Examination of Factors that Influence Computer Technology Use for Classroom Instruction by Teachers in Ohio Public High Schools

A dissertation presented to
the faculty of
the College of Education of Ohio University

In partial fulfillment
of the requirements for the degree
Doctor of Philosophy

Gambu Wani Latio
June 2009

© 2009 Gambu Wani Latio. All Rights Reserved.
This dissertation titled
Examination of Factors that Influence Computer Technology Use for Classroom
Instruction by Teachers in Ohio Public High Schools

by

GAMBU WANI LATIO

has been approved for
the Department of Educational Studies
and the College of Education by

_______________________________

Teresa J. Franklin
Associate Professor of Educational Studies

_______________________________

Renée A. Middleton
Dean, College of Education
ABSTRACT
LATIO, GAMBU WANI, Ph.D., June 2009, Curriculum and Instruction, Instructional Technology. Examination of Factors that Influence Computer Technology Use for Classroom Instruction by Teachers in Ohio Public High Schools (228 pp.)

Director of Dissertation: Teresa J. Franklin

The focus of this research was to determine the extent to which teachers in Ohio public high schools use computers in classroom instruction, and investigation of barriers to teachers’ integration of computers into classroom instruction and learning. The analyses were based on a sample of 256 teachers randomly selected from 18 randomly selected high schools across the state. About 77% of the participants considered themselves well prepared to use computers for classroom instruction effectively, while 83% considered themselves proficient in computer technology integration. Although the majority of the participants had attained the necessary computer skills, teachers’ use of computers for classroom learning was low and sporadic at best, averaging 1.8 times a week, a level equivalence of computer novice. Both computer proficiency and availability of computers in Ohio public high school classrooms greatly affected teachers’ extent of computer technology use in classroom learning. Only 12% of the proficient teachers taught in classrooms with five or more computers, compared with 71% who taught in classrooms with one to four computers or had no computers at all on average. Overall, 12% of the teachers used computers for classroom learning three to four times per week or daily, at most, 4% of them taught in classrooms with an average of five to ten or more computers. The results suggested that lack of access to adequate computers in the
classrooms severely curtails teachers’ use of computers in classroom learning on a
regular basis. Classroom student-to-instructional computer ratio, teachers’ attained level
of computer technology proficiency, teachers’ attitude towards computer use in
classroom instruction, and perceived value of computers in instruction were predictors of
the extent of teachers’ computer use for classroom instruction in Ohio public high
schools. Two of the other variables, resistance to change, and location of computers in
the schools (except classroom) were not predictors of teachers’ use of computers in
classroom learning. Teachers in Ohio public schools stated that lack of access to adequate
computers in the classrooms, lack of time, and location of adequate computers in the
classroom are major barriers to widespread integration of computers into school
curricula.

Approved: 

Teresa J. Franklin

Associate Professor of Educational Studies
To my adoptive parents, Verna Feith and Allen Feith, whose unconditional love and support enabled me to achieve my academic dream.

Praise be to God!
ACKNOWLEDGEMENTS

It would not have been possible for me to complete this research study without the help from all those who guided, encouraged, and cheered me on during my academic journey. I am forever indebted to my dissertation committee members for their advice, guidance, and time. Sincere gratitude to my dissertation committee chair, Dr. Teresa J. Franklin, for her advice, understanding, and availability for consultation even on short notice. To Professor George Johanson, my research advisor, I am so grateful for his critical feedback and availability at all times. Your thought-provoking questions and insights motivated me to probe deeper into the data analysis. You have forever influenced my thinking and view of data analyses, for which I am deeply grateful. I am also grateful to Dr. David Moore and Dr. Don Flournoy for their useful suggestions and encouragement.

I am also deeply indebted and forever grateful to my beloved wife, Annie Njeri Latio, and my children, Mbote G. W. Latio, Keji G. W. Latio, and Wani G. W. Latio, for their unconditional support, patience, and understanding without which I could not have accomplished my academic dream. You are always my source of motivation, inspiration, and strength that enabled to “Keep on keeping on” even when the going got tough.

Thanks to my longtime mentors, Professor Sam Laki and Mrs. Sue Cook, for challenging and encouraging me early in this journey to pursue graduate studies. Lastly, but certainly not least, many thanks to the school principals and the high school teachers who took part in this study because without your help and cooperation, this study would not have been accomplished.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>3</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>5</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>6</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>12</td>
</tr>
<tr>
<td>CHAPTER 1: THE STUDY PROBLEM</td>
<td>14</td>
</tr>
<tr>
<td>Introduction</td>
<td>14</td>
</tr>
<tr>
<td>Background of the Study</td>
<td>14</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>15</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>18</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>19</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>22</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>26</td>
</tr>
<tr>
<td>Delimitations of the Study</td>
<td>27</td>
</tr>
<tr>
<td>Organization of the Study</td>
<td>27</td>
</tr>
<tr>
<td>CHAPTER 2: LITERATURE REVIEW</td>
<td>29</td>
</tr>
<tr>
<td>Introduction</td>
<td>29</td>
</tr>
<tr>
<td>General Overview</td>
<td>29</td>
</tr>
<tr>
<td>Critical Review of Relevant Literature on Computers</td>
<td>30</td>
</tr>
<tr>
<td>Availability of Computers in U. S. Public Schools</td>
<td>30</td>
</tr>
<tr>
<td>Availability of the Internet in United States’ Public Schools</td>
<td>32</td>
</tr>
<tr>
<td>Types of Internet Connectivity</td>
<td>33</td>
</tr>
</tbody>
</table>
CHAPTER 3: METHODOLOGY ................................................................. 68

Chapter Overview .................................................................................. 68

Variables Examined ................................................................................ 68

Operational Definition of Variables ....................................................... 69

Population of Interest ........................................................................... 71

Determination of Sample Size ............................................................... 72

Rates of Survey Returns ...................................................................... 73

Discretionary Computer-Using Teachers .............................................. 73

Inadmissible Surveys ........................................................................... 75

Instrumentation .................................................................................... 75
APPENDIX I: Scatterplot for Residuals and Predicted Values of Criterion .................. 223
APPENDIX J: Scatterplot for Standardised Predicted Values of the Criterion .......... 225
APPENDIX K: Histogram of Frequency of the Scores and Regression Residuals ....... 227
LIST OF TABLES

Table 2.1 Access to and Distribution of Computers in Ohio Public Schools.......................... 45
Table 3.1 Data Dictionary of the Variables Investigated in the Study .................................. 79
Table 3.2 Socioeconomic Indicators Used for Classifying Public Schools in Ohio ............ 83
Table 3.3 Typology of School Districts in Ohio Public School Systems ................................. 84
Table 3.4 Stratified School Districts and Public High Schools in Ohio .............................. 86
Table 3.5 Stratified Ten Percent of Randomly Selected Public High Schools .................. 87
Table 4.1 Randomly Selected Ohio Public High Schools and the Respondents .............. 96
Table 4.2 Overall Alpha Magnitudes for the Construct Measures ..................................... 102
Table 4.3 Comparison of Construct Scales with Focal Items Removed (Bold Type) .... 105
Table 4.4 Numbers and Percentages of Study Participants by Levels of Education ...... 110
Table 4.5 Numbers and Percentages of Teachers by Years of Teaching ........................... 111
Table 4.6 Number of Teachers and Subjects Taught in Ohio Public High Schools ...... 113
Table 4.7 Teachers’ Level of Computer Technology Proficiency ................................. 116
Table 4.8 Student Access to Computers in Ohio Public High School Classrooms .... 117
Table 4.9 Teachers’ Computer Use for Teaching Students Academic Skills ............ 118
Table 4.10 Computer Proficiency and Computer Use for Classroom Instruction ....... 121
Table 4.11 Crosstabulation of Classroom Computer Access with Computer use for Instruction ................................................................. 122
Table 4.12 Crosstabulation of Classroom Computer Access with Computer use for Learning Academic Skills ......................................................... 125
Table 4.13 Crosstabulation of Access to Classroom Computers with Teachers’ Computer Technology Proficiency Level ................................................................. 127

Table 4.14 Regression Statistics for the Predictors and the Criterion Variables .......... 129

Table 4.15 Correlations and Descriptive Statistics of the Variables ......................... 131

Table 4.16 Regression of Data with Highly Correlated Items Removed ..................... 134

Table 4.17 Barriers to Classroom Integration of Computers in Ohio Public High Schools ...................................................................................................... 140

Table 4.18 Software Used in Classroom Instruction in Ohio Public High Schools ...... 147

Table 4.19 Regression Analysis with Nondiscretionary Teachers Included .............. 150

Table 4.20 Regression Coefficients from Analysis of Data with Computer Lab Student Ratio .............................................................................................. 151

Table 4.21 Descriptive Statistics for Non-teaching Computer Uses (Variables) .......... 152
CHAPTER 1: THE STUDY PROBLEM

Introduction

Background of the Study

As the global economy has changed from industrial to information-service-based economies, demand for computer-skilled workers who are capable of harnessing emerging technologies to efficiently produce new goods and services has increased (CEO Forum, 2001b; Karolyn & Pains, 2004). Thus, U.S. leaders are concerned that the low academic performance in public high schools undermines the nation's global economic competitiveness (Lemke & Gonzales, 2006; Culp, Honey, & Mandinach, 2003). To sustain United States’ competitiveness in the information technology-based global economy, the nation’s secondary school system is under pressure to produce the much-needed technologically skilled workforce (CEO Forum; Partnership for 21st Century Skills [PFTFCS], 2006). For this reason, acquisition of computer technology skills is no longer a luxury but a necessity for both individual and national success in the technology-driven job market (PFTFCS; CEO Forum).

Equipping U.S. schoolchildren with computer skills is therefore a national endeavor that has remained a central focus of U.S. education policy to date. Over the past 10 years, policymakers have intensively focused on getting more computer technology into public schools (Trotter, 2007). To achieve this goal, various local, state, and federal initiatives spend billions of dollars each year to provide teachers and students with computer technology as a learning and instructional tool in the public schools (Trotter; Barron, Kemker, Harmes & Kalaydjian, 2003). According to available literature (Kleiner
& Farris, 2002, Parsad & Jones, 2005), the substantial investment in computer technology has led to improved availability of and access to computers and the Internet in U.S. public schools.

Computers in the classroom present teachers with a great opportunity to provide learning materials to their students in ways that were never available a decade ago (Roblyer, 2004; Resta, Patru, & Khvilon, 2002). It is was necessary to determine whether the technology available in the public high schools was optimally used for classroom instruction, and whether such use is paying off in terms of improvement in teaching practices and student academic achievement.

*Statement of the Problem*

Whereas the public acceptance and recognition of the need for access to quality education through computer technology continues to grow, funding has been a challenge due to economic hardships (Ohio School Technology Implementation Task Force, [OSTITF], 2002). In spite of this fiscal obstacle, Ohio has continued to provide funding for computer technology integration and professional development in the state. According to state reports, access to computer technology in Ohio public schools has improved overtime, as indicated by the increased in the number of students per instructional computer, and percentages of teachers receiving professional development (Education Week: Technology Counts, 2004; eTech Ohio, 2003). In 2003, the average number of students per instructional computer had improved dramatically, to a statewide average student per computer ratio of 3.3 and 7.1 in the classrooms, 15.4 in computer labs (Education Week: Technology counts, 2003). By 2006, the statewide average ratios
were 3.5 students per instructional computer, 5.8 students per instructional computer in the classroom, and 13 students per computer in the computer labs (Education Week: Technology Counts, 2006). In 2008, the average ratio of students per instructional computer was 3.5, while the ratio of students per high-speed Internet-connected computer was 3.4 (Education Week: Technology Counts, 2008). A biannual report on the conditions of computer technology implementation in Ohio released in 2003, indicated that about 52% teachers in Ohio public school received computer technology professional development (CTPD) in general computer use, 45%, of the teachers received CTPD in computer technology integration, while 43% of the teachers received CTPD in software use respectively (eTech Ohio, 2003). These numbers are very low, compared with the emphasis on importance of CTPD, and millions of dollars spent on computer technology integration in the classrooms. In spite of the ready availability of these resources, less than one-fifth of the teachers in Ohio public schools use computers to support standards-based instruction on a regular basis (eTech Ohio).

Regarding academic achievement, the academic performance of students at various grade levels in proficiency, achievement tests, and Ohio Graduation Tests (OGT) is low. Except for language arts, Ohio students performed poorly in mathematics, science, and social studies across grade levels, according to the 2007 Ohio annual educational progress report (ODE, 2007). The report also revealed differences in student achievement along racial, economic, and gender lines. Although the average state standard or cutoff point is 75% for most of the subjects, only the 10th grade met this standard in mathematics, while no grade
level met the achievement standard in science and mathematics in the 2005 report card. Except for the 10th grade, critical information on student achievement in the other high school grade levels was not available.

Available literature (Education Week: Technology Counts, 2008, 2005; eTech Ohio, 2008) indicates that teachers in Ohio public schools have access to adequate computers in their classrooms and that the majority of the teachers are proficient in computer use in classroom instruction. Evidence of extensive use of computers for classroom instruction and the positive impact of such use in learning and teaching are hard to find. Nationally, the average student achievement is barely any better than it was a decade ago (Lemke & Gonzales 2006; Cuban, 2001). In 2006, Ohio annual educational progress report still showed a dismal academic improvement in the state’s public high schools. It appears teachers have not yet matched the apparent easy access to computers in the classrooms with widespread routine use of computers for classroom instruction and learning (Combs, 2003). Therefore, the impact of computer technology on student achievement has remained minimal.

It is in light of this research evidence that this study examines the extent of computer use in classroom instruction and learning by Ohio public high school teachers. Various factors (both internal and external) greatly influence a teachers’ use of computers for classroom learning. Based on a review of the current research literature (Norris, Sullivan, Poirot, & Soloway, 2003; Becker, 2001, 2000; Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000), on integration of computers into school curricula,
the researcher hypothesized that some internal and external factors influence teachers’ extent of computer use in classroom instruction more than others. This viewpoint influenced the selection of the internal and external factors examined in this study. The internal factors selected for this study were teachers’ attitude towards computer use in classroom instruction, teachers’ perceived value of computers in education, and teachers’ resistance to change. The external factors included teachers’ attained level of computer technology proficiency, classroom student-to-instructional computer ratio, and location of computers in the classrooms.

**Purpose of the Study**

The primary goal of the study was to examine the extent to which teachers in Ohio public high schools use computers in classroom instruction, factors that predict such extent of use, and major barriers to such use. The factors examined in this study include teachers’ attitude towards computer use for classroom instruction, teachers’ perceived value of computers in classroom instruction, teachers’ resistance to change, location of computers in the classroom, classroom student-to-instructional computer ratio, and teachers’ attained level of computer technology proficiency. Teachers’ consistent and widespread use of computers in classroom instruction helps students acquire research, communication, analytic, and problem solving skills, which ultimately improves students’ academic achievement (Bebell, Russell, & O’Dwyer, 2004; Roblyer, 2004; Norris, et al., 2003). The researcher postulated that teachers in Ohio public high schools were using computers three to four times a week or daily on a regular basis, and that this is the extent of computer technology use sufficient to affect student academic learning
outcomes. This study aims at determining if teachers in Ohio public high schools are using computers in classroom learning computers three to four times a week or daily on a regular basis. The research questions investigated in the study are:

1. To what extent do teachers in Ohio public high schools use computers in their classroom instruction on a regular basis?

2. Does location of computers in schools (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), and teachers’ attitudes (TCAT) towards computer use in classroom instruction, teachers’ perceived value of computers in instruction (TPCV), and resistance to change (TRTCH), predict teachers’ extent of computer use in classroom instruction in Ohio public high schools?

3. What do teachers in Ohio public high schools consider the main obstacles to their use of computer technology in classroom instruction on a regular basis?

*Significance of the Study*

Ohio spends billions of dollars to bring computer technology into the public schools and to provide computer technology professional development (CTPD) for teachers (eTech Ohio, 2008; Education Week: Technology Counts, 2004). All this is in an effort to enhance teaching and learning through computer technology use in curriculum implementation and in hopes of improving student achievement in the public schools. The level of technology use by teachers in Ohio does not correspond to the
degree of computers available in the public schools (eTech Ohio, 2003). In addition, statewide studies investigating the extent or level to which high school teachers use computers in classroom instruction in Ohio public schools system are lacking.

This study investigated selected factors hypothesized to influence teachers’ use of computers in classroom instruction and learning. The purpose of which was to determine which of the factors investigated were predictors of teachers’ extent of computer technology use in classroom instruction. The decision to focus on computer use in Ohio high schools is twofold. First, studies that focused on computer technology use in Ohio K-12 public high schools are hard to find. Second, Ohio high school academic achievement in both the local and national achievements tests is low. With the emphasis on acquisition of computer technology skills in the workplace and the substantial investment of taxpayers’ money in computer technology in the schools, there is need for the public to know the extent of computer technology use in classroom instruction in Ohio public high schools (Barron, Kemker, Harmes, & Kalaydjian, 2003).

This study has policy implications and the information gained from this study will contribute to the knowledge base on computer technology use in Ohio public schools, and in high schools in particular. The results of the study may help policymakers determine the level of access or availability of computers in the schools, and the extent of their use in classroom instruction and learning. Such information can help Ohio decisionmakers arrive at informed positions regarding technology use, support, availability, and ability to assess whether the schools are optimally using computer technology for improving academic standards.
Knowing predictors of teachers’ computer use in classroom instruction helps educators strategically realign teacher training and CTPD programs to meet the needs of individual teachers. This information is particularly important in times of dwindling funding, diminishing passage of schools levies, and accountability required at all levels.

