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BRIDGING THE DIGITAL DIVIDE THROUGH THE INTEGRATION OF COMPUTER AND INFORMATION TECHNOLOGY IN SCIENCE EDUCATION: AN ACTION RESEARCH STUDY

A dissertation submitted

by

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to

Fielding Graduate Institute

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DOCTOR OF EDUCATION

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Abstract

Bridging the Digital Divide Through the Integration of Computer and Information Technology in Science Education: An Action Research Study

by

Gail Laverne Brown

The presence of a digital divide, computer and information technology integration effectiveness, and barriers to continued usage of computer and information technology were investigated. Thirty-four African American and Caucasian American students (17 males and 17 females) in grades 9-11 from 2 Georgia high school science classes were exposed to 30 hours of hands-on computer and information technology skills. The purpose of the exposure was to improve students' computer and information technology skills. Pre-study and post-study skills surveys, and structured interviews were used to compare race, gender, income, grade-level, and age differences with respect to computer usage. A paired t-test and McNemar test determined mean differences between student pre-study and post-study perceived skills levels. The results were consistent with findings of the National Telecommunications and Information Administration (2000) that indicated the presence of a digital divide and digital inclusion. Caucasian American participants were found to have more at-home computer and Internet access than African American participants, indicating that there is a digital divide by ethnicity. Caucasian American females were found to have more computer and Internet access which was an indication of digital inclusion. Sophomores had more at-home computer access and Internet access than other levels indicating digital inclusion. Students receiving regular

meals had more computer and Internet access than students receiving free/reduced meals. Older students had more computer and Internet access than younger students. African American males had been using computer and information technology the longest which is an indication of inclusion. The paired t-test and McNemar test revealed significant perceived student increases in all skills levels. Interviews did not reveal any barriers to continued usage of the computer and information technology skills.

key words: digital divide, computers, information technology, integration, science education, digital inclusion

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Dedication

To my mother, Corine; fiancé, Alfonzo; best friend, Dorothy; and my Gullah relatives (past and present) who never stopped believing in me. Surely, God selected all of you.

Table of Contents

Lists of Tables and Figures

Tables

Figures

CHAPTER ONE

Introduction

This dissertation sought to evaluate the effectiveness of integrating computer and information technology skills into science classes to narrow the digital divide. The digital divide is computer and information technology illiteracy in certain sectors of our society. The digital divide has reached enormous levels within the United States and globally (Information Technology Association of America, 1997). If not corrected, the digital divide will cause serious economic and social disparities within our country (Bolt & Crawford, 2000; Hoffman & Novak, 2000; Irving, Levy, McConnaughey, Everette, & Lader, 1999; McConnaughey & Lader, 1998; "Digital Divide", 2000). Instead of a society that fosters freedom, liberty, justice, and opportunity for all, we have become a country of prosperous citizens (haves) versus nonprosperous citizens (have-nots). The nonprosperous citizens will exist at the mercy of the prosperous citizens.

Education can continue to assist in solving societal problems (Davis & Trebian, 2001; Donlevy, 2000; "Digital Divide", 2000; Stoicheva, 2000; U. S. Department of Education, 2001). Scientific, research, and educational organizations and leaders have stressed the integration of technology into science education (chapter 2). It was my hope that, if effective, this action research study would be used as a model for science teachers to integrate computer and information technology skills as useful tools in making students become more scientifically literate. With the advent of high speed video games, today's students have embraced current technology. Their eagerness could serve as a useful tool

for the integration of current computer and information technology and the enhancement of scientific knowledge through Internet research.

The study determined which computer and information technology skills high school students needed. The skills were taught at school, and students obtained hands-on experience during class (Appendix C, Appendix E). Pre-study (before) and post-study (after) skills surveys were distributed to students on the first day and the last day of the study. Students determined their own skills levels using the pre-study and post-study skills surveys. Ten students in this study were interviewed to determine additional barriers that existed to their continued use of computer and information technology after the study. The rest of chapter 1 will include the statement of the problem, purpose of the study, study goals, hypotheses, historical background, limitations of the study, and the significance of the study.

