanding and using computers.	1	2	3	4
(34)	I believe that men and women are better suited for different careers.	1	2	3	4
(35)	I would consider pursuing a career that is considered nontraditional for my gender.	1	2	3	4

Part 3

Read the following four questions and answer "yes" or "no" according to your experience.

(36) Do you use a desktop computer at home in addition to your school-issued laptop?
1 = yes
2 = no

(37) Do you have Internet (World Wide Web / WWW) access at home?
1 = yes
2 = no

Please continue to the next page

Read the following questions and circle the appropriate answer according to your specific experience and circumstances.

Part 4

(38) How many computers are in your home, not counting your school-issued iBook?

1 = 1 computer
2 = 2 computers
3 = 3 computers
4 = More than 3 computers

(39) On average, how many hours per day do you use your computer outside of school?

1 = 1 hour
2 = 2 hours
3 = 3 hours
4 = 4 hours
5 = 5 hours or more

(40) What type of software to you enjoy using most?

1 = games
2 = web page design
3 = music recording
4 = word processing
5 = painting/drawing/ animation design

(41) What do you use the computer for the most?

1 = surfing the Internet
2 = e-mail
3 = chat rooms
4 = creating art or music
5 = school assignments
6 = creating/maintaining a web site
7 = maintaining/reading blogs
8 = playing games

(42) How would you rate your interest in what makes a computer work?

1 = Very interested.
2 = Slightly interested.
3 = Not interested at all.

Please continue to the next page

Part 5

Please answer the following questions about yourself.

Circle the best or most appropriate answer:

(43) I am a ... 1 = boy
2 = girl

(44) My race/ethnicity is considered... 1) Caucasian
2) African-American
3) Hispanic
3) Other _____
(Please fill in the blank)

END OF SURVEY

Thank you for your participation in this survey!

Please give the completed survey form to your teacher now

APPENDIX I

Outline of Training for Teachers Agreeing to Administer Computer Attitude Questionnaires

Training for Teachers Agreeing to Administer
Computer Attitude Questionnaires
October 24, 2006

Kitty J. Boitnott, Research Coordinator/Doctoral Candidate
Virginia Commonwealth University

I. Overview of Research in Public Elementary and Secondary Schools

A. Federal regulations protect human subjects
   1. Children are considered "vulnerable subjects" and special rules must be followed for their protection
   2. Multiple levels of protection for children exist
   3. "Children" are persons who have not reached the legal age for consent

B. Local approval has been obtained by the HCPS administration and School Board and VCU's Institutional Review Board

II. Parental consent

A. Informational letters will be sent home outlining purpose and scope of the study including opt out forms for parents not wishing their child participate

B. Contact information will be provided for parents who want more information

C. Parents may opt to take their children out of the study by filling out the form and returning it to the Research Coordinator, Kitty Boitnott

III. Assent procedure for students

A. Students are to be informed of the upcoming survey in advance

B. A "Survey Administration Script" is to be read *verbatim* to all potential participants on the day prior to the administration of the survey

C. Students are to be given a "Youth Assent Form" to read over while the "Survey Administration Script" is being read aloud

D. Upon completion of the reading of the "Survey Administration Form," any student questions should be taken and answered

E. Any questions that the teacher cannot answer should be directed to the Research Coordinator as soon as possible by phone or e-mail

F. Teachers and administrators should be available to answer questions in private if necessary

G. Any student who wishes to may take the "Youth Assent Form" home to discuss with a parent may do so

H. "Youth Assent Forms" are to be collected and checked for signatures before distribution of the "Computer Attitude Questionnaire"

I. In the context of this discussion, "assent" means that a child has voluntarily offered affirmative agreement to participate in the research study.

IV. Voluntary Nature of the Study and Confidentiality Issues

A. Students are to be assured that their participation in this study is completely voluntary

B. Names and student ID numbers will NOT be collected as part of the data collection—all data will be anonymous

C. Grades will be in no way affected whether a student participates in the study or not

D. Any student who starts the survey may change his/her mind and stop at any point if she/he wishes

E. No student should feel coerced by teachers, administrators, or peers to participate in the study

F. An alternative activity will be provided for those students who opt Themselves (or their parents have chosen to opt them) out of the study

G. All data collected will be kept confidential with regard to individual answers

H. The database that will be used in maintaining the collected data will be kept secure at all times

I. Students will learn of the results of the study upon its completion as will parents and school officials

J. For students who may be cognitively or emotionally impaired in such a way that participating in the study is not practical, the teacher or case manager in charge of that child may make that determination after careful consideration and procure the alternative activity for him/her to complete while the other students fill out the survey

H. Upon completion of the survey, teachers who have administered the survey should collect them and place them in a sealed envelope. The envelopes should be placed in a secure location (an administrator's office or office vault) until the Research Coordinator can get to the school to personally pick up the surveys. They should NOT be placed in Inter Office Mail (pony) for security reasons.

V. Questions

Contact Information:

Kitty J. Boitnott, Research Coordinator
P. O. Box *TBD*
Glen Allen, VA 23060
Home Phone:
Cell Phone:
Email:

OR

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OR

Dr. James H. McMillan
School of Education
Virginia Commonwealth University
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Richmond, VA 23284-2020

OR

Office of Research Subjects Protection
Office of Research
BioTech Research Park Building One
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VITA

Kitty J. Boitnott was born on October 13, 1952 in Roanoke, Virginia. She graduated from Franklin County High School, Rocky Mount, Virginia, in 1971. She received her Bachelor of Arts degree from Longwood College in 1975. She received her Master of Arts in Liberal Studies degree from Hollins College in 1987. She received her Education Specialist degree from the University of Virginia in 2000. She achieved National Board Certified Teacher certification in Library Media for Early Childhood and Young Adult in 2003.

Ms. Boitnott is currently the Library Information Specialist at Chamberlayne Elementary School in Henrico County, Virginia. She has served as president of the local education association in Roanoke County, as a member of the Virginia Education Association Board of Directors, as a member of the Advisory Board for Teacher Education and Licensure, and as a member of the Virginia Department of Education's Committee to Enhance K-12 Public Education. She currently serves on the Board of Directors of the Virginia Educational Media Association (VEMA). She is a member of Phi Delta Kappa, the Association for Supervision and Curriculum Development, and the American Library Association.