Because the study focuses on a specific school level, in this case, high schools, educators and researchers may have more confidence in the findings of the proposed study than in the findings of general (K-12) studies. Investigation of a combination of external and internal factors provides a better understanding of how these factors influence teachers’ use of computers in classroom instruction. This is important for two main reasons:

1. If the location of computers in the classroom, attained level of computer proficiency and classroom student-to-computer ratio are significant predictors of teachers’ use of computers in classroom instruction, then school and district leaders will be in better position to address the matter at the classroom level.

2. If resistance to change, teachers’ attitudes towards computers, and perceived value of computers in learning are hindrances to teachers’ widespread use of computer technology for classroom instruction in Ohio, school and district administrators will be in better positions to develop specific solutions for training and tailoring CTPD to meet specific needs of individual teachers.

3. Ohio taxpayers will be able to know whether the millions of tax dollars spent on computer technology was well spent or nor. This information has direct implications for the passage of school levies—the local source of school funding. This is important
because as the cost of computer technology continues to fall, public desire for evidence of positive impact of computer use on student achievement is on the rise (Barron et al., 2003).

**Definition of Terms**

Definition of terms used in the study is to assure a common understanding of the meaning for all terms used throughout the study.

*Academic year* in this study is the period that begins on August 1 and ends on June 15, during which K-12 schools are in session.

*Access* is the ease with which teachers and students obtain and use computers for learning at home and in school (Ogle, Branch, Canada, Christmas, Clement, Fillion et al., 2003). Access here refers to availability of computers in the classroom and computer lab and the ease with which students and teachers can obtain and use the computers at any time they choose.

*Availability*, for the purpose of this study, means that students and teachers have access to or can use computers whenever they want.

*Classroom student-to-instructional computer ratio* is the number of students per functional Internet-connected computers located in the classroom for student learning.

*Computer* refers to a desktop or laptop microcomputer with multimedia capability and Internet connectivity located in the classroom for teaching and learning. “Computer” or “computers” used in this study, refers to an up-to-date functioning and Internet-connected multimedia computer used in classroom teaching and learning in the public schools.
*Computer technology* refers to computers with multimedia capability, Internet connectivity, and peripherals (printers, scanners, projectors, and digital videos) that function harmoniously together, used as a tool to enhance teaching and student learning in the implementation of school curricula across subjects in the public schools. This definition of computer technology goes beyond the hardware, software, and the Internet infrastructure and used in the context of educational use of computers (Ogle, et al., 2003). It is important to point out here that, in this study, the terms “computer technology” and “educational technology” mean the same thing and used interchangeably.

*Discretionary computer-using teacher* refers to a teacher who is a trained professional to teach non-technology subjects in the high school curricula, but uses computer technology to do so.

*Drill-and-practice software* refers to instructional software that presents problems to a student to work on one at a time and provides immediate feedback on the correctness of responses or solutions (Roblyer, 2004).

*Gender* here refers to whether the sexual characteristic of the research participant is male or female.

*High school or Secondary school*, in this study, is an education institution, which provides academic learning for 9th-12th graders in the public school system.

*High school/Secondary school teachers* are trained and licensed teachers who teach 9th-12th graders in the Ohio public school system.

*Infrastructure* covers both cabling (wire, fiber optic or coaxial) and devices such as routers, modems, or codes (Ogle, et al., 2003).
Innovation diffusion is the process by which a new idea or technology spreads among members of a social system over time (Rogers, 2003).

Intermediate computer user is a teacher who uses computers regularly—at least three to four times a week.

Internet is a system of computers networked together with cables, enabling electronic communication between and among computers that are near-or far-facilitating data transfer, file transfer, and electronic mail (Ogle, et al., 2003).

Instructional software, also known as Courseware, is software (such as tutorials, drill and practice, simulations, instructional games and problem solving) designed to deliver learning instruction or supporting learning activities to the learner (Roblyer, 2004).

Integration of computers in curriculum refers to everyday use of computer technology as an instructional and learning tool by discretionary high school teachers.

Item validity refers to the relevance or accuracy of each item and the instrument in measuring the content area being investigated (Gay & Airasian, 2003).

Non-discretionary computer-using teachers are those teachers whose primary training is to teach computer technology or business technology in high schools, and their use of computers for classroom instruction is higher than that of teachers who teach other subjects.

Non-computer user is a teacher who does not use computers for classroom instruction at all.
Novice computer user is a teacher who uses computers for classroom instruction once or twice a week at most.

Practitioner, in this study refers to a teacher who uses computers at least three to four times a week or daily for his or her classroom instruction.

Presentation software is a program designed to allow users to display images and text to enhance their talks/discussions (Roblyer, 2004).

Problem-solving software is an instructional computer program, which presents users with a sequence of steps for solving everyday problems, such as mathematical problems, or helps the learner gain skills in problem solving (Roblyer).

Productivity software is a computer program designed to help computer users work more effectively and efficiently while performing their daily activities (Shelly, Ashman, Gunter, & Gunter, 2004).

Reliability is the degree to which an instrument or the items measure whatever it or they are supposed to measure (Gay & Airasian, 2003).

Sampling rate is the number of selections made from a frame to achieve the desired sample size divided by the number of selections in the frame (Czaja & Blair, 1996).

Study population refers to the high school teachers (those teachers who teach 9th – 12th grades) in the Ohio public school system.

Teachers’ attitude towards computer use for classroom instruction refers to positive or negative emotional dispositions that influence teachers’ use or failure to use
the computers in their classroom teaching based on perception and belief that computers are either useful or useless in classroom teaching.

*Technology integration* is a process in which an individual teacher is using computers in classroom instruction at his/her competence level.

*Tutorial/instructional software* is computer software that provides a learner with a complete sequence of instructions to learn how to solve an everyday problem or learn a problem-solving strategy.

*Validity* is concerned with how well the research instrument measures teachers’ use of computers for classroom instruction in Ohio public high schools.

*Vocational school* refers to an educational establishment in the public school system which prepares learners for careers that are based in manual or practical activities, traditionally non-academic, and directly related to a specific trade, occupation, or vocation.

**Limitations of the Study**

The population of this study is limited to high school teachers of grades 9-12 in Ohio public schools. Therefore, the exclusion of K-8 teachers and teachers from private schools in the state limits the generalization of the findings of the study to all teachers in Ohio. The instrument used for data gathering is self-reporting and carries a certain degree of participant bias. The factors examined in the study are not under the control of the researcher, the study is not experimental, and the factors examined are not the only ones that influence integration of computers into school curriculum. Other factors, such as school characteristics (school level, enrollment size, location of the school, and poverty
concentration) do affect the use of computers in classroom learning (Smerdon, et al., 2000). The prediction model does not include all possible factors that predict teachers’ extent of computer use in classroom instruction.

**Delimitations of the Study**

The focus of this study is statewide use of computers in classroom instruction by high school teachers in Ohio public high schools. Although the population for this study consists of high school teachers in Ohio public schools, data from teachers trained in computer science and business education were not included in the analyses. This is because their training predisposes them to disproportionately higher computer use in classroom instruction, and, possibly, a more positive attitude towards computer use in classroom teaching than teachers of other subjects (Becker, 2001).

**Organization of the Study**

This study is comprised of five chapters Chapter 1 introduces the background to the study, a statement of the problem, the purpose of the study, the research questions, and significance of the study. The chapter also includes definitions of terms, limitations, and delimitation. Chapter 2 provides the review of the relevant literature related to this study with summary and conclusions. Chapter 3 covers methodology of the study, which includes research design, operational definitions of the variables, identification of the population of interest, and determination of sample size, design of sampling frame, and instrumentation. The chapter also includes development, piloting, reliability and validity of the instrument used for collecting the data used in the study. Chapter 4 covers data
collection, data analyses, and presentation of the findings. Chapter 5 presents summary conclusions and recommendations for further research.
CHAPTER 2: LITERATURE REVIEW

Introduction

*General Overview*

Educators introduced computer technology into school curricula because of its high potential to enhance learning, teaching, and, subsequently, student academic performance (CEO Forum, 2001a; Norton, Campbell, McRobbie, & Cooper, 2000). Advancement in computer technology, coupled with the pervasive use of computers in every facet of life, has made computer technology an important feature of the educational landscape, particularly in the developed countries (Granger, Morbey, Lotherington, Owston, & Wideman, 2002). Computer use in the implementation of standards-based school curriculum is being articulated in a wider context of educational reform—acquisition of 21st-century computer skills and lifelong learning abilities (Law, Lee & Chow, 2002).

In today’s information-driven global economy, the importance of student acquisition of computer skills cannot be stressed enough (CEO Forum, 2001a). Globally, computer technology occupies a central place in education reform and economic progress of a nation. To achieve the desired educational reforms, governments, mainly in the industrialized countries, are spending billions of dollars annually on the implementation of computer technology-based-curricula (Bebell, Russell, & O’Dwyer, 2004; Roblyer, 2004).

Expectation for computer use in classroom instruction to improve academic achievement (Kozma, 2003; CEO Forum, 2001a), and to prepare students for life in the
21st-century workplace (CEO Forum, 2001b; Law, et al., 2002; Partnership for the 21st Century Skills [PFTCS], 2006) has been high. In addition, the surge in computer use in everyday life has increased the demand on educational institutions to achieve and maintain technology currency in order to respond to and shape national socio economic development (Granger, et al., 2002).

Acquisition of computer skills and lifelong learning ability are the key elements needed by individuals and the country to ensure national socioeconomic progress in the information-based global economy of today (CEO Forum, 2001b; Karolyn & Pains, 2004). For this reason, countries, both the rich and poor, are striving to equip their schools with the latest computer technology in an effort to produce computer-savvy school graduates. In particular, equipping students with problem-solving, research, communications, and analytic skills is critical (Barron, Kemker, Harmes, & Kalaydjian, 2003). Such computer-skilled graduates are creative, confident, and productive users of the new technologies who also understand the impact of the emerging technologies on society (Ainley, Banks, & Fleming, 2002; Bebell, Russell, & O’Dwyer, 2004). For this reason, production of a computer-skilled workforce has become a matter of urgency for countries in the information age (CEO Forum, 2001a; Karolyn & Pains).

Critical Review of Relevant Literature on Computers

Availability of Computers in U. S. Public Schools

Introduction of computer technology into the U.S. school curriculum was in order to improve teaching practices and learning (Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000). This was in an effort to produce a well-educated and
technologically skilled workforce responsible for sustaining America’s economic superiority in the information-driven global economy (Culp, Honey, & Mandinach, 2003). Because access to multimedia computers and the Internet affects educational achievement, it is important to know the extent of availability and use of such technology resources for learning in the public schools (Ogle, T., Branch, M., Canada, B., Christmas, O., Clement, J., & Fillion, J. et al., 2003). Availability of computer technology refers to access to up-to-date or multimedia computers in instructional settings (computer lab and the classroom) in the public school, and it means that students and teachers have access to and can use the technology whenever they want. According to the International Society for Technology [ISTE], easy access to computer technology is the prerequisite for effective use of technology as a powerful learning tool.

Student-to-instruction computer ratio or the ratio of students-to-computers with high-speed connectivity indicates the level of access to computer technology in public schools in the United States (Ogle, et al., 2003; Becker, 2001; CEO Forum, 2000). Both the national and state student-to-instructional computer ratios are obtained by dividing the total number of registered students in the public schools by the total number of computers used for student use (Barron, et al., 2003; Ogle, et al., 2003; Smerdon et al., 2000). In more recent reports (Education Week: Technology Counts 2008, 2007), student computer ratio has been referred to as the ratio of students to modern computers. Modern computer refers here, refers to a computer with multimedia capabilities, and manufactured five years prior to the data collection. It is worth noting that in this study, the total number of computers used for computation of the classroom student-to-
instructional computer ratio does not include computers used by school administrators or those for exclusive teachers’ use.

United States schools have made great strides in improving access to computer technology as indicated by the average national student-to-instructional computer ratio and student-to-instructional-multimedia computer ratio of the 5:1 and 10:1, respectively (CEO Forum, 2000). In 2008, the national student-to-instructional computer ratio was even much lower, at 3.8:1 (Education Week: Technology Counts, 2008).

Availability of the Internet in United States’ Public Schools

Internet connectivity in U.S. schools has increased substantially since its introduction in 1994 (Williams, 2000). Internet availability in the public schools presented as the percentage of classrooms and computer labs with Internet access or as percentage of public schools with Internet access (Ogle, et al., 2003). Sometimes this ratio is referred to as, the ratio of students-to-instructional computer with Internet connectivity. The ratio of students to instructional computers with Internet access was obtained by dividing the total number of students in all public schools by the total number of instructional computers with Internet access in all public schools (including schools with not Internet access) (Parsad & Jones, 2005).

Kleiner and Farris (2002), Kleiner and Lewis (2003), and Parsad and Jones (2005) have documented a substantial increase in the number of schools and instruction rooms with Internet connectivity in U. S. public schools. According to Kleiner and Farris, the percentage of public schools with Internet access more than doubled from 35% in 1994 to
99% in 2001, while the number of instruction rooms with Internet access steadily increased from 3% to 87% in the same period.

Whereas no overall increase in percentage of schools with Internet was realized, the percentage of instruction rooms increased to 92% in 2002 (Kleiner & Lewis, 2003). Parsad and Jones (2005) state that by fall of 2003, nearly 100% of public schools in the United States already have Internet access, while schools with instructional rooms with Internet connectivity increased to 93%.

In terms of student-to-instructional computer with Internet connectivity, Cattagni and Farris (2001) reported that the ratio of instructional computer with Internet connectivity steadily improved (decreased) from 9:1 in 1999 to 7:1 in 2000. This ratio further improved to 4.8:1 in 2002 (Kleiner & Lewis, 2003). By 2003, the ratio improved to 4.4:1, from 12.1:1 in 1998, when it was first measured (Parsad & Jones, 2005). In 2008, the ratio of student-to-instructional computer with high-speed Internet connectivity was 3.7:1. The rapid increase in Internet access in public schools in the United States is due to the increased funding for Internet connectivity over the last decade.

*Types of Internet Connectivity*

As Internet access in schools increased, the types of connectivity to the Internet have also evolved over time. Dial-up was the main mode of accessing the Internet when the Internet, was first introduced into the classrooms. Now wireless and broadband connectivity are common. In 2003, about 95% of public schools in the country were using broadband connectivity to the Internet, up from 80% in 2000 (Parsad & Jones,
2005). Parsad and Jones further state that the percentage of public schools using wireless Internet access increased from 23% in 2002 to 32% in 2003. They maintain that 92% of all the schools using wireless Internet connectivity in 2003 also used broadband wireless connectivity.

Empirical evidence (Smerdon, et al., 2000) suggests that access to, and availability, of computers and the Internet in U.S. public schools are well past the level practitioners deem necessary to achieve the desired student learning outcomes. One important question to researchers concerns the matter of equity in the distribution of computers and the Internet in the country. When examining the distribution of computers available in United States public schools, it is important to take into consideration the location of each school to determine whether the school is urban, suburban or rural.

*Distribution of Computers and Internet in United States’ Public Schools*

Since its introduction into the U.S. school curriculum two decades ago, availability and integration of computer technology into school curriculum have taken a central place in the national educational policy. Given the perceived impact of computer technology on learning and teaching practices, it is important to examine the progress made in the acquisition, distribution, and use of computer technology in the U.S. education landscape (CEO Forum, 2001a, 2001b).

Investment in computer technology in the nation’s public schools has increased substantially, a reflection of the increasing importance of computer technology in learning and instruction (CEO Forum, 2001a). The substantial investment led to increased availability and access to computers and the Internet in U.S. public schools as
indicated by the decrease in student-to-instructional computer ratio from about 5:1 in 2000 to 3.8:1 in 2006 (Education Week: Technology Counts, 2007). The national average student-to-instructional computer ratio is low, meaning high access to the technology, but the distribution of the technology may not be even. Distribution of the technology in U.S. public schools and the factors that influence it are worth examining.

While the purpose of using computers in schools may be universal, the extent to which teachers use computers varies with school characteristics such as school size, level, locale, poverty concentration, and minority enrollment (Ainley, Bank, & Fleming, 2002). In addition, Williams (2000) pointed out that despite the major gains made by public schools in obtaining access to computers and Internet infrastructure, not all schools had enjoyed the same progress by the end of 1999. National studies (Cattagni & Farris, 2001; Kleiner & Lewis, 2003; Smerdon, et al., 2000) have shown that U.S. public schools have made tremendous progress in acquiring computer and Internet access. Access to computer technology in the U.S. public schools, expressed as student-to-instructional-multimedia-computer ratio and student-to-instructional-multimedia-computer-with-Internet connectivity presently stands at 3.8:1 and 3.7, respectively (Education Week: Technology Counts, 2008). Nonetheless, distribution of computers and the Internet in the public schools varies by school characteristics–school level, size, locale, poverty level, racial composition, and other socio economic factors (CEO Forum, 2001a; Ogle, et al., 2003).
School Level

Access to computers and the Internet in the public schools varies with school level. In terms of instructional level, the national average ratio of the number of student-to-instructional computer with Internet connectivity in 2000 was 8:1 in the elementary schools and 5:1 in the high schools (CEO Forum, 2001a; Cattagni & Farris, 2001). During the same period, 76% of elementary schools had access to the Internet compared with 79% of the high schools; and student-to-instructional computer ratios of 8:1 and 5:1, respectively (CEO Forum, 2001a).

School Size

School size also influences student access to computers and the Internet in public schools. Williams (2000) reported that medium-sized and large public schools in the United States had higher classroom student-to-Internet-connected-computer ratios of 9:1 and 10:1 compared with 6:1 in the small schools. According to Kleiner and Ferris (2002) the ratio of classroom student-to-instructional computer with Internet access varied by school size from 9:1, 12.3:1, and 13:1 for small, medium and large schools in 1998 to 4:1, 5.6:1, and 5.4:1 respectively in 2001. Parsad and Jones (2005) reported that the ratio of student-to-instructional computer with Internet connectivity was 3.2:1 in small schools, 4.7:1 in medium sized schools and 4.3:1 in large schools.