Statement of the Problem

The problem was that there existed a computer and information technology literacy gap between groups within the United States (Bolt & Crawford, 2000). The National Telecommunications and Information Administration (NTIA) of the U. S. Department of Commerce stated in its study "Falling Through the Net: Toward Digital Inclusion" (2000) that there was a tremendous discontinuity between computer and information technology literacy among specific minority groups when compared nationally (Levy et al., 2000). Minority groups were not showing the same computer and information technology infiltration as the rest of the country. These groups were mainly

African American and Latino American. Over the past 5 years, some students have matriculated at Peach City High School without adequate computer and information technology preparation. This occurred because students were not required to specifically take courses in computer and information technology.

The State of Georgia's guidelines for graduation required that all students were to receive preparatory coursework in core electives amounting to one unit. The core electives represented a broad field that encompassed many branches (technology, fine arts, ROTC, foreign language, or vocational). A student could easily avoid computer and information technology by taking courses in one of the other branches of the core electives category that does not require use of computers or the Internet. This was true of students who were anticipating matriculation at a 4-year college after high school (college prep) and those who would matriculate at a technical school or college (tech prep). To complicate matters, the field of technology alone was very broad. Technology could range from construction to culinary arts. Consequently, students could quite easily take courses within technology without ever taking computer and information technology courses.

I first observed the ability to avoid computer and information technology courses 3 years ago when I was an academic advisor. During that time there were only two teachers who taught keyboarding and word-processing at Peach City High. Now, there are three. Each of these teachers saw a turnover of approximately one hundred students per year if they took keyboarding and word-processing. Consequently, in a given year, only about one-fourth of the total student population (285 students) was enrolled in one of

the computer and information technology courses. Understandably, students took courses during different years; yet, there was still the probability that many students would not be exposed to computer and information technology skills. For example, permanent records and data clerk records in the Peach City High Guidance and Data Clerk Offices revealed that 40 of 162 seniors (approximately 25%) in the 2001 graduating class had not taken a computer and information technology course. Although, this data reveals that 75% of the 2001 graduating seniors have taken computer and information technology courses, the closing of the digital divide will require computer and information technology literacy by all students.

Public school students in Georgia were required to take 3 years of high school science for graduation. By integrating computer and information technology into science classes, all students received hands-on exposure to computer and information technology, thereby narrowing the digital divide. This study impacted students in the two participating science classes and their communities. The narrowing of the digital divide would occur by continuously incorporating computer and information technology skills into science classes.

This study affected students enrolled in two science classes at the study setting in Georgia during a given year. Ultimately, the study has the potential to affect all students graduating from the study setting and their communities. If all science classes would integrate computer and information technology, all students would be exposed to computer and information technology, and no student would graduate without the exposure. Consequently, no student would be unprepared in computer and information

technology. Furthermore, this study had tremendous community impact. Since the digital divide was of pandemic proportions (Bolt & Crawford, 2000), it was hoped that the skills students obtained in high school would be used within the community to teach other students and adults. Consequently, more citizens (old and young) will become computer and information technology literate.

Purpose of the Study

The purpose of this study was to determine the effectiveness of a science computer and information technology teaching integration (Appendix E) as a means of bridging the digital divide. The integration involved Peach City High School biology and applied biochemistry student participants being exposed to 30 hours of hands-on computer and information technology training while matriculating in specified science courses. The training involved students using science computer software, Microsoft Word, Microsoft PowerPoint, Microsoft Access, copyright skills, troubleshooting skills, and the Internet for science education during the second semester of the 2000-2001 school year. The training was held in the Peach City High School math and science computer lab. The training was expected to improve the computer and information technology skills of participating students.

Study Goals

There were five goals to this study. The first goal was to determine whether a digital divide existed at the study setting (demographics). The second goal was to

determine which computer and information technology skills were deemed necessary for students prior to graduation (chapter 2). The third goal was to determine the effectiveness of incorporating computer and information technology skills into science classes by using the paired t-test and McNemar test of pre-study and post-study skills. Both tests determined whether there was a difference in before and after study skills. The fourth goal was to determine whether there were barriers to continuous application of the skills in everyday life by using 15 structured interview questions. The fifth goal was to address ways that secondary science could contribute to bridging the digital divide and providing future job skills.