School access to the Internet varies with schools size. According to CEO Forum (2001a), small schools (fewer than 300 students), medium-sized schools (300-900 students), and large schools (1,000 or more students) had student-to-instructional computer ratios of 4:1, 7:1, and 7:1, respectively. In the same report, 96% of small
schools, 98% of medium schools, and 99% of large schools had access to the Internet. Kleiner and Farris (2002) reported that 99% of small schools, 99% of medium sized schools, and 100% in large schools by the end of 2001. According to Prasad and Jones (2005), access to the Internet had reached 100% capacity in small, medium, and large schools.

**School Location**

Location of public schools in the United States plays a role in the distribution of computers in the public schools. Schools can be rural, suburb, town, or city schools based on their location. In 2003, the ratio of students to instructional computer with Internet connectivity were 3.8:1 in rural schools, 4.6:1 in urban schools, and 5:1 in city schools (Parsad & Jones, 2005). According to these researchers, access to the Internet also varies with location of schools to the extent that 94% of rural schools, 97% of town schools, 94% of urban schools, and 90% of city schools had Internet access by the end of 2003. The availability of the Internet in public schools also varied with location of the school. According to Kleiner and Lewis (2003), Internet access in instruction rooms varied by location of the school to the extent that the Internet was provided in the city schools, urban and rural schools at 88%, 96% and 93% respectively.

**Poverty Concentration**

The level of poverty concentration in the schools does affect availability of computer technology in schools. Cattagni and Farris (2001) and the CEO Forum (2001a, 2001b) reported that schools in areas of extreme poverty (schools with 75% or higher percentage of students with a reduced-price or free lunch) have a higher classroom
student-to-instructional-Internet connected instructional computer ratio of 9:1, compared with 6:1 in schools with 35% or less poverty concentration. Similarly, Kleiner and Lewis (2003) state that schools with high poverty concentration have 5.5:1 student-to-instructional computers with Internet connectivity ratio, compared with 4.6:1 in schools with the lowest poverty concentrations (schools with 20% or less poverty concentration) in the same time period.

These findings are similar to Parsad and Jones’ (2005) report that the ratio of student-to-instruction computer with Internet connectivity was 5.1:1 in schools located in areas of high concentration of poverty versus the 4.2:1 ratio in schools located in areas of lowest poverty concentration. In terms of access to computer technology in the classroom, it was found that 60% of the classrooms in the schools located in high poverty areas had access to the Internet, compared with 77% to 82% of classrooms in lower poverty concentration schools (National Post Secondary Education Cooperative [NPEC], 2004). Availability of the Internet in public schools in 2006 also varied with location of the school. The national average student-to-instructional computer ratio in high poverty and low poverty schools were 3.7:1 and 3.6 respectively, while the overall national average student-to-instructional computer ratio was 3.8:1 (Education Week: Technology Counts, 2007).

Minority Enrollment

Minority concentration in the public schools affects access and distribution of computers. By the end of 2006, the overall national ratio of students-to-instructional computer ratio was 3.7:1; it was 4.1:1 in high minority schools and 3.5:1 in low minority
schools (Education Week: Technology Counts, 2007). Cattagni and Farris (2001) reported that schools with high minority enrollments (schools with 50% or more minority students enrolled) have a higher ratio of classroom student-to-instructional computer with Internet access of 8:1, compared with 6:1 in schools with less minority enrollment (20% or lower minority enrollment). Similarly, only 64% of the classrooms in schools with high minority enrollments have Internet connectivity, compared with 79% to 85% of instructional rooms in schools with low minority enrollments (NPEC, 2004).

The use of the Internet and the type of Internet connectivity (dial-up, wireless, and broadband) in United States public schools varied with school characteristics (Kleiner & Lewis, 2003; Parsad & Jones, 2005). Kleiner and Lewis further state that the probability of a school using a broadband Internet connectivity increases with school size, from 90% to 100% in small and large schools, respectively. In addition, Parsad and Jones assert that rural schools are less likely to use broadband connectivity to the Internet than schools in other locales such as city or urban areas.

Parsad and Jones (2005) further stated that in 2003, the proportion of public schools with wireless Internet connectivity increased with school size but decreased with the increase in poverty concentration. The researchers also found that only 25% of public schools in the highest poverty concentration areas have wireless Internet connectivity compared with 36% of schools in areas with the lowest poverty concentration. Furthermore, 42% of the high schools were more likely to use wireless Internet connectivity, compared with 29% of primary or elementary schools in the same period (Parsad & Jones, 2005).
Availability of Computers in Ohio Public Schools

Access to computer technology by students and teachers in Ohio public schools is a critical component of Ohio’s economic development, which is why integration of computer technology into classroom learning has been the focus of educators and policymakers in the state. Integration of computer technology into classroom instruction and learning in Ohio public schools began with the creation of Ohio SchoolNet (OSN) now eTech Ohio, in 1994 (OSN, 2000). Indeed, Ohio was one of the pioneer states implementing computer technology integration into classroom learning in an effort to improve student academic outcomes (Daniel & Nancy, 2002). Since then, Ohio has invested substantial amounts of money for computer technology and CTPD in the public schools for both instructional and administrative use (The Ohio School Technology Implementation Task Force, [OSTITF], 2002).

In the recent past, the Third Frontier Project (TFP), a statewide economic development initiative—an initiative directly linked to availability of computer technology in the public schools. Under this plan, all K-12 schools joined TFP in 2003 (Park & Staresina, 2004). The goal was to develop stronger technological links between school districts and higher education institutions in order to expand educational research in Ohio schools. Building a high-speed fiber-optic network, in addition to the T-1 lines, was one way to achieve the goal. The T-1 cables are high-speed cables compared to the phone lines used in Internet infrastructure. During 2003/2004 fiscal year, $6.4 million were appropriated with another $7.8 million in 2005 (Education week: technology
Counts, 2005, 2006). The substantial investment in computer technology and broadband Internet connections led to improved access to computer and the Internet in Ohio schools.

The availability of computer technology in Ohio public schools is, measured as the average number of students per instructional computer in the classrooms or computer labs. These ratios are indicative of the level at which students in Ohio public schools have access to the technology in the instructional settings (OSTITF, 2002). Available literature indicated that computer technology access by students and teachers in Ohio public schools has improved steadily over time since computers were first introduced into Ohio public schools in 1994 (OSTITF).

According to Ohio School Net (2000), Ohio policymakers and educators focused on the major goal of having a classroom-student-to-instructional multimedia computer ratio of 5:1, but the journey toward this goal has been slow. At the end of 2002, access to computers was at the ratio of 10:1(eTech Ohio, 2003). At the end of 2003, the ratio was recorded at 5.8:1 for classroom students to instructional computer ratio while 13.8:1 was the average computer lab student-to-instructional computer ratio of 13.8:1, compared with the corresponding national ratios of 8:1 and 13:1, respectively (Education Week: Technology Counts, 2004). Ohio was number eight among the 10 states making the first quintile as technology leaders in the nation, with South Dakota on top of the list (Education Week: Technology Counts, 2005). The report showed classroom student-to-instructional computer ratio in Ohio was of 5.8:1 compared with 7.6:1, the national average classroom-student-to-instructional computer ratio. The state technology report of 2007(Education Week: Technology Counts, 2007) indicated that Ohio had reached its
state goal of having a ratio of five students per instructional computer in the K-8 grades and now, the focus is on the remaining grade levels. The average classroom student-to-instructional computer ratio improved to 3.5:1, compared with the national average ratio of 3.8:1 (Education Week: Technology Counts, 2008). It is worth noting that the state average classroom student-to-instructional computer ratio does not mean all classrooms and computer labs across the state have the same averages.

*Availability of Internet in Ohio Public Schools*

Availability of the Internet in Ohio public schools measured as percentage of schools or percentage of instructional classrooms with Internet access or as a ratio of classroom students to high-speed Internet-connected computers (Ogle, et al., 2002). The classroom student-to-Internet-connected instructional computer ratio measures the degree or ease with which students and teachers access computers and the Internet in their schools (OSTITF, 2002).

Because access to the Internet in classrooms provides teachers and students with a wide variety of resources and learning materials (Ogle et al., 2003), Ohio invested substantially in Internet availability in the public schools (eTech Ohio, 2003). Availability of the Internet in Ohio public schools expressed as 6:1 and 15:1 ratios of students to instructional computers with Internet connectivity in the classrooms and computer labs (Education Week: Technology Counts, 2004). By early 2008, access to the Internet had greatly improved, as indicated by the small number of students per Internet connected computer. The average ratio of classroom students to multimedia instructional computer connected to high-speed Internet in Ohio public schools was 3.4:1.
compared with the national average ratio of 3.7 (Education Week: Technology Counts, 2008).

Expressed as percentage of schools with Internet connectivity, 92% of public schools in Ohio had computers with Internet connection in one or more classrooms by the end of 2004 (Education Week: Technology Counts, 2005). According to the results discussed, availability of computers and the Internet in Ohio public schools has improved over time since its introduction in the classrooms. The low classroom student-to-Internet-connected instructional computer ratio means easy access to the technology, which should in turn translate to a higher level of computer use in classroom instruction by teachers in the public schools (NPEC, 2004).

Distribution of Computers and the Internet in Ohio Public Schools

Even distribution of computers and the Internet in the schools is an important prerequisite for effective statewide use of computer technology in the schools. Kleiner and Lewis (2003) reported that distribution of computers and the Internet in the nation’s public schools varied with school characteristics such as school size, school level, locale, poverty concentration, and minority concentrations, among other factors.

Similarly, school characteristics greatly influence distribution of computer technology in Ohio public schools. By the end of 2003, Ohio had attained an overall average classroom student-to-instructional computer ratio of 4:1 statewide, 5:1 in high poverty schools; and 5:1 in schools with high-minority student enrollment, compared with the corresponding national average ratios of 4:1, 5:1, and 5:1 respectively (Education Week: Technology Counts, 2004). According to the same report, during the
same period, the average percentages of schools with Internet access in high-poverty schools was 98%, and in the high-minority enrollment schools it was 98%, compared with the national percentage averages of 98% and 97% respectively. Since 2005, access and distribution of computer technology in Ohio public schools improved somewhat as indicated by the state average classroom student-to-instructional computer ratios with respect to school socio economic factors (Education Week: Technology Counts, 2007) as presented in Table 2.1.
The national and state average ratios in Table 2.1 seem to suggest that the
distribution of the computer technology resources is even across the state. Such
observation seems to concur with findings of Kleiner and Farris (2002), and Williams,
(2000) who claimed that access to computers and the Internet in United States public
schools no longer varies by school characteristics. These researchers seem to suggest that
inequality in access to computers and the digital divide no longer exist in the United States public schools. This is not true because disparities in availability of computers and the Internet in the United States public schools do exist.

The comparison of access to or availability of computers and the Internet in Ohio public schools was based on data that did not include schools from high socioeconomic locations, as well as predominantly White schools. A casual look at these statistics projects the perception that there are no longer any disparities in the distribution of computer technology resources in Ohio public schools.

School characteristics such as poverty concentration, minority student enrollment, geographical location, and school size are important indicators of availability and access to computer technology in the schools. In other words, these school characteristics are major factors of disparities in computer technology access in the public schools across the nation, and these disparities, in turn, perpetuate a digital divide. Therefore, any assertion of presence or absence of a digital divide based on analyses of data from schools in predominantly low-income areas or wealthy schools alone can be misleading.

Although claims of the eradication of the digital divide and inequalities in access to computer technology resources by schools may be good news, such claims may give the false perception that there in no longer inequality problem. Inequality in access to computers and the Internet resources is an impediment to a widespread and effective use of computers in classroom instruction by schoolteachers, yet inequality negatively affects the degree of computer use by students and teachers and, subsequently, student achievement.
Computer Technology Use in the Instructional Settings

Since computer technology was introduced into education to enhance learning and instruction, extensive use of computers by teachers in implementing standards-based curricula in the public schools is vital if the expected outcome is to be achieved (Smerdon, al., 2000). Other studies (CEO Forum, 2001b; Kleiner & Farris, 2002; Kleiner & Lewis, 2003) indicate that as access to computers and the Internet continues to improve, computer use in classroom learning as a teaching tool can improve learning outcomes.

According to the available data on national and state student-to-computer ratios reported in empirical studies, computer technology and the Internet are more readily accessible to teachers and students in United States public schools now more than ever. In their national study of access to computers in the public schools, Smerdon, et al., (2000) reported that 84% of the teachers surveyed in the study, reported having computers in their classrooms, while 95% state they had computers elsewhere in the schools. The researchers reported that 53% of the surveyed teachers said they used computers for classroom instruction during class time, while 39% of the teachers with computers and the Internet available in their classrooms used the technology for creating instructional materials. Other researchers Kleiner and Farris (2002), and Kleiner and Lewis (2003) investigated availability and the use of computers in classroom instruction and found that nearly all public school teachers (99%) had access to computers and the Internet in their schools in 2002.
According to NPEC (2004), more elementary school teachers (56%) were likely to use computers and the Internet for classroom instruction than high school teachers (44%) were. The same report further indicated that for both types of use and the extent of use, 30% of teachers assigned their students to use computers for learning how to do research, while 41% of the teachers assigned their students to use computers as a productivity tool (NPEC, 2004). The same study found that 39% of the elementary teachers were more likely to assign their students to use the computers for drill exercises than 12% of the high school teachers. In addition, 31% of elementary school teachers were more likely to assign their students to use computers for problem solving than were high school teachers (20%). Overall, 41% of high school teachers were more likely to assign their students to use computers for research compared with 25% of the elementary school teachers (NPEC). A survey conducted by OSN (2000), on computer technology use in classroom instruction by Ohio public schools found that 80% of teachers in the public schools do not use computers in their daily classroom instruction.

According to the 2006 national state technology report (NSTR), Ohio only scored a D, in “The state ability to use the technology in classroom instruction” measure (Education Week: Technology Counts, 2007). This is problematic given that the literature (Education Week: Technology Counts, 2004; 2005) reported that Ohio schools have high computer and Internet availability. Such findings also show that computer technology in Ohio public schools was underutilized. Given the substantial tax dollars invested in computer technology in Ohio public schools, Ohio taxpayers are pressing educators and policymakers in the state for more accountability for the effective use of the technology.
The public deserves to know whether the computer technology on which millions of their tax money is spent has led to ready acceptance and widespread use in classroom instruction by the teachers.

*Effects of Technology on Student Achievement*

As the tool of choice for educational reform, computer technology for improving student learning is widely perceived to be critical. For this reason, the effect of computer technology use for learning on student achievement has been widely studied (Angrist & Lavy, 2002; Fuchs & Woessmann, 2004). Educators began looking for empirical evidence on the effect of computer use for learning on student achievement as early as the 1970s by reviewing a number of studies on computer use. It was not until 1975, when meta-analysis, a research analysis tool was introduced into the field of educational research, and has since improved in-depth analysis (Glass, 2000).

The emergence of meta-analysis has led to a cascade of meta-analytic studies on the effects of computer technology on student achievement. Most of the meta-analysis studies conducted on the impact of computer technology on student achievement have reported some positive effect sizes. The more recent meta-analyses, of Waxman, Lin, and Michko (2003), which analyzed 42 studies published from 1997 to 2003, with a combined sample of 7,000 students, found a mean effect size of .410. The findings of these researchers suggest that the overall effect size of technology on student achievement is greater than previously stated.

The effect of computer technology on student achievement has been a contentious and controversial issue. According to Blackman, Hild, and Wilson-McLaughlin (2002),
there are two camps. On the one side of the debate are the skeptics and opponents of
computer use in education. The critics of computer use in instruction, such as Cuban
(2001), argued a decade ago that computer use in education does not improve student
achievement. Other researchers (Angrist & Lavy, 2002) added their voices on lack of
effects of computer technology on student achievement when they studied the effect of
computer-aided instruction (CAI) on mathematics achievement of fourth-grade students
in Israel. Furthermore, Fuchs and Woessmann (2004) attribute reported positive effect of
computer use on student achievement to claims made by politicians and software
vendors.

On the other side of the debate are the supporters of computer use in education
who believe that computer technology use in education improves learning and teaching
and thus embrace technology use in schools (CEO, 2001a). These people continue to
promote acquisition and use of computers in the public schools. Computer technology
enthusiasts seem to draw their enthusiasm for computer use in education from the
growing body of studies (CEO Forum, 2001b; Schacter, 2000) that show various benefits
of using computers in education. A review of the research literature on the impact of
computer technology (Honey, 2001; Norris, Smolka, & Soloway, 2000; Norris, Sullivan,
Poirot, & Soloway, 2003) strongly suggests that computer use in classroom instruction
has a positive impact on learning and teaching in the schools.

It appears that opponents of computer use in education based their opposition on
findings of early meta-analyses studies conducted between the early 1980s and the mid-
1990s. If that is the case, then their claim that computer technology use in education
“does not improve student achievement” is inaccurate, because most of the meta-analysis studies, for example, Waxman, Lin, and Michko (2003), have found positive effects of computer use in learning on student achievement. Waxman, Connell and Gray (2002) reported similar findings from their synthesis of more recent research studies on the effects of using computer technology for teaching and learning on student learning outcomes.

The current position of the opponents of computer technology integration would be credible, if were articulating it on lack of large effect sizes, because most of the effect sizes reported so far ranged from small to medium. Whereas empirical evidence suggests that computer technology use in learning improves student achievement, the small magnitude of the effect sizes reported, may be attributed to various characteristics of research design methodology, year of publication, type or mode of computer application used, as well as the complexity of meta-analysis itself (Waxman, et al., 2003). These researchers contend that without these extraneous characteristics of the individual studies used in the meta-analyses, the overall effects sizes for computer technology on student achievement could be greater than reported currently.

Bebell, Russell, and O’Dwyer (2004) cautioned that before the effect of computer use in education is analyzed policymakers must first clearly understand how students and teachers should use the technology. Knowledge of how computer technology integration and how teachers are using the technology is important because full participation and the extensive use of computers by schoolteachers are key components to improved classroom learning and instruction.
Effects of Computer Technology on Teaching Practices

The importance of the teachers’ role in effective use of computer technology to improve learning cannot be overemphasized. However, teachers cannot effectively integrate computer technology into their school curriculum when they do not have ready access to the technology and the necessary skills to use the technology at any time (Ogle, et al., 2003). Availability of effective computers and Internet infrastructure alone does lead to effective use of computers in the schools (Granger, et al., 2002). Therefore, the extent to which teachers embrace and use computer technology for classroom instruction makes a difference. But teachers need to have easy access to computers in their classrooms as well as possessing proficient computer skills in order to be confident in applying the technology wherever and whenever appropriate, and they must make wise, informed decisions about technology use if students are to do as well. A number of external and internal barriers undermine the extent of teachers’ use of computers in classroom instruction.

Barriers to Integration of Computers in U. S. Public Schools

Generally, barriers to integration of computer technology into school curricula by teachers are comprised of internal and external factors or first-order and second-order factors (Blackman, Hild, & Wilson-McLaughlin, 2002). On the one hand, the internal or secondary factors are comprised of dispositions, such as attitude, beliefs, values, and perceptions. On the other hand, the external factors or first-order factors include school characteristics, lack of time, computers and computer skills. Researchers like Lanahan
and Boysen (2005) and Smerdon, et al. (2000) state that teachers’ perceptions of technology use for classroom instruction vary with external and internal factors.

*External Barriers to Integration of Computers into Classroom Instruction*

The factors that fall under this category include school characteristics, socio economic factors, availability of the computer technology, and training and professional development. The school characteristics include school level (elementary and high school), school size (enrollment), and locale, while socio economic factors include minority enrollment concentration. Barriers to computer technology integration include school level factors and socio economic factors. Smerdon, et al. (2000), reported that 38% of the teachers indicated lack of adequate computers in their classrooms, while 37% of the teachers said lack of release time for learning to use computers and the Internet were the greatest barriers to their use of computer in classroom instruction.

Location of computers in the schools, computer to student ratio, and access to computers by teachers and students have been prominently reported as major factors that impede or increase use of computers in classroom teaching and learning (Lanahan & Shieh, 2002; Mathews & Guarino, 2000; Williams, 2000). When introduced into school curricula for the first time, computers were often set up in shared instructional spaces such as computer labs and libraries. Setting up computers in the classroom was undesirable at the time, because having computers in the classroom would limit the use of those computers by students in other classes. Smerdon, et al. (2000) found that of all the teachers surveyed, 84% reported having computers in their classrooms, nearly all (98%) of them, reported using the computers to some extent. Comparatively, of all the teachers
(95%) who reported having no computers in their classrooms, only 85% reported using the computers for learning.

The researchers concluded that teachers with adequate computers in their classrooms were likely to use computers for classroom instruction than those teachers without computers in their classrooms. Lanahan and Shieh (2002) reported that 65% of teachers who indicated having computers and Internet in their classrooms used the technology for classroom instruction, compared with 38% of teachers who reported having no computers in their classrooms. Access to computers located in computer labs is often limited because computer lab use requires scheduling ahead of time. This limitation means teachers may not be able to use the computers as frequently as they would use computers located in their classrooms. Empirically, there is a significant correlation between availability of computers in the classroom and level of computer use in classroom instruction (Becker, 2000, 2001).

Classroom student-to-instructional computer ratio is a measure of the degree of access to or availability of computers in a learning environment. As schools acquire more and more computers over time, the ratios of students per instructional computer in instruction rooms have improved drastically in schools across the nation. According to Ansell and Park (2003), national average student-to-instructional computer ratios averages were 7:1 in the classroom 15:1 in the computer labs.

Lack of computers and Internet in the classroom impedes computer use in school curricula (Becker, 2000). In their analysis of survey responses of K-12 teachers (Norris et al., 2003) asserted that, “The single most significant predictor of technology use is the
number of classroom computers” (p. 22). While investigating use of computers in classroom instruction by high school teachers in rural Idaho, Mathews and Guarino (2000) reported that the number of computers in the classroom is the best predictor of teachers’ actual use of computer technology. Becker (2000) has shown that classroom student-to-instruction computer ratio is a significant factor in determining the extent to which teachers use computers in classroom teaching. When teachers have access to computers, they are likely to use the computers for instruction and learning in their classrooms (Roblyer, 2004). However, regarding the impact of student-to-computer ratio on student achievement, empirical findings are mixed. While some researchers, such as Norris et al. (2003), Ogle et al. (2003), and Becker (2001), reported that student-to-instructional computer ratio positively affects student achievement; others such as Cuban, (2001), reported the contrary.

Internal Barriers to Integration of Computers into Classroom Instruction

Dusick and Yildirim (2000) and Fulton (2000) have grouped together personal dispositions or internal factors into a group called socio cognitive factors. The factors that fall under this category include attitude, anxiety, willingness to face the risk of failure in using a new technology, perception of technology’s relevance, and lack of knowledge. Other researchers (Vannatta & Fordham, 2004) reported that beliefs and dispositions of a teacher do correlate with successful technology integration. Similarly, Albion (2001) stressed that teachers’ beliefs, specifically, self-efficacy beliefs, “are important and measurable components that influence technology integration” (p.2). Teachers’ beliefs
about the role and value of computer use in learning and instruction may influence their attitudes towards computers and adoption of new pedagogies, one way or the other.

Computer technology use for classroom learning was to improve teaching and learning which in turn could improve student academic achievement. To use computer technology effectively requires that teachers change their traditional teaching practices. Like any other innovation, computer use in classroom instruction comes with some uncertainty and perceived risk (Rogers, 2003). According to Rogers, the uncertainty and the perceived risk trigger fear in the teachers, and the fear subsequently generates teachers’ resistance to computer use in classroom teaching. Since resistance hampers widespread computer use for classroom instruction by the teachers in the nation’s public schools, this negatively affects both teachers’ level of computer use in classroom instruction and student learning outcomes.

Teachers’ resistance to computer technology use in classroom instruction may be due to fear of failure, lack of training, and perceived value or usefulness of the technology (Rogers, 2003; Wiles, 2005). Conceptually, education reform assumed that beliefs and norms govern school change (Wiles). The underlying premise behind this assumption is that school as an organization is a social unit composed of aggregate teachers’ beliefs and subjective norms (Carter & Leeh, 2001).

According to Wiles (2005), when group norms become “a majority belief,” it inevitably enhances spontaneous change. Similarly, when computer use in classroom learning becomes a norm among teachers, then it enhances widespread use of the technology in the classrooms across subjects. A number of researchers have studied
teachers’ resistance to computer technology use for classroom learning. Vannatta and Fordham (2004) investigated the other side of resistance to change (willingness to change) and found that lack of willingness to change (resistance to change) is a barrier to computer technology use by teachers.

Like resistance to an innovation, resistance to computer use for classroom instruction by teachers may be an outward expression of internal predispositions toward computers, such as attitude, lack of computer experience, and lack of perceived benefits of using computers in teaching (Rogers, 2003). Subsequently, resistance to computer technology use for classroom instruction innovation hinders realization of computer technology potential to improve teaching and learning in the public schools (Hills, Reeves, & Heidemeir, 2000).

As an internal disposition a teacher’s computer attitude influences that teacher’s extent of computer use in classroom instruction depending on whether her or his attitude is negative or positive. As Picciano (2002) succinctly puts it, unless appropriately addressed, teachers’ negative computer attitudes hinder widespread use of computers in curriculum implementation. Studies (Becker, 2000, 2001) have shown that teachers’ attitudes towards computer use greatly determine teachers’ extent of computer use in classroom instruction. Norris, et al., (2003) reported that teachers’ attitudes toward computer technology were not a predictor of technology use in classroom instruction.

*Teachers’ Perceived Value of Computer Use in Classroom Instruction*

Before any innovation can be accepted and used, the potential users have to see or perceive the potential benefits that may accrue from accepting and using the innovation.
In order to use computer technology effectively, educators must clearly be convinced of the benefits that accrue from such use (Rogers, 2003). Available literature suggests a range of benefits, which accrue from teachers’ use of computers in classroom teaching. These benefits include, but are not limited to, an increase in student achievement (Norris, et al., 2003), enhancement of instruction and effective control of the various faces of teaching (CEO, 2001b). In spite of all these benefits, Roblyer (2004) argues that it is imperative that a teacher feels that the innovation is compatible with her or his values, beliefs, pedagogical orientations, and attitude towards teaching and learning in order for the teacher to adopt the innovation. It is at such level of association of computer technology with personal needs and gains that computer use in classroom instruction becomes a norm and its use becomes widespread among teachers.

**Computer Technology Professional Development**

Indeed, computer technology presents teachers with many ways to enhance learning and instruction (Resta, et al., 2002), but availability of computer technology in the classrooms alone, without providing teachers with the necessary training and CTPD may not lead to attainment of the expected learning outcomes (CEO Forum, 2001a). Conversely, availability of computer technology alone (without sustained training and CTPD) may not lead to a widespread and effective use of the technology in classroom learning.

Access to adequate computer technology and sustained CTPD are essential for successful integration of computer technology into school curricula. Sustained CTPD is essential for effective integration of computer technology into classroom instruction and
learning because it helps teachers understand and acquire the skills required to apply the technology in their classroom settings (Ogle, et al., 2003). Formal CTPD and collaboration with other teachers are critical components in proving teachers with continuous training opportunities, for enhancing computer technology skills and application, to keep in step with continuous changes in computer technology (Henke, Chen & Geis, 2000 METIRI Group, 2006).

Formal CTPD consists of school and district staff development programs conducted on weekends or at the end of the school year, the duration of which is typically an equivalent of one day (Parsad, Lewis, & Farris, 2001). The areas covered in such training sessions include hardware and software applications and integration of computers into classroom instruction (Ogle, et al., 2003). In the past, CTPD was criticized for lack of continuity between what teachers learn and what goes on in the classroom with respect to continuous evolution of computer technology (Parsad et al.), and lack of adequate funding at both the national and state level (CEO Forum, 2001a). By the turn of the Centenary, funding for CTPD had increased to 25% of the national spending on computer technology integration in United States public schools. As a result, access to CTPD improved greatly with more opportunities for teachers to receive CTPD online, and through seminars or workshops on regular basis all year round (Education Week: Technology Counts, 2008; Ogle et al., 2002).

Participation in CTPD and teachers’ use of computer technology in classroom instruction influences teachers’ competence and level of integration of the technology in classroom instruction. In a national study, Smerdon, et al.(2000) reported that teachers
who spent more time in CTPD activities (34% who spent 9 to 32 hours and 66% who spent more than 32 hours) felt confident and well prepared to integrate computer technology into classroom instruction than those who spent less time (less than 9 hours) in CTPD activities. In a similar study (Rowand, 2000), in which teachers were asked to focus on the various potentials of computer or Internet use in the classroom, 23% reported feeling well prepared to use the technology but only 10% indicated feeling very well prepared.

Acquisition of computer skills and the level of confidence and proficiency in using the technology determine whether teachers can adopt the technology or not. The knowledge acquired during CTPD enables teachers to use computers in classroom instruction. This link makes CTPD a key factor for a successful and effective use of computers in the implementation of standards-based school curricula by teachers.

In essence, CTPD serves as the bridge between where prospective and experienced educators are now, and where they will need to be, in order to meet the new challenges of guiding students to achieve higher standards of learning and development (CEO Forum, 2001a). The importance of CTPD, as a link to effective integration of technology into curricula cannot be overstressed.

Inadequate training and lack of CTPD may negatively influence widespread extent of computer use in classroom learning and instruction. For this reason, the level of teachers’ CTPD may directly affect their computer use in classroom instruction. Subsequently, the focus of CTPD must be the acquiring technology skills, as well as addressing the difficult problem—teacher attitude towards computer use in classroom
Availability and frequent provision of adequate and appropriate CTPD to teachers promotes teachers’ use of computer technology in teaching (Ogle, et al., 2003). For example, when Bussey, Dormody, and VanLeeuwen (2000) investigated computer technology use in education in New Mexico, they stated that lack of adequate CTPD (lack of educational programs to learn about technology education) was a major barrier to computer technology use by high school teachers.

**Barriers to Computer Use in Ohio Public Schools**

Review of the literature reveals that the barriers reported to hinder integration of computer technology at the national level are the same factors that also hinder integration of computers in Ohio public schools. The factors are comprised of internal or teacher dispositions and external factors. Researchers (Franklin, 1999; Maddin, 2002; Muir-Herzig, 2004; Vannatta & Fordham, 2004) have investigated a number of factors that promote or impede infusion of computer technology in Ohio public schools. Teachers’ attitudes towards computer use in classroom instruction was found to be a critical factor in influencing the extent to which teachers in Ohio public schools use computers and the Internet for instruction and learning (Albejadi, 2000; Franklin, 1999; Vannatta & Fordham, 2004). In his investigation of the use of the Internet for learning by elementary and high school teachers in Ohio public schools, Albejadi also found teachers’ attitudes towards computer use and computer proficiency were significant predictors of the level of Internet use.

In a similar study, Vannatta and Fordham (2004) investigated teacher attributes that affect teachers’ use of computers in classroom instruction among elementary and
high school teachers in Northwest Ohio. The researchers found that openness/willingness to change and level of computer proficiency were significant factors in influencing teachers’ use of computers for class instruction. Integration of computers into classroom instruction by K-4 teachers in Ohio was influenced by teachers’ CTPD level, lack of access to computers, lack of computer training, and lack of time to learn how to use the technology (Franklin, 1999). Muir-Herzig (2004) points out that the low level of teachers’ use of computers for classroom instruction affects computer use for learning by at-risk students.

A critical review of the literature on teachers’ use of computers for classroom instruction in Ohio public schools reveals similar patterns as those studies completed at the national level. Studies at both national and state levels use sample populations that combine K-12 participants but statewide studies that focus on specific school level, especially high school, are lacking. Careful review of the literature revealed few studies that examined statewide use of computer technology for curriculum implementation in high schools in Ohio. Because the literature indicates that Ohio schools have low student-to-instructional computer ratio, it is important to examine the impact of computer technology on teaching practices of high school teachers in Ohio and student learning outcomes.

Limitations of Prior Studies

Since the early 1990s, the National Center for Educational Statistics (NCES) has been tracking the progress of availability and integration of computer technology in the country. The studies covered various aspects of computer technology integration in
United States’ public schools and the impact of the technology on teaching and learning. The studies focused on availability, access, distribution of computer technology, availability of training and CTPD, and the impact of computer technology and the Internet on student achievement. The data gathered from the national studies provide the backbone of research on instructional technology use in classroom instruction at the national and the state levels. Subsequently, the findings of these studies have been critical in informing United States’ education policy over the years. Because of the important role these studies play in policymaking, it is important to discuss some common limitations of these prior studies.

Studies conducted to assess computer technology use in the public schools should focus on integration of computer technology by discretionary teachers rather than by non-discretionary teachers (Norris, et al. 2003). These researchers argue that inclusion of the non-discretionary teachers in a study sample of studies investigating integration of technology into school curricula weakens otherwise informative studies. However, prior studies on integration of computer technology into school curricula used samples that included non-discretionary computer-using teachers. Therefore, the results of such studies are flawed and, misleading.

In addition, generalization of the findings of such studies across the entire K-12 regardless of the size and the composition of the sample population used was misleading. Closer examination of the literature reveals that the population samples used for most of the studies comprises elementary, middle, and high school teachers or a combination of these levels. For example, Ravitz, Wong, & Becker, (1998) surveyed 4th–and 8th–grade
teachers and 12th-grade students on use of computer technology in classroom learning and instruction, but they generalized their findings to the K-12 teachers. Generally, even when the sample used was a convenient sample, usually the researchers present their findings as covering K-12 populations. Findings of studies that used samples that included participants across K-12 are hard to generalize to a specific school level. State and national studies that focus on specific school level (elementary, middle, or high school) are in short supply. Because computer technology use in classroom learning is a complex process, and influenced by a variety of factors, studies that address educational problems at specific school level are more informative to policymakers than findings of studies that generally use across-the-board study sample populations.

**Framework**

Review of available literature suggests that computer technology integration into school curricula occurs in a continuum along which teachers implement computer technology use in classroom instruction at different levels (Moersch, 1995). As teachers progress in their acquisition of computer technology skills, they also progress in their implementation of computer technology integration in classroom instruction towards becoming full-fledged computer technology users in their teaching practices (Barron, et al., 2003; Bebell, et al., 2004). The literature further reveals that access to computer technology in United States’ public schools is at adequate levels— as indicated by the fewer number of students sharing a computer.

This study focused on determining the extent to which teachers in Ohio public schools use computers in classroom instruction. Because teachers implement computer
technology integration at different levels, levels of technology implementation (LoTi) provide the framework for examining the extent to which teachers in Ohio public high schools integrate computer technology in classroom instruction. It was the results of an effort to understand teachers’ integration of computer technology into school curricula (Moersch, 1995). According to Moersch, eight levels (ranging from 0 to 6) were identifiable as district stages of teachers’ integration computer technology along the technology continuum. The stages are non-use, awareness, exploration, infusion, integration (mechanical), integration (routine), expansion, and refinement. This framework views computer technology integration occurring in a continuum, along which teachers at one end of the continuum (level 0) tend to avoid using computer technology for their classroom instruction (non-users), and such teachers employ teacher-centered instructional approaches or pedagogies. At the other end of the continuum (level 6), are the teachers who tend to be innovators and they actively use computers for classroom instruction, and utilize learner-centered instructional pedagogies or approaches.