Research Questions

Research Question 1: Was there a digital divide at the study setting based on race, socioeconomic status, gender, grade level, and age (demographics)?

Research Question 2: Will the integration of computer and information technology skills through 30 hours of hands-on training into the sample population reflect improvement in their computer and information technology literacy after the study (pre-study and post-study surveys)?

Research Question 3: Were there barriers other than computer and information technology skills literacy that prevented students from continuing to use the acquired computer and information technology integration skills (structured interviews)?

Hypothesis

There was a null hypothesis (H_0) and an alternative hypothesis (H_A) for the computer and information technology skills integration. H_0 was that there was no true mean difference (difference between two means) between pre-study and post-study perceived skill levels. H_A was that the true mean difference was greater at post-study than pre-study.

Historical Background

A detailed history of the digital divide and computer and information technology is provided in the Literature Review (chapter 2). This study's background began in 1994 with the introduction of a computer in every classroom at Peach City High School. The money was donated from proceeds of the Georgia Lottery Program (chapter 2). My science students were required to type all science research papers. In 1996, grant money from a local foundation was used to purchase ecological CD-ROMs on biomes for students to use with computers. In 1998, a Math/Science computer lab was established. Internet wiring and networking followed for the computer lab and all classrooms.

During this time, seven African American students in my science classes were not aware of the Internet. This unawareness of the Internet by African American students was also noticed by two business education teachers and three English teachers at Peach City High School. I began to explain the Internet and its history to students. Subsequently, I began to show students how to use the Internet, and required them to use the Internet as a resource tool for preparing biology reports. They were also made aware

of the availability of the Internet at county libraries, and state technical schools, colleges, and universities.

In 1999, at the High Schools That Work Conference in Atlanta, Georgia, the digital divide was explained by Information Technology Association of America (ITAA). This association was a membership-based organization of information technology companies. I had not heard of the digital divide until this time.

In 2000, at ITAA's convocation in Chicago, Illinois, the digital divide was mentioned again as well as the need for more skilled workers. Since 2000, I have served as a member of the ITAA Workforce Committee which regularly addresses the digital divide and issues relating to increasing the skilled labor workforce in the United States. As a committee member, I have participated in ITAA teleconferences and the drafting of an action research study on the digital divide.

Limitations of the Study

The study was limited to two classes of science students that participated. Likewise, it was limited to the confines of the computer lab, and to the site resources. Some students worked in pairs at computer stations where necessary because there were an insufficient number of computers in the computer lab to afford each student an individual computer.

The study did not investigate the current State of Georgia science curriculum and site science teacher barriers and their usage of computers in their classes. In addition, the

study did not determine whether site science teachers were using in-class or library computers for their classes.

Significance of the Study

The new millennium has manifested a change in the workforce that is normally seen when a new technological revolution occurs. The current job trend continues to move toward computer and information technology (ITAA, 2000). According to ITAA, approximately 10 million employees work in some field of computer and information technology (ITAA, 2000). The majority of employees work for information technology corporations (ITAA, 1997). In 2000, ITAA predicted that only 1.6 positions would be filled for every 10 information technology vacancies.

With the current shortage of computer and information technology employees and an exponentially growing market, industry and academia have joined forces to supply more skilled employees to eliminate the shortage while also trying to bridge the digital divide. If the digital divide can be reduced through education, there stands a possibility that many of the nonprosperous citizens will become employed in computer and information technology fields. Though much attention has focused on higher education, this study investigated the use of secondary science in bridging the digital divide.

As previously stated, the literature review in chapter 2 provided the history of computer and information technology. Additionally, chapter 2 traced the digital divide from its inception to now. It presented research by government, industry, and private

organizations in an effort to establish the presence of the digital divide. Chapter 2 ended with science integration case studies.