On the basis of this framework, four possible levels of teachers’ use of computers in classroom instruction—non-computers, novice, intermediate, and the practitioners—were derived and used in the explanation of the extent of computer technology use for classroom instruction in Ohio public high schools. The non-users refers to the level at which teachers do not use computers at all in their classroom instruction; novice refers to the level at which teachers rarely use computers (once or twice a week at most). Intermediate refers to the level at which teachers use computers three to four times a
week. This is the minimum level at which teachers should be using computers in order to positively affect learning outcomes. Practitioners refer to those teachers who use computers daily in their classroom teaching, and these teachers are enthusiastic in helping other teachers to do the same.

The interpretation of technology use in this study is not just the performance of isolated tasks (e.g., word processing a research paper, creating a multimedia slide show, browsing the Internet). Rather, it is the integration of technology in purposeful ways that build and strengthen problem-solving, research, communication, and analytic skills, all of which are vital skills required in the 21st century workplace (MERITI Group, 2006; Karolyn, & Pains, 2004).

Summary

The need for computer-savvy employees in the workplace is the driving force behind technology use in classroom learning. The passion with which society and the business community in particular have embraced computers and the Internet means that the educational institutions will have to continue providing the technology for learning. Resta et al. (2002) argues that if teachers are not trained to acquire the necessary skills have easy access to adequate computers in their classrooms, and are given both the technical and moral support they need to effectively and routinely use computers in their everyday teaching, then the scarce resources invested in computer technology in the public schools are wasted.

The reviewed literature indicated that teachers and students in Ohio public schools have ready access to computer technology in their classrooms, as indicated by the
low students-to-instructional computer ratio. Ohio also provides continuous computer technology professional development to the teachers in various formats—seminar and online. Critical analysis of the literature on the integration of computer technology helped in the identification of internal and external factors examined in this study. The internal factors include teachers’ attitude toward computer use in classroom instruction, teachers’ perceived value of computers in education by teachers, and teachers’ resistance to change. The external factors include teachers’ attained level of proficiency in computers, CTPD, classroom student-to-instructional computer ratio, and location of computers in the school. Since these factors influence computer use learning one way or the other, they are the variables examined in this study to determine their predicting power on teachers’ extent of computer use in classroom instruction and to what extent these factors influence the use of computer technology in Ohio public high schools.
CHAPTER 3: METHODOLOGY

Chapter Overview

Chapter 3 of this research presents the research methodology, specifically, identification of the population of study, variables, research questions, determination of the sample size, construction of sampling frame, the development of the research instrument, pilot study, operational definition, data collection, and multiple regression design. Development of a prediction model or regression equation that has both generalizability and predictive power is critical in this study. A regression equation that has low predictive power is of limited utility and low scientific value (Cohen, 1988; Stevens, 1999). According to Stevens, sample size and the number of predictors are two critical factors that determine the model’s generalizability and reliability.

Variables Examined

The variables examined as possible predictors of integration of computer technology in the public schools were: location of computers in the school (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), teachers’ perceived computer value in classroom instruction (TPCV), teachers’ attitudes towards computer use for classroom instruction (TCAT), and teachers’ resistance to change (TRTCH). The study attempted to the extent to which each of these factors promotes or hinders teachers’ extent of computer use for classroom instruction in Ohio public schools on a regular basis. The extent of computer use on a regular basis in this context means teachers using computers for
classroom instruction at least three to four times a week or daily. The three research questions are:

1. To what extent do teachers in Ohio public high schools use computers in their classroom instruction on a regular basis?

2. Does location of computers in the classrooms (LOCIC), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), teachers’ attitudes towards computer use in classroom instruction (TCAT), teachers’ perceived value of computers in instruction (TPCV), and teachers’ resistance to change (TRTCH) predict teachers’ extent of computer use in classroom instruction in Ohio public high schools?

3. What do teachers in Ohio public high schools consider the main obstacles to their use of computer technology in classroom instruction on a regular basis?

Operational Definition of Variables

Demographic data present the characteristics and composition of the population of study. In this study, this information was obtained from items 1, 2, 3, 4, and 5 of the survey questionnaire.

Classroom student-to-instructional computer ratio (CSTICR) is the average quotient of the number of registered students in a classroom who are taught by the teacher during the school year when the survey was conducted (item 6) divided by the total number of computers in the classrooms used for student learning (item 7a). The
computers referred to here are up-to-date multimedia computers connected to the Internet located in the classroom in the public schools (item 7a).

*Teachers’ perceived value of computer use in classroom instruction* (TPCV) is the resultant magnitude of improved student achievement and teaching inherent in the appropriate use of computer technology in the classroom. Operationally, this variable is the mean of items 8, 9, 10, 11, and 12 in the study questionnaire.

*Teachers’ attitudes towards computer use for classroom instruction* (TCAT) are the positive or negative feelings or emotions of teachers toward their use of computers for classroom instruction. Operationally, this variable is the mean of items 13, 14, 15, and 16 in the study questionnaire.

*Teachers’ resistance to change* (TRTCH) is the refusal to use or limited use of computers in classroom instruction by a teacher because such use entails adoption of new teaching approaches. Operationally, resistance to change is the mean value of items 17, 18, 19, 20, and 21 in the study questionnaire.

*Location of computers in the school* (LOCIS) refers to availability of computers for the sole purpose of student learning in the classroom, operationally defined as the mean of items 22, 23, 24, and 25 in the study questionnaire.

*Teachers’ attained level of computer technology proficiency* (TALOCP) refers to teachers’ computer skills necessary for classroom instruction. Through CTPD workshops and seminars, peer training, self-training, and college coursework, or a combination of these methods teachers may acquire these skills. The variable was measured as the mean of items 27 and 28 in the study questionnaire.
Teachers’ extent of computer use in classroom instruction (TEOCUICI) refers to mean of items 30 in the questionnaire. In this study, the use of computers three to four times a week or daily is the productive level of computer technology in classroom instruction. When teachers use computers two or fewer times per week, this constitutes low use or underutilization of the technology, which does not affect learning positively.

The non-instructional uses of computers in education included teachers’ use of e-mail for communicating with students’ parents, lesson planning, and record keeping (items 32a, 32b, 32c, and 32d from the study questionnaire) and were analyzed to establish the existence of correlation between teachers’ discretionary computer use for classroom instruction and the non-instructional uses. This is important because the researcher postulated that teachers who use computers for non-instructional purposes on a regular basis equally use computers for classroom instruction on a regular basis.

Population of Interest

High school teachers in the Ohio public school system is the population of interest for this study. A number of factors influenced the choice of this sector of the population of teachers in Ohio public school system. Ohio has invested substantially in computer technology integration in the public schools, which is a good indicator of the state’s commitment to providing a better teaching and learning environment in the public schools. Available literature (Education Week: Technology Counts, 2007, 2008) indicates that Ohio public schools are well equipped with computers and the Internet in their classrooms. The low average classroom student-to-instructional computer ratios of 4:1 and the 5:1 classroom student-to-instructional computer ratio of computers connected to
the Internet (Park & Staresina, 2004) indicate the availability of computer technology in Ohio schools.

In addition, various researchers (Albejadi, 2000; Franklin, 1999; Vannatta & Fordham, 2004) have studied computer integration into Ohio public school classrooms. Specifically, Albejadi investigated Internet use in classroom learning in elementary and high schools in Ohio. Franklin examined factors that influence use of computer technology use in K-4 in Ohio Public Schools. Vannatta and Fordham investigated computer technology use in both elementary and high schools in Northwest Ohio. As in studies at the national level, these studies investigated computer technology use in K-12 in general. Studies that specifically focused on statewide computer use by Ohio high schools teachers are lacking. Yet such studies could shed light on whether the teachers are using computers for classrooms instruction on a regular basis or not. In addition, empirical studies on computer use at different school levels are important for policymaking on providing student achievement, strategic planning of teacher education, and professional development in the state.

Determination of Sample Size

As is the case in a research study of this nature, appropriate sample size is important, because cross-validity of the regression equation depends primarily on the sample size (Gay & Ariasian, 2003). Lack of reported coefficient of determination ($R^2$) for the population of study in any field complicates the determination of sample size for regression studies. This study faced the same dilemma, because prior empirical multiple regression studies on integration of computers into school curricula have not determined
coefficients of determination that could be used in the estimation of the sample size. In addition, there were other factors, such as low rate of survey return, exclusion of non-discretionary computer-using participants (computer and business technology teachers), and rejection of inadmissible questionnaires, those questionnaires that could be returned blank or not filled out completely and correctly.

Rates of Survey Returns

A study conducted by Carter and Leeh (2001) comparing levels of integration of computer technology in schools in two countries, obtained 32% and 39% rates of return. A large-scale study (Barron, Kemker, Harmes, & Kalaydjian, 2003) on integration of technology in K-12 schools obtained a 39% response rate. Norris, Sullivan, Poirot and Soloway (2003) obtained nearly 91% return rate, but this is an exception to the rule.

Studies on computer technology use by teachers in Ohio have reported moderately high rates of return. Franklin (1999), in a study on integration of technology by K-4 grade teachers in Ohio, reported a 70% return rate. Given the varied and inconsistent rates of return on survey studies, it is hard to determine a precise sample size for a study. Moreover, rates of survey returns are getting lower and lower to varying degrees.

Discretionary Computer-Using Teachers

The primary goal of this study was to predict the extent of computer use in classroom instruction by high school teachers in Ohio, specifically the use of computers for implementing the standards-based school curricula across subjects by teachers whose use of computers for classroom teaching is discretionary. Some researchers (Becker,
in national studies have shown that 90% of computer science teachers and 69% of business education teachers frequently require their students to use computers for learning, compared with only 2% to 19% of their counterparts teaching science, language arts, mathematics, social studies, foreign languages, and fine art subjects. Ravitz, Wong, and Becker (1998) argue that use of computers for classroom instruction by computer science and business education teachers is non-discretionary because they use computers disproportionately more than the discretionary computer-using teachers do.

In spite of such empirical evidence, most studies on computer technology use by K-12 public schools teachers often included non-discretionary computer using teachers (teachers trained to teach computer science in high school) in their study samples (Norris, Sullivan, Poirot, & Soloway, 2003). Research indicates that at least 19% of secondary school teachers nationwide have at least a minor in computer science (Ansell & Park, 2003). To conduct a study with a sample that does not include non-discretionary computer-using teachers would be more informative.

Since the focus of this study was to determine the extent of computer use for classroom instruction by discretionary computer-using high school teachers in Ohio, non-discretionary computer using teachers (e.g., business education teachers and computer technology teachers), were excluded from the sample. However, elimination of non-discretionary teachers from the sample reduces the ultimate sample size.
Inadmissible Surveys

Rejection of returned responses that are inadmissible because of missing data also reduces the ultimate sample size. For example, Norris et al. (2003) reported 1.7% while Wang (2002) found 5% of the returned responses were inadmissible. The inadmissible responses are the questionnaires filled out incorrectly or questionnaires with some of the required information missing. Inclusion of data from such responses for analysis may lead to inaccurate findings and, ultimately, wrong conclusions.

When the necessary empirical statistical coefficients are not present in the literature, Cohen (1988) recommend use of predetermined estimate values of effect size ($f^2 = .13$, power = .80, $\alpha = .05$) for estimating the sample size. These values were used using G*Power 2, a computer software. G*Power 2 is a high-precision statistical power analyses computer software (Erdfelder, Faul, & Buchner, 1998). The estimated sample size obtained was 364. Doubling this number to 728 would be sufficient to enable the researcher to split the sample into two halves, where one-half would be used to regression model construction and the other for cross-validation of the regression model obtained. Considering the factors discussed above, which could lower the ultimate sample size, the researcher planned to mail out 1,000 questionnaires and an expected return rate was about 30%.

Instrumentation

Development of the Instrument

In order to measure the extent to which high school teachers in the Ohio public school system use computers in their classroom teaching, the researcher developed a
survey questionnaire. Information from the literature review, focus group discussions (Appendix A), and items adapted from prior instruments (Appendix C) were used to develop the instrument.

The focus group discussion involved in-service teachers who are pursuing master’s degree and doctorate students in Instructional Technology in the college of education at Ohio University. Responses and comments from the focus group discussion led to themes that relate to the participants’ views and perceptions of computer technology use in the public schools. This information provided the foundation for the construction of the questionnaire and the operational definitions of the variables in the study.

The instrument comprised of three sections. Section 1, contained seven items (1-7) that gathered demographic data of the participants, number of students in the classrooms, number of computers in the classrooms and in the computer labs, as well as the number of computers connected to the Internet used for student learning.

Section 2, contains Likert scale items for measuring six of the variables in the study. Items 8-25, each has a four-point-Likert response scale, ranging from 1 = strongly disagree to 4 = strongly agree. These items measure four of the variables relating to the dispositions of the teachers towards computer use in education. Items 26-31 address the methods by which the teachers acquired their computer skills, level of computer competency, regular use of computers for classroom instruction, as well as the non-teaching uses of computers. The value of each variable is the mean score of all the items for that particular subscale or variable.
Section 3, contained two open-ended questions: One question asks teachers what factors they see as the main obstacles or hindrance to their regular or routine use of computers for classroom instruction. The second question asks teachers to name the software they use on a regular basis for their classroom instruction.

Measurement Issues

For research findings to be of value, the need for a reliable instrument cannot be stressed enough (Gay & Airasian, 2003). Consistence, validity, and reliability of the individual items and the instrument as a whole were determined using the data from the pilot study data. The validity, reliability, and precision of the instrument were determined using a two-prong approach, informal and formal (Gay & Airasian; Tuckman, 1999).

The informal approach utilized input from experts in the research and instructional technology fields in the College of Education at Ohio University. These experts examined the instrument and evaluated the wording of the items, content, structure, and the organization with respect to both the objectives and the study questions. The suggestions and comments from the experts were incorporated to improve the final version of the instrument was improved using comments and the instrument was pilot tested and the data collected analyzed. The data analyses mainly focused on reliability and the validity of the items and the instrument as a whole.

Pilot Study

When the study instrument was ready, the researcher contacted the principal of one high school in southeastern Ohio. The school principal wanted a written permission from the District Superintendent’s Office prior to conducting the study in the school. The
researcher contacted the Superintendent through a letter, seeking permission to conduct
the study in the public high schools in the district. Although it took several phone calls
and three visits to the district superintendent’s office, permission to conduct the study
was eventually granted.

The researcher was able to begin the pilot study soon after receiving the
permission because Ohio University’s Institutional Review Board (IRB) (see Appendix
D) had already approved the study. However, at the time, the schools were to close in two
weeks’ time for the end of the academic year. The researcher went to the high school and
informed the assistant principal that the district superintendent had granted permission for
conducting the study and the school principal gave approval for the study to be conducted
in the school. The following day, the researcher delivered the research packages to the
school.

The package consisted of 60 questionnaires and consent forms for all the teachers
in the school and a cover letter to the assistant principal. The researcher requested that the
school administration place the research packets into the mailboxes of all the teachers in
the school. The teachers returned their completed questionnaires and the signed consent
forms to the school secretary within one week (as stipulated in the instruction to the
participants) and the researcher collected the returned questionnaires. Before entering the
data into a computer, the questionnaires examined for any missing information. Table 3.1
shows the summary of the variables studied. Statistic Package for Social Studies (SPSS,
Version 14), was used for analyzing the data.
Table 3.1.

Data Dictionary of the Variables Investigated in the Study

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSTICR</td>
<td>Represents classroom student-to-instructional computer ratio, an independent or predictor variable.</td>
</tr>
<tr>
<td>LOCIS</td>
<td>Represents location of computers in the school—computer labs, media centers, and classrooms.</td>
</tr>
<tr>
<td>TEOCUICI</td>
<td>Represents the teachers’ extent or level of computer use for classroom instruction by teachers on a regular basis.</td>
</tr>
<tr>
<td>TALOCP</td>
<td>Represents teachers’ attained level of computer proficiency in knowing and using computers for classroom learning and instruction.</td>
</tr>
<tr>
<td>TCAT</td>
<td>Represents teachers’ attitude towards computer use in classroom instruction and learning.</td>
</tr>
<tr>
<td>TPCV</td>
<td>Represents teachers’ perceived value of computer use for classroom instruction.</td>
</tr>
<tr>
<td>TRTCH</td>
<td>Represents teachers’ resistance to change for using computers for classroom instruction and learning.</td>
</tr>
</tbody>
</table>

Inter-item correlation analyses were conducted for each of the four multi-item constructs to insure the reliability of the instrument. The outputs were then examined to ensure that the means obtained were within the range of the expected values (1-4), and that there were no abnormally large variances. The mean for each of the construct
variables was within the expected range of values. The correlation outputs revealed high inter-item correlations of .70 or higher for all the items except items LOCIS 1 to 4, TPCV 5, TCAT 4, TRTCH 1 and TRTCH 2. Although these items had corrected inter-item correlations below .7, only LOCIS 3 and 4 had correlations below .40. In this study, correlations of .40 or higher were considered high while those below .40 were considered moderate to low (Green & Salkind, 2003).

The high inter-item correlation and correlations between the variables indicate that the items measure the same thing. The overall reliability coefficient of the instrument or the Cronbach’s alpha obtained was .84. A high Cronbach’s alpha indicates that the set of the items analyzed measure a single unidirectional latent construct (Dennis, Hinkle, Wiersma, Stephen, & Jurs, 2003; Tabachnick & Fidell, 1993). Cronbach’s alpha is the appropriate measure to use because it is a suitable measure of reliability of Likert scale items (Gay & Airasian, 2003).

High inter-item correlations imply that Cronbach’s coefficient will also be high, and the converse is true. Arguably, if the inter-item correlations are high, then it is evident that the items are measuring the same underlying construct. High inter-item correlations and Cronbach’s alpha obtained in this pilot study suggest that the items measure a single unidirectional latent construct and that the instrument is reliable.

Besides reliability and validity analyses, piloting the instrument allowed the researcher to gauge the minimum average time a participant needs to complete the questionnaire. It also helped in determining any multicollinearity among the variables investigated in the study, as well as to estimate rate of return. Based on the results of the
pilot study, the average time for completing the questionnaire was about 10 to 15 minutes.

The rate of return for this pilot study was 18%. The low rate of return was most likely due to Athens City School District granting permission two weeks before the schools closed for the end of the 2006 academic year at which time teachers were busy preparing their students for exams before the schools closed for summer break. For this same reason, it was not possible for the researcher to follow up on the non-respondents because of the school closing. The pilot study provided useful information for improving the instrument. With the instrument ready, the next step was to develop a sampling plan.

_Sampling Frame_

After the pilot study, the sampling frame for the study was constructed. The Ohio Department of Education (ODE) does not maintain a database registry of all public school teachers in the state. If available, such a registry would have provided an ideal sampling frame for random selection of the participants. To overcome this problem, the researcher contacted ODE for information on the Ohio public school system. The ODE website and the Ohio Educational Directory (OED) for academic year 2005-2006, were the two sources recommended by the ODE official. The researcher procured a copy of the OED for the 2005-2006 fiscal years. The directory and ODE website (http://www.ode.state.oh.us) provided the necessary information needed for constructing the sampling frame. In Ohio, there are nine school districts categorized by eight socio economic, geographic location, and administrative indicators developed by the state (see Table 3.2).
Based on these state predetermined indicators, there are nine stratified clusters or categories of school districts in Ohio, numbered 0-8 as shown in Table 3.2. In addition to this classification, school districts in categories 0 and 8 have additional special characteristics. Category 0 consists of school districts that are extremely small and geographically isolated from the rest of the state, such as Kelly’s Island, and College Corner, school districts with a small and sparse population, very small student population, high poverty, and less educated adult population (Ohio Department of Education, 2005).
Table 3.2.

**Socioeconomic Indicators Used for Classifying Public Schools in Ohio**

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>% workforce- Admin/Professional (2000 census).</td>
</tr>
<tr>
<td>3.</td>
<td>% of adult population with college degree or more (2000 census).</td>
</tr>
<tr>
<td>5.</td>
<td>Total Average daily maintenance (ADM) FY2004 (EMIS).</td>
</tr>
<tr>
<td>7.</td>
<td>Agriculture assessed valuation as percentage of residential Agriculture (FY2004).</td>
</tr>
<tr>
<td>8.</td>
<td>Minority ADM as percentage of total ADM (FY2004 EMIS).</td>
</tr>
</tbody>
</table>

*Source:* Ohio Department of Education website (http://www.ode.state.oh.us).

*Note:* These Socioeconomic factors are state constructed and used for classifying and describing school districts in Ohio.

According to the information from the ODE website, North Bass Local School district does not yet have a high school. College Corner, Put-In-Bay, and Kelly’s Island school districts have a high school each but have a very small combined high school student population of only 73 students and 23 teachers total.
Table 3.3.

**Typology of School Districts in Ohio Public School Systems**

<table>
<thead>
<tr>
<th>Typological Code</th>
<th>Description of the district characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.</td>
<td>Kelly’s Island LSD, North Bass Island LSD, Middle Bass Island LSD, Put-in-Bay Island LSD, and College Corner school districts.</td>
</tr>
<tr>
<td>1.</td>
<td>Rural/Agricultural—high poverty, low median income</td>
</tr>
<tr>
<td>2.</td>
<td>Rural/Agricultural—small student population, low poverty, low to moderate median income.</td>
</tr>
<tr>
<td>3.</td>
<td>Rural/Small Town—moderate to high median income.</td>
</tr>
<tr>
<td>4.</td>
<td>Urban—low median income, high poverty.</td>
</tr>
<tr>
<td>5.</td>
<td>Major Urban—very high poverty.</td>
</tr>
<tr>
<td>7.</td>
<td>Urban/Suburban—very high median income, very low poverty</td>
</tr>
</tbody>
</table>

Source: Ohio Department of Education website: [http://www.ode.state.oh.us](http://www.ode.state.oh.us)

Category 8 comprised all Joint Vocational Schools Districts (JVSD). The goal of joint vocational schools is to prepare students for the workplace. Students study specific trades or vocations of their interest and, seek employment following graduation or successful completion of their training. Vocational schools differ from the traditional high schools, which offer general education and prepare students for college education. In
this study, traditional high school is an educational establishment that houses 9 to 12 academic grade levels, the 9th grade being the lowest level and 12th the highest level. Vocational or technical, probation and correctional schools, schools of performing art, community high schools, and academies were excluded from the sample because they too did not meet the definition in this study of a traditional or typical high school.

The sampling frames for this study were the ODE website and the OED. The ODE defines a high school as a facility that houses 6 to 12 grade levels, with 6th grade as the lowest level, and 12th grade as the highest level (OED, 2006). According to this definition, there are 1,312 public schools in Ohio classified as high schools (schools comprising 6th to 12th grades). However, for this study, a high school was defined as an educational establishment that houses 9 to 12 academic grade levels, the 9th grade being the lowest level and 12th the highest level. Based on this definition 566 schools were ultimately identified as possible participants in the study. These schools were then grouped by their typological categories (0-7) making a stratified sampling frame shown in Table 3.4.
Table 3.4.

*Stratified School Districts and Public High Schools in Ohio*

<table>
<thead>
<tr>
<th>Typological Categories</th>
<th>No. of School Districts</th>
<th>No. of Senior High Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>73</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>67</td>
<td>68</td>
</tr>
<tr>
<td>4</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>62</td>
</tr>
<tr>
<td>6</td>
<td>98</td>
<td>107</td>
</tr>
<tr>
<td>7</td>
<td>44</td>
<td>48</td>
</tr>
<tr>
<td>Total</td>
<td>501</td>
<td>566</td>
</tr>
</tbody>
</table>

**Sample Selection**

The process of sample selection for this study faced a number of challenges. First, direct random selection of participants from the selected high schools by the researcher was impossible. Second, the researcher was not in a position to predetermine the number of school principals who would allow their schools to participate in the study. Third, prior predetermination of the number of teachers who would be willing to complete and return the questionnaires was not possible. The schools were sorted alphabetically by
typological categories, school district, and from each category (except for category 0, which only has a single qualified high school), 10% of the high schools were randomly selected. The single school in category 0 was included in the sample. The final statewide randomly selected representative sample comprised of 59 high schools as shown in Table 3.5.

Table 3.5.

*Stratified Ten Percent of Randomly Selected Public High Schools*

<table>
<thead>
<tr>
<th>Typological Categories</th>
<th>Senior High Schools</th>
<th>Senior High Schools selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>75</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>120</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>68</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>62</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>107</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>48</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>566</strong></td>
<td><strong>59</strong></td>
</tr>
</tbody>
</table>
The main objective of the study was to determine the extent of teachers’ use of computers in classroom instruction in Ohio public schools and the factors that predict such use. The predictors were determined by a linear multiple regression analysis. The null hypothesis ($H_0$) states that there is no relationship between location of computers in the school (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer proficiency (TALOCP), teachers’ perceived value of computers in classroom instruction (TPCV), teachers’ attitudes towards computer use for classroom instruction (TCAT), teachers’ resistance to change (TRTCH), and extent of computer use for classroom instruction (TEOCUICI) in Ohio public high schools. As an equation, the hypothesis is expressed as:

$$H_0: \hat{Y}_{TEOCUICI} \neq b_1CSTICR \neq b_2TALOCP \neq b_3TPCV \neq b_4TCAT \neq b_5LOCIS \neq b_6TRTCH \neq 0.$$  

The alternative hypothesis ($H_A$) states that there is no relationship between location of computers in the school (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer proficiency (TALOCP), teachers’ perceived value of computers in classroom instruction (TPCV), teachers’ attitudes towards computer use for classroom instruction (TCAT), teachers’ resistance to change (TRTCH), and extent of computer use for classroom instruction (TEOCUICI) in Ohio public high schools. As an equation, the hypothesis is expressed as:

$$H_1: \hat{Y}_{TEOCUICI} = b_1CSTICR = b_2TALOCP = b_3TPCV = b_4TCAT = b_5LOCIS = b_6TRTCH = 0.$$
Summary

This chapter focused on the research methodology, detailing all the necessary approaches and steps needed to improve overall validity of the study findings. Because validity of the study depends on the design, sample size, sample selection, reliability, and validity of the instrument, these comprehensive aspects of the methodology are critical. Reliability and validity of the instrument were enhanced using formal and informal methods. The informal method involved incorporation of suggestions from experts in the field who agreed to review the instruments. The formal method entailed item reliability and multiple construct reliability analyses. Cross-validity power analysis methods are other safeguards embedded into the research methodology to improve reliability of the prediction model. Other safeguards included correct data entry and data analysis procedures, all in an effort to obtain reliable findings.
CHAPTER 4: DATA COLLECTION AND ANALYSES

Chapter Overview

This chapter describes the process of data collection, data processing, and empirical data analyses aimed at meeting the objectives of the study. The data analyses primarily focused on descriptive analyses of the study variables and the empirical statistical analyses. Methods of analyses utilized were selected based on the nature of the research questions. Specifically, descriptive analysis addressed the responses of the teachers to the open-ended question, while cross-tabulation and multiple regression statistical methods were used to address the other questions.

Purpose of the Study

The purpose of this study was to examine predictors of teachers’ extent of computer use in classroom instruction, primary factors teachers view as major barriers to their integration of computers into classroom instruction and learning, and to determine the extent to which teachers in Ohio public high schools use computers in classroom instruction. Many factors, including access to technology itself, influence a meaningful and sustained integration of computers into classroom instruction by teachers. As national spending on computer technology in United States’ public schools has increased substantially, estimated at $5.2 billion a year (Reeds, Roberts, Lunsford, Strassberg, Becker, Mann, & Shakeshaft, 2001), availability of computers and the Internet in the public schools has been on the rise. Access to computers in the public schools has improved dramatically as shown by the drop in the national average classroom student-to-high-speed instructional computers ratio from 6.6:1 in 2000 to 3.7:1 in 2006.
(Education Week: Technology Counts, 2007). In Ohio, the average ratio of classroom student-to-instructional computer connected to high-speed Internet improved from 10:1 in 2002 (eTech Ohio, 2003) to 3.4:1 in 2006 (Education Week: Technology Counts, 2007). As the availability of computers in the schools has increased, so has the interest in the extent and purpose for which the technology is used (Hogarty, Lang, & Kromrey, 2003). Information on teachers’ extent of computer use in classroom instruction Ohio public schools is lacking. This study, therefore, aims at contributing to the literature on the extent of computer technology use in classroom instruction in Ohio public school system.

There were three research questions considered in this study. First, to what extent do teachers in Ohio public high schools use computers in their classroom instruction on a regular basis? (Regular basis here is when teachers use computers at least three to four times a week or daily for classroom instruction). Second, does location of computers in schools (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), and teachers’ attitudes (TCAT) towards computer use in classroom instruction, teachers’ perceived value of computers in instruction (TPCV), and resistance to change (TRTCH), predict teachers’ extent of computer use in classroom instruction in Ohio public high schools? Third, what do teachers in Ohio public high schools consider the main obstacles to their use of computer technology in classroom instruction on a regular basis?
Data Collection Process

Permission to Enter the Research Field

Gaining access to the research field and winning the trust and cooperation of school administrators was critical in this study. Equally important was the method of communication to reach those in authority in the field—in this case, the school principals. Given the slow nature of conventional mail, and the poor response rate from school administrators, direct phone calls to school principals was the method the researcher chose to reach the principals of the selected schools, in order to ask for their permission to conduct the research in their schools.

The researcher began calling the school principals of the 59 randomly selected schools on April 28, 2007. The process of permission seeking lasted for three weeks. Each day, the phone calls were made systematically, following an alphabetical ordering of the 59 selected schools. To ensure that each school has a fair chance during the permission-seeking process, the same procedure was followed each time.

Whenever a principal answered the phone, the researcher introduced himself, then briefly explained the purpose of the study, and possible benefits of the study to the participating school, and then asked the principal for his or her permission to conduct the study in the school. Some principals were receptive and easily granted permission; others refused outright. Some wanted permission from their respective district superintendents before they could allow the study to be conducted in their schools. No permission was sought from any superintendent for those school principals who required it. The reason was based on the experience during the pilot study; obtaining such permission was a slow
and time-consuming process. In addition, time was of the essence as schools were due to close in June for the end of school year.

*Distribution of the Questionnaires*

At the end of each phone-calling day, the researcher prepared and mailed the research packages to those schools for which permission was granted. A research package to a school consisted of the letter to the school principal (Appendix E), and packets for all teachers in the high school. The number of research packets mailed to each school depended on the total number of teachers in the school. The letter contained instructions for the distribution of the questionnaires to mailboxes of all teachers in the school, and expressed thanks to the school administrators for their cooperation and participation in the study. The research packet to each teacher consisted of the questionnaire (Appendix B), consent form (Appendix G), and a stamped, addressed return envelope for sending the completed questionnaire back to the researcher.

A systematic coding method in which each questionnaire was given a unique code for easy identification and tracking purposes was used. The same code was placed on the return envelope, for the same purpose. The code consisted of a numerical number, which stands for the category to which the school was classified in the state, the school name (abbreviated), and a numerical count number of the questionnaire. For example, the code 2MTVERHS20, stands for a questionnaire sent to Mt. Vernon high school, a category 2 school, and the questionnaire was number 20. The questionnaires for each school were numbered from one to the last number, which depended on the reported total number of teachers currently teaching in the school.
Once a research package was mailed to a school the researcher e-mailed the school principal, thanking him or her for allowing the researcher to survey the teachers in his or her school, and informing the principal that the research package was already on the way. The procedure was applied to all the 18 schools for which permission was obtained.

The data collection process was a slow and tedious one, because most of the time, the principals were either out of the office or would not take the call at the time. When a principal was not in the office at the time of the phone call, the researcher sought to talk to the assistant principal. If the assistant principal were not available, the researcher would then leave a message in the principal’s voice mail. In addition, a follow-up e-mail, briefly outlining the purpose of the study, how the schools were selected, and the possible benefits of the study to participating schools were sent to the principals.

By the end of the permission-seeking process, at least three phone calls were made and at least two e-mails were sent to the principals of the schools from which permission was never obtained. Although the first phase of the data collection process (permission seeking) lasted three weeks, the data collection process lasted longer with the last research packages send out on May 28, 2007. Returned questionnaires continued to trickle in until the second week of June when the data collection process was ended. Generally, the process of data collection was accomplished in six weeks.

*Returned Questionnaires*

Out of the 59 randomly selected high schools, 18 agreed to participate in the study. No permission was obtained from any of the randomly selected high schools in
categories 0 and 5. The difficulty the researcher faced with the schools in these categories was that, for category 0, there was only one high school in the district, which could not be reached at the time due to bad phone line. There were more high schools in category 5 from which other set of high schools could have been selected, but there was no time left before the schools closed for the summer school break. The researcher had planned to mail out 1,000 questionnaires; a number that was obtained as described in Chapter 3. However, the 18 participating schools had 958 teachers to whom questionnaires were mailed. Of the 958 questionnaires mailed, 294 were returned as summarized in Table 4.1.
Table 4.1.

Randomly Selected Ohio Public High Schools and the Respondents

<table>
<thead>
<tr>
<th>Typological Category</th>
<th>No. of Schools Selected</th>
<th>No. of Schools Surveyed</th>
<th>No. of Surveys Sent</th>
<th>Surveys Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>3</td>
<td>99</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>4</td>
<td>169</td>
<td>71</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>2</td>
<td>94</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>3</td>
<td>157</td>
<td>48</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>4</td>
<td>304</td>
<td>105</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>2</td>
<td>135</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59</strong></td>
<td><strong>18</strong></td>
<td><strong>958</strong></td>
<td><strong>294</strong></td>
</tr>
</tbody>
</table>

*Note: Category 0 has only one high school, which could not be reached due to bad phone lines. Therefore, there were no other schools to choose from this category. For category 5, school principals of the selected schools did not grant permission and there was not enough time left to choose other schools because schools were closing for summer break.*
Data Processing

Data Screening

Data screening is an important process in a research of this kind because it helps in eliminating errors, which if not identified and rectified, may ruin otherwise good research. When the data collection process ended, the researcher began the data screening process. The researcher methodically examined each of the 294 returned questionnaires in order to find and eliminate any questionnaires that did not meet the criteria for this study. During the screening process, it was determined that 14 questionnaires were returned blank, and 24 others were completed and returned by non-discretionary teachers. Data from non-discretionary teachers were excluded from the analysis because the focus of the study was the use of computers in Ohio public high schools by discretionary from the analyses because the focus of this study was the use of computers in Ohio public high school computer-using teachers. Computer and business technology teachers have disproportionately more computers in their classrooms than their counterparts teaching the traditional subject, and their use of computers is non-discretionary (Norris, et al., 2003). The overall return rate for this study was 31%, but 4.5% of the questionnaires were unusable, giving an ultimate return rate of 27% for the final sample size of 256 valid questionnaires used in the analyses.

Data Coding

The screened records were then carefully coded using the unique systematic coding approach discussed earlier. Similarly, each record was carefully coded based on the structure of each item in the research questionnaire (Appendix B). Items 1-7 were not
Likert items, and some of these items have levels while others do not. For example, items 1, 3, 4, and 5 have levels while items 2, 6, and 7 do not.

Item 1 in the questionnaire referred to the highest level of education attained by a teacher. It was coded EDLEVEL with levels 1 = Bachelor’s degree, 2 = Masters degree, 3 = Masters + 30 years of service, and 4 = Doctorate degree. Item 2 referred to number of years in the teaching service, coded YRSERV. Item 3 referred to the grade level (s) the teacher taught during the academic year in which the study was conducted. It was coded GRDTGHT with levels 1 = grade 9, 2 = grade 10, 3 = grade 11, 4 = grade 12, and 5 = grades 9 -12. Item 4 addressed subjects a teacher taught during the academic year in which the study was conducted. It was coded SUBTGHT with levels 1 = English, 2 = mathematics, 3 = sciences, 4 = social studies, 5 = inclusion subject (all the four traditional subjects), 6 = industrial Arts—construction, wood and metal work, 7 = Art, 8 = agricultural science, 9 = physical education, 10 = music, 11 = French, 12 = Spanish, 13= Greek, 14 = German, 15 = special education, and 16 = guidance and counseling.

Item 5 refers to the gender of the participant, coded GENDER with 1 = male, and 2 = female. Item 6, coded as No_STUDS was about class size or number of students in the class, while item 7 refers to: (a) the number of computers in the classroom, (b) number of computers in the computer lab, and (c) number of computers in the classroom connected to the Internet, all of which were CLCOMPS, LABCOMPS, and COMWINT, respectively.

Items 8 to 25 are Likert scale items, all of which have metric response scales in which 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agree (A), and 4 = Strongly
Except for the eight items (12, 16, 17, 18, 19, 20, 21, and 22) that were negatively phrased, all the Likert items in the instrument are positively phrased. High scores of items represent high value on the underlying constructs, and low scores represent low values of the constructs being measured. Item 26 referred to methods of training through which teachers acquired their computer skills and the resulting computer proficiency. The methods used for CTPD, are workshops, seminars, and now online options, peer training, personal effort or self-training, and college training. The teachers were asked to state the extent to which each of the above methods prepared them to use computer technology in classroom instruction. Each method was coded at four levels and scored as follows: 1 = Not Prepared, 2 = Minimally prepared, 3 = Prepared, and 4 = Highly Prepared.

Item 27 taps into teachers’ self-perceptions of degree of preparedness to use computers in classroom instruction and asks participants to rate their perceived levels of computer readiness on a scale that was scored as follows: 1 = Not Prepared, 2 = Minimally Prepared, 3 = Prepared, and 4 = Highly Prepared. In item 28, each participant was asked to rank his or her ability or proficiency in using computers for classroom instruction. The response levels were scored as follows: 1 = Non-User, 2 = Novice, 3 = Intermediate, and 4 = Practitioner.

Items 29 to 32 assessed teachers’ extent of computer use for instructional and non-instructional uses of computers. These items were scored as follows: 1 = Never, 2 = One to Two times a Week, 3 = Three to Four times a Week, and 4 = Daily. In this study, using computers three four times per week or daily on regular basis was the level of
computer use that can have a positive impact on academic outcomes of the student. After coding, the data were entered into a data set file using Statistical Package for Social Sciences (SPSS, version 15.0). The unique coding approach used in this study effectively reduced data entry errors. Next, the data set file was printed, and each case or record was examined for missing data or mistyped values. After ascertaining that there were no errors in the data set, the data were ready for analyses.

Data Analyses

Preliminary Construct Analyses

The six variables hypothesized to be predictors of teachers’ extent of computer technology use in classroom instruction were: classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), teachers’ attitude toward computer use in classroom instruction (TCAT), teachers’ perceived computer value computing classroom instruction or learning (TPCV), resistance to change (TRTCH), and location of computers in the school (LOCIS). Four of the six variables (TCAT, TPCV, TRTCH, and LOCIS) are construct variables measured by 18 Likert scale items numbered 8 to 25 in the instrument or questionnaire (Appendix B). Individually, items 8 to 12 measured the construct TPCV; items 13 to 16 measured TCAT; items 17 to 21 measured TRTCH; and items 22 to 25 measured LOCIS construct.

Preliminary Item Reliability

Before conducting the item reliability analyses, the eight negatively phrased items (items 12, 16, 17, 18, 19, 20, 21, and 22) were first reverse-scored so that high values of these items represent high scores for the underlying constructs they measure. The 18
items were coded accordingly. For instance, the items for teachers’ perceived computer value for classroom instruction (TPCV) were coded as TPCV1, TPCV2, TPCV3, TPCV4, and TPCV5. The items TCAT1, TCAT2, TCAT3, and TCAT4 were for teachers’ attitude towards computer use in classroom instruction (TCAT). For teachers’ resistance to change (TRTCH), the items were coded as TRTCH1, TRTCH2, TRTCH3, TRTCH4, and TRTCH5, while for location of computers in the school (LOCIS), the items were coded as LOCIS1, LOCIS2, LOCIS3, and LOCIS4. As Leech, Barrett, and Morgan (2005), and Green and Salkind (2003) recommend, descriptive statistics, reliability estimates, and bivariate correlations were generated, then examined, for possible errors and any other data anomalies.

Internal consistency reliability analyses were conducted to examine the reliability of each item for a single construct. The results (Appendix H) showed moderate to high (.40 or above) corrected item-total correlations for the items measuring perceived computer value (TPCV), except for item TPCV1 which reads “computer use in classroom teaching equips students with the skills necessary to succeed in the information age” \((r = .337)\). This was surprising because the statement is pivotal in the push for transfer of computer skills perceived necessary for success in the information age. The coefficient of reliability or Cronbach’s alpha for this measure was .70.

For the variable teachers’ attitude towards computer use in classroom instruction (TCAT), two items had corrected item-total correlations greater than .40, but the other two had correlations less than .40. The two items with low corrected item-total correlations were TCAT1, which reads, “Schoolteachers should use computers in their
classroom instruction on a daily basis” ($r = .395$), while TCAT4 reads, “I am reluctant to use computers in classroom teaching because computers make my teaching job harder” ($r = .325$). However, the coefficient of reliability or Cronbach’s alpha obtained for this variable was .70.

For resistance to change, all the items in this variable had high item-total correlations of .5 or higher, except item TRTCH5, which reads, “when searching for new instructional materials and methods, I often look for the ones that require little change” ($r = .346$). Cronbach’s alpha for this variable was .75. Location of computers in the school (LOCIS) was the variable with the lowest overall Cronbach’s alpha (.429). Cronbach’s alpha for each construct are summarized in Table 4.2.

Table 4.2.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cronbach’s Alpha ($\alpha$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRTCH</td>
<td>.75</td>
</tr>
<tr>
<td>TCAT</td>
<td>.70</td>
</tr>
<tr>
<td>TPCV</td>
<td>.70</td>
</tr>
<tr>
<td>LOCIS</td>
<td>.43</td>
</tr>
</tbody>
</table>
Multiple Constructs Reliability Analysis

Multiple construct reliability analyses were conducted to determine the overall Cronbach’s alpha for assessing the unidirectional measure of teachers’ extent of computer use in classroom instruction (Appendix H). The goal of these analysis was to assess how well the items altogether measure the overall dimension—the extent of teachers’ use of computers in classroom instruction in Ohio public high schools. As shown in Appendix H, most of the items had moderate to high (≥ .40) corrected item-total correlations except for five items. The five items were TPCV1 (r = .331), TRTCH5 (r = .333), LOCIS1 (r = .119), LOCIS2 (r = .012), and LOCIS4 (r = .124).

Although these items had low correlations, each of the constructs had a high Cronbach’s alpha except for LOCIS, which had a coefficient alpha of .40 as shown in Table 4.2. In addition, the overall Cronbach’s alpha was .814, which is considered high. The high coefficient of reliability indicates that the measures in this questionnaire form a scale that has reasonable internal consistency reliability. The five items with less than .40 corrected item-total correlations were not deleted from the instrument for two reasons. First, deleting these items would only increase the overall value of coefficient alpha by 2%, which is a minimal increase. Second, the items had a good conceptual fit with the overall concept of the study. Because coefficient of reliability for each of the four construct measures, as well as the overall Cronbach’s alpha, were high, the items in the instrument were reliable and measure the underlying construct the items were designed to measure. Green and Salkind (2003) caution that when the same sample was used for computing
both the corrected item-total correlations and the coefficient alpha, the high Cronbach’s alpha may be an overestimate of the population coefficient alpha.

Convergent and Discriminant Validities

It was difficult to select items that were appropriate for the study based on the analysis of corrected item total correlation shown in Appendix H. Besides the low corrected item total correlations, the positive correlations between items and corrected item-total correlations measure both the relevant construct plus irrelevant factors shared by the other items (Green & Salkind, 2003; Leech, Barrett, & Morgan, 2005). Green and Salkind recommend convergent and discriminant validity analyses of the items that measure a construct. To resolve this dilemma, convergent and discriminant validities for all the items of each variable or construct were obtained by computing the correlations between its own items and the total score of that measure (Table 4.3). The results showed each item had high convergent validity, an indication that the items were good measure of each construct and ultimately the dependent variable.
Table 4.3.

Comparison of Construct Scales with Focal Items Removed (Bold Type)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Construct Item Statement</th>
<th>Teachers’ Perceived Computer Value (TPCV)</th>
<th>Construct Item Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TPCV</td>
<td>TCAT</td>
</tr>
<tr>
<td>TPCV1</td>
<td>Computer use in classroom teaching equips students with the skill necessary to succeed in the information age</td>
<td>.584</td>
<td>.272</td>
</tr>
<tr>
<td>TPCV2</td>
<td>My teaching practices are increasingly Dependent on my computer use in class learning</td>
<td>.730</td>
<td>.481</td>
</tr>
<tr>
<td>TPCV3</td>
<td>Using computers in classroom teaching allows me to teach my students in practical and creative ways</td>
<td>.704</td>
<td>.551</td>
</tr>
<tr>
<td>TPCV4</td>
<td>Knowing how to use computers in classroom teaching is a must-have skill for every teacher</td>
<td>.674</td>
<td>.417</td>
</tr>
<tr>
<td>TPCV5</td>
<td>Computer use in classroom learning Does not improve students’ academic achievements</td>
<td>.675</td>
<td>.478</td>
</tr>
</tbody>
</table>
Table 4.3 Continued

<table>
<thead>
<tr>
<th>Teachers’ Computer Attitude (TCAT)</th>
<th>TPCV</th>
<th>TCAT</th>
<th>TRTCH</th>
<th>LOCIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAT1 Schoolteachers should use computers in their classroom instruction on daily basis.</td>
<td>.453</td>
<td>.695</td>
<td>.334</td>
<td>.172</td>
</tr>
<tr>
<td>TCAT2 I enjoy using computers for teaching my Students</td>
<td>.537</td>
<td>.807</td>
<td>.410</td>
<td>.222</td>
</tr>
<tr>
<td>TCAT3 I like using computers in classroom teaching when they have the software I need.</td>
<td>.433</td>
<td>.714</td>
<td>.330</td>
<td>.294</td>
</tr>
<tr>
<td>TCAT4 I am reluctant to use computers in classroom teaching because computers make my teaching job harder</td>
<td>.401</td>
<td>.611</td>
<td>.605</td>
<td>-.017</td>
</tr>
</tbody>
</table>

Teachers’ Resistance to Change (TRTCH)

| TRTCH1 I do not use computers in classroom Teaching because they require too much of my time | .524 | .533 | .757 | .016 |
| TRTCH2 Using computers for classroom teaching forces teachers to abandon effective time-tested teaching methods | .340 | .356 | .692 | .065 |
| TRTCH3 I teach more effectively without using computers | .440 | .448 | .753 | .060 |
Table 4.3 Continued

<table>
<thead>
<tr>
<th>TRTCH4</th>
<th>I do not use computers in my classroom</th>
<th>TPCV</th>
<th>TCAT</th>
<th>TRTCH</th>
<th>LOCIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teaching because they are a distraction to my students</td>
<td>.444</td>
<td>.483</td>
<td>.760</td>
<td>.030</td>
</tr>
</tbody>
</table>

| TRTCH5 | When searching for new instructional materials and methods, I often look for the ones that require little change | .296 | .264 | .575  | .072  |

Location of Computers in the School (LOCIS)

| LOCIS1 | Location of computers in the school does not affect the extent to which I use computers for classroom instruction | .073 | .055 | .007  | .632  |
|        |                                                                                                                                  |
| LOCIS2 | I find computers located in a computer Lab less used than those located in the classroom | -.032 | .002 | -.076 | .566  |
|        |                                                                                                                                  |
| LOCIS3 | Having computers available in my classroom promotes my daily computer use for classroom teaching. | .381 | .423 | .314  | .524  |
|        |                                                                                                                                  |
| LOCIS4 | Lack of computers in my classroom impedes my level of computer use for teaching | .079 | .065 | -.065 | .702  |
The convergent and discriminant validities shown in Table 4.3 support the evidence that items of each variable or measure were more correlated with their own scales than with the scales of the other variables. High internal consistency reliabilities of the four variables suggest that the items or measures were consistent with each other (in measuring that variable) and that each measure was free from measurement errors (Leech, et al., 2005). However, there are relatively high discriminant correlations between some items: for instance the correlations between TRTCH1 and mean score of TPCV \( (r = .524) \), between TRTCH1 and mean score of TCAT \( (r = .533) \), between TCAT2 and mean score of TPCV \( (r = .537) \), between TPCV5 and mean score of TCAT \( (r = .551) \), and between TCAT4 and mean score of TRTCH \( (r = .605) \). These high correlations may be an indication of some multicollinearity among these variables.

Additional analyses for collinearity were conducted to investigate either any collinearity were conducted and discussed later in this chapter.

*The Construct Variables*

Reliability and convergent and discriminant analyses were conducted in an effort to determine whether the items and, subsequently, the construct variables were reliable measures of the independent variables. The individual items measuring each of the four constructs were summed up to obtain the value of that particular construct. The attained level of computer proficiency refers to teachers’ computer skills attained though various training methods—CTPD, peer training, self-training, and college training. These methods enable a teacher to acquire his or her current level of computer skills or attained level of computer proficiency (TALOCP). The magnitude of the variable TALOCP was
the mean score of the values respondents assigned to item 27. The variable classroom student-to-instructional computer ratio (CSTICR) is the quotient of number of computers in the classrooms for student use (item 7a) and the number of students in the classrooms (item 6). These research variables were selected based on the literature review to provide answers to the research questions. For the variable TEOCUICI, the value was computed as mean of the item 30.

**Statistical Analyses**

The main objective of this study was to determine the extent to which teachers in Ohio public high schools use computers in classroom instruction and learning on a regular basis. The analyses included descriptive and inferential statistical analyses of the data collected. The descriptive analysis involved demographics, years of experience, class size, grade level, and the subjects taught.

**Demographic Statistics and Educational Qualifications**

The sample size for this study was 256 teachers from 18 randomly selected public high schools in Ohio. Of the 256 participants, 41% were males, and 59% were females from rural and urban schools across the state. The respondents teach a wide range of academic subjects and possess a broad range of academic qualifications. Regarding level of education attained, 26% of the teachers hold bachelor’s degrees as the highest level of academic qualification, 73% of the participants hold masters degrees, and .4% hold doctorate degrees (Table 4.4). All the participants were certified teachers as required by Ohio law.
Table 4.4.

*Numbers and Percentages of Study Participants by Levels of Education*

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s Degree</td>
<td>67</td>
<td>26.2</td>
</tr>
<tr>
<td>Masters Degree</td>
<td>134</td>
<td>52.3</td>
</tr>
<tr>
<td>Masters Degree Plus 30</td>
<td>54</td>
<td>21.1</td>
</tr>
<tr>
<td>Doctoral Degree</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>256</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note. N = 256. All the teachers in this study are licensed teachers.*

*Years of Service*

Analysis of the years of teaching service reveals a wide variation in the longevity of teaching for teachers in Ohio public schools represented in the study sample. The period of teaching experience ranged from 1 to 37 years, with the mean of 16 years as presented in Table 4.5.
Table 4.5.

_Numbers and Percentages of Teachers by Years of Teaching_

<table>
<thead>
<tr>
<th>Period of Service</th>
<th>Number of Teachers</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5 years</td>
<td>46</td>
<td>18</td>
</tr>
<tr>
<td>6-10 years</td>
<td>49</td>
<td>19</td>
</tr>
<tr>
<td>11-15 years</td>
<td>51</td>
<td>20</td>
</tr>
<tr>
<td>16-20 years</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>&gt; 20 years</td>
<td>82</td>
<td>32</td>
</tr>
</tbody>
</table>

_Class Size_

The number of students in the classroom for this study varied greatly, ranging from 2 students in a special education class to 60 in an English class, and the mean class size was 21. Knowing the class size in this study was important because it was a key factor in the computation of the classroom student-to-instructional computer ratio.

_Grade Level and Subjects Taught_

The 256 teachers teach different levels in the high schools with the majority of the respondents (72%) teaching multiple grade levels (9-12), while 28% indicated they were teaching single-grade levels. The respondents teach a wide variety of subjects in Ohio public schools. As shown in Table 4.6, 68% of the teachers teach the traditional academic subjects, of which 19.1% teach English, 20.3% teach mathematics, 14.1% teach science,
while 14.8% teach social sciences. Interestingly, 2.7% of the teachers teach “Inclusion subject”—meaning they teach all the four traditional or core subjects.

The remaining 27% of the participants teach minor subjects comprising foreign languages, music, Agricultural sciences, arts, physical education, special education, and guidance and counseling. Specifically, 2% teach Industrial arts, 7.8% teach arts, .8% teach Agricultural sciences, 3.9% teach physical education (PE), and 3.9% teach music. As indicated in Table 4.6, seven percent of the teachers teach foreign languages where 2.3% teach French, 3.1%, teach Spanish, .8% teach Greek, .4% teach German, 2.3% teach Special education, and 2.7% teach Guidance and Counseling.
Table 4.6.

Number of Teachers and Subjects Taught in Ohio Public High Schools

<table>
<thead>
<tr>
<th>Subject</th>
<th>Number of Teachers</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>48</td>
<td>19.1</td>
</tr>
<tr>
<td>Mathematics</td>
<td>51</td>
<td>20.3</td>
</tr>
<tr>
<td>Sciences</td>
<td>33</td>
<td>14.1</td>
</tr>
<tr>
<td>Social Studies</td>
<td>38</td>
<td>14.8</td>
</tr>
<tr>
<td>Inclusion, All Subjects</td>
<td>4</td>
<td>2.7</td>
</tr>
<tr>
<td>Industrial Arts</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Art</td>
<td>20</td>
<td>7.8</td>
</tr>
<tr>
<td>Agriculture Science</td>
<td>2</td>
<td>.8</td>
</tr>
<tr>
<td>Physical Education</td>
<td>10</td>
<td>3.9</td>
</tr>
<tr>
<td>Music</td>
<td>7</td>
<td>2.7</td>
</tr>
<tr>
<td>French</td>
<td>6</td>
<td>2.3</td>
</tr>
<tr>
<td>Spanish</td>
<td>8</td>
<td>3.1</td>
</tr>
<tr>
<td>Greek</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>German</td>
<td>2</td>
<td>.8</td>
</tr>
<tr>
<td>Special Education</td>
<td>6</td>
<td>2.3</td>
</tr>
<tr>
<td>Guidance and Counseling</td>
<td>7</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>256</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>


Research Question 1

To What Extent do Teachers in Ohio Public High Schools Use Computers for Classroom Instruction?

A better understanding of teachers’ extent of computer technology use for classroom instruction is possible when availability of computers in the classrooms and teachers’ computer proficiency are factored into the analysis. The data used for the analysis were obtained from items 7a, 28, 29, and 30 in the questionnaire (Appendix B). Item 7a concerns the number of computers available in the classrooms for student use, while item 28 addressed teachers’ computer proficiency levels. Items 29 and 30 provided data for computer use in classroom instruction in general, and for teaching students specific academic skills, respectively.

Teachers’ computer proficiency was categorized into four levels—Non-Users, Novice, Intermediate, and Practitioner. The participants were asked to state their levels of computer proficiency, based on the statements and the definitions of each of the computer proficiency levels provided. A non-user is a teacher who has no computer skills or proficiency and does not use computers in classroom instruction. The statement to which the teacher agreed or disagreed read: “I am aware of the availability of computer technology in my school, but I do not use the technology for classroom instruction. I am still learning the basics.” Novice is a teacher who has some basic computer skills and uses computers in his or her classroom instruction to a limited extent—one or twice a week at most. The statement to which the teacher agreed or disagreed read: “I have some
basic computer skills and I use computers for classroom instruction once or twice a week at most.”

An intermediate computer user is a teacher who is competent, has acquired appropriate computer skills and uses computers for classroom instruction on a regular basis. The statement to which the participants agreed or disagreed stated, “I have gained some confidence in using computers for classroom instruction and for doing specific tasks to some extent, but I am not yet able to integrate computers fully into all phases of my classroom teaching at least three to four times a week.” Practitioner is a teacher who uses computers daily for his or her classroom instruction. The statement to which the teacher disagreed or agreed read: “I am confident to use computer technology fully in many applications for my classroom teaching. I even look out for new software to use for classroom teaching.” The responses of the participants are summarized in Table 4.7.

As shown in Table 4.7, about 83% of the teachers were proficient (24% practitioners versus 59% intermediate computer users) enough to use computer technology for classroom instruction effectively. Comparatively, 17% of the participants indicated that they were minimally proficient (3% were non-proficient and 14% were novice) computer users.
### Table 4.7. 

**Teachers’ Level of Computer Technology Proficiency**

<table>
<thead>
<tr>
<th>Proficiency</th>
<th>Number of Responses</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-proficient</td>
<td>8</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Novice</td>
<td>36</td>
<td>14.1</td>
<td>17.2</td>
</tr>
<tr>
<td>Intermediate</td>
<td>151</td>
<td>59.0</td>
<td>76.2</td>
</tr>
<tr>
<td>Practitioner</td>
<td>61</td>
<td>23.8</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>256</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

**Availability of Computers in Ohio Public High School Classrooms**

Seamless integration of computers into classroom curricula requires student access to adequate computers in the classrooms. To gauge the availability of computers in Ohio public high schools, the participants were asked to state the number of computers (item 7a) available for student use in their classrooms. As shown in Table 4.8, there is a scanty availability of computers in Ohio public high school classrooms. Fifteen percent of the participants had no computers in their classrooms at all, 47% had only one computer for the whole class to share. Moreover, 27% of the teachers had two to four computers in their classrooms while only a small fraction (12%) of the participants had five or more student computers in their classrooms. Overall, 61% of the teachers either
had no computers for student use in their classrooms or had only a single computer for the whole class to use for classroom learning.

Table 4.8.

*Student Access to Computers in Ohio Public High School Classrooms*

<table>
<thead>
<tr>
<th>Number of Classroom Computers</th>
<th>Valid Responses</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>38</td>
<td>14.8</td>
<td>14.8</td>
</tr>
<tr>
<td>1</td>
<td>119</td>
<td>46.5</td>
<td>61.3</td>
</tr>
<tr>
<td>2-4</td>
<td>68</td>
<td>26.6</td>
<td>87.9</td>
</tr>
<tr>
<td>5-10</td>
<td>15</td>
<td>5.9</td>
<td>93.8</td>
</tr>
<tr>
<td>&gt;10</td>
<td>16</td>
<td>6.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>256</td>
<td>100.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note: The valid percentages may not add up to 100 due to rounding.*

*Computer Use for Teaching Students Academic Skills*

Analysis of the data on computer technology use for classroom instruction showed that about 65% of the participants never or rarely used computers in their classroom instruction, while 35% used computers in their classroom instruction at least three to four times a week or daily (Table 4.9). Analysis of computer use for teaching students specific academic skills, also shown in the same table indicate that the vast
majority of the teachers (93%) never or rarely used computers for teaching their students analytic skills. Only 7% of the participants used computers for teaching their students the academic skills on a regular basis. Eighty-nine percent of the participants never or only occasionally used computers for teaching their students problem-solving skills, while 11% indicated that they used computers for teaching their students on a regular basis. For teaching students research skills, 82% of the teachers, compared with 18% never or rarely used computers for teaching their students research skills. On the average, 88% of teachers never or rarely used computers for teaching their students the academic skills, and only 12% of the teachers used computers for teaching their students the skills on a regular basis (Table 4.9).

Table 4.9.

*Teachers’ Computer Use for Teaching Students Academic Skills*

<table>
<thead>
<tr>
<th>Use</th>
<th>Frequency of Computer use for Classroom Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One or Two</td>
</tr>
<tr>
<td></td>
<td>Never (%)</td>
</tr>
<tr>
<td>General Instruction</td>
<td>17.6</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>52.7</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>45.3</td>
</tr>
<tr>
<td>Research</td>
<td>24.6</td>
</tr>
</tbody>
</table>

*Note: The valid percentages may not add up to 100 due to rounding.*
Analysis of Computer Proficiency and Computer use for Classroom Instruction

Cross-tabulation of teachers’ level of computer proficiency with the extent of computer use for classroom instruction showed that 29% of the proficient teachers used computers at least three to four times per week or daily on a regular basis, compared with 44% who never or rarely used computers for classroom instruction. About 3% of the novice or non-proficient teachers used computers three to four times a week or daily, while 21% never or rarely used computers for classroom instruction.

When teachers’ level of computer proficiency was cross-tabulated with teachers’ frequency of computer use for teaching students analytic skills, 7% of the proficient teachers used computers for teaching their students the analytic skills on a regular basis. Comparatively, 76% of the computer proficient teachers never or rarely used computers for teaching their students analytic skills. No computer novices and non-proficient teachers used computers for teaching the skills on regular basis. About 17% of these teachers never or rarely used computers for teaching students the analytic skills.

Cross-tabulation of teachers’ level of computer proficiency with frequency of computer use for teaching students research skills indicated that 17% of the computer proficient teachers used computers for teaching student research skills three to four times a week or daily. Over two-thirds (66%) of these teachers never or rarely used computers for teaching their students the skill. Of the total 17% of the novices and non-proficient teachers, 16% never or rarely used computers for teaching students the research skills, and only 1% of these teachers indicated using computers for teaching their students research skills three to four times a week or daily.
Cross-tabulations of teachers’ level of computer proficiency and frequency of computer use for teaching students problem-solving skills revealed that 10% of computer proficient teachers used computers for teaching their students problem-solving skills on a regular basis, compared with 73% who never or rarely used computers for teaching the skill. Conversely, all the 17% of the novices and non-proficient teachers never or rarely used computers for teaching the students the problem-solving skills. No novice or non-proficient teachers used computers for teaching the students this skill, three or more times a week.

As shown in Table 4.10, on the average, 71% of the proficient teachers never or rarely used computers for teaching their students the academic skills, compared with on the 12% who used computers three-to-four times a week or daily. Seventeen percent of the non-proficient and novice teachers never or rarely—using computers once or twice a week, for teaching students the academic skills.
<table>
<thead>
<tr>
<th>Proficiency Level</th>
<th>Computers Use for Classroom Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never (%)</td>
</tr>
<tr>
<td>Non-user</td>
<td>3 (%)</td>
</tr>
<tr>
<td>Novice</td>
<td>9 (%)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>24 (%)</td>
</tr>
<tr>
<td>Practitioner</td>
<td>5% (%)</td>
</tr>
<tr>
<td>Total</td>
<td>41 (%)</td>
</tr>
</tbody>
</table>

Note. Percentages may not add up to 100% due to rounding off.

**Analysis of Classroom Computer Access and Student Academic skills**

When teachers’ extent of computer use in classroom instruction was cross-tabulated with access to computers in the classrooms 12% of the teachers work in classrooms with five or more computers in their classrooms, but only 8% of these teachers used computers for classroom instruction at least three times a week on a regular basis (Table 4.11). Comparatively, 59% of the teachers worked in the classrooms with no computers or only had one computer for the whole class to share. About 44% of these teachers never or rarely used computers for classroom instruction. About 14% of the teachers who worked in classrooms with single computers reported using computers for...
classroom instruction at least three times on a regular basis, while 1% of the teachers who had no computers in their classrooms reported using computers for classroom instruction three to four times a week. Of the 26% of teachers who taught in classroom with two to four computes in the classroom, they were nearly split even between those who used computers on a regular basis (12%) and those who never or rarely used computers for classroom instruction (14%).

Table 4.11.

*Crosstabulation of Classroom Computer Access with Computer use for Instruction*

<table>
<thead>
<tr>
<th>Number of Classroom Computers</th>
<th>Frequency of computer use in classroom instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td></td>
<td>(%)</td>
</tr>
<tr>
<td>None</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2-4</td>
<td>2</td>
</tr>
<tr>
<td>5-10</td>
<td>0</td>
</tr>
<tr>
<td>&gt;10</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
</tr>
</tbody>
</table>

*Note.* Percentages may not add up to 100% due to rounding off.
When teachers’ extent of computer use for teaching students problem-solving skills was cross-tabulated with classroom computer access, 12% of the teachers taught in classrooms with five or more computers but only 3% of them used computers at least three to four times a week or daily on a regular basis. Sixty-one percent of the teachers worked in classrooms with one or no computer for students use. Fifty-seven percent of these teachers never or rarely used computers for teaching their students the academics skill compared with the 4% who used computer on a regular basis.

Although crosstabulation analysis of teachers’ extent of computer use for teaching students research skills and the access to computers in the classrooms revealed that 12% of the teachers taught in classrooms with five or more computers, only about 4% of these teachers used computers for teaching their students research skills on a regular basis. Comparatively, of the 61% of the teachers taught in classroom with no or only a single computer for the whole class, 56% never or hardly used computers for teaching their students research skills, and only 5% used computers for this purpose on a regular basis. About 27% of the teachers worked in classrooms with an average of two to four computers for student use, but only 9% teach students research skills three to four times a week or daily.

Cross-tabulation of computer use for teaching students analytic skills with access to computers in the classroom showed that 12% of the teachers worked in the classrooms with five or more computers, but only 3% used computers for teaching students analytics skills three to four times a week or daily on a regular basis. Out of the 61% teachers with no computers or had a single computer in their classrooms, only 3% used computers for
teaching their students analytic skills at least three times a week compared with the 59% who never or rarely used the computers for teaching their students. Only 2% out of the 27% teachers who had an average of two to four computers in their classrooms used computers at least three times a week for teaching their students analytic skills.

*Overall Computer use for Classroom Instruction with respect to Computers Access*

Table 4.12 summarizes the averages of computer use for teaching students the academic skills in relation to availability of computers in the classrooms. On average, 15% of the teachers work in the classrooms with no access to the technology, 7% of whom indicated using computers only once or twice a week, and the rest never used computers for teaching their students the academic skills. About 47% of the teachers work in classrooms with only a single computer for classroom learning. Twenty-three percent of these teachers never used computers for teaching their students, 20% only used the technology occasionally, while only 4% used computers at least three times per week. Of the 26% of the teachers working in classrooms with an average of two to four computers in the classrooms, only 4% used computers for classroom learning at least three to four times a week or daily, 7% never use computers at all, and 15% use the computers occasionally. About 13% of the teachers work in classrooms with moderate computer access (classrooms with averages of five to ten or more computers). Three percent of these teachers never used computers for classroom learning, 6% used computers occasionally (one to two times per week), and 4% used the computers three to four times a week or daily. These results show that majority of the teachers work in
classrooms with no computers or lack of access to the computers greatly influences teachers’ level of computer use for teaching students the academic skills.

Table 4.12.

*Crosstabulation of Classroom Computer Access with Computer use for Learning*

*Academic Skills*

<table>
<thead>
<tr>
<th>No. of Classroom Computers (%)</th>
<th>Frequency of Computer use in Classroom Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>None</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>2-4</td>
<td>7</td>
</tr>
<tr>
<td>5-10</td>
<td>3</td>
</tr>
<tr>
<td>&gt;10</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
</tr>
</tbody>
</table>

Note. Percentages do not add up to 100 due to rounding off numbers

*Analysis of Interaction between Computer Proficiency and Access to Computers*

The analysis of extent of computer use for classroom instruction may be incomplete without factoring in the interactive effect of teachers’ computer proficiency and availability of computers in the classrooms. To evaluate this interactive effect, these
two factors were crosstabulated and the results summarized in Table 4.13. About 83% of
the participants were computer proficient teachers (59% intermediate and 24%
practitioners) compared with 17% who were not proficient (4% non-users and 14%
ovices). Only 12 percent of the proficient teachers taught in classroom moderate
computer access (averages five to ten or more computers), compared with 47% who
taught in classroom with a single computer or no computer for class use, while 23%
taught in classrooms with an average of 2-4 computers for student use. Nearly all the
novice and non-proficient teachers (14%) taught in classrooms with no or had only one
computer for classroom learning, and 3% taught in classrooms averaging two to four
computers each. No novice and non-proficient teachers taught in classrooms with five to
ten or more computers. These results show that both compute proficiency and access to
adequate computers in the classrooms determine the extent to which teachers use
computer technology in classroom learning. Moreover, access to adequate computers in
the classrooms in particular, is a major limiting factor to teachers’ extent of computers in
classroom instruction.
Table 4.13.

*Crosstabulation of Access to Classroom Computers with Teachers’ Computer Technology Proficiency Level*

<table>
<thead>
<tr>
<th>Number of Classroom Computers</th>
<th>Proficiency Level of Computer Use in Classroom Instruction</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-users (%)</td>
<td>Novices (%)</td>
<td>Intermediate (%)</td>
<td>Practitioner (%)</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>9</td>
<td>28</td>
<td>9</td>
</tr>
<tr>
<td>2-4</td>
<td>1</td>
<td>2</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>5-10</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>&gt;10</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>14</td>
<td>59</td>
<td>24</td>
</tr>
</tbody>
</table>

Note. Total percentages may not add up to 100% due to rounding off numbers.
Research Question 2

Does location of computers in schools (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), teachers’ attitude towards computer use in classroom instruction (TCAT), teachers’ perceived value of computers in instruction (TPCV, and resistance to change (TRTCH) predict use of computer in classroom instruction (TEOCUICI) by Ohio public high school teachers?

Multiple regressions were conducted to examine predictors of teachers’ extent of computer technology use in Ohio public high schools, using the simultaneous or enter method and the results are shown in Table 4.14. All the six independent variables in combination significantly predicted teachers’ extent of computer use in classroom instruction where $R = .652$, $R^2 = .425$, Adjusted $R^2 = .411$, $F (6, 249) = 30.638$, $p < .001$. Classroom student-to-instructional computer ratio, teachers’ attained level of computer proficiency, teachers’ perceived value of computers in education, and teachers’ attitudes toward computer use in classroom instruction significantly predict teachers’ extent of computer use in classroom instruction. As shown in Table 4.14, teachers’ resistance to change (TRTCH) and location of computers in the schools (LOCIS) were not significant predictors of the extent of teachers’ use of computers for classroom instruction (TEOCUICI).

Although the sample coefficient alpha ($R^2$) was high, it was not used for explaining the variance because the $R^2$ often overestimates the coefficient alpha of the population (Green & Salkind, 2003). In this study, Adjusted $R^2$ was reported instead of
As indicated in Table 4.14, the Adjusted $R^2 = .411$, meaning that 41% of the variance of the extent of teachers’ use of computers in classroom instruction was explained by the regression model. According to Cohen (1988), 41% is a large effect size.

Table 4.14.

Regression Statistics for the Predictors and the Criterion Variables

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>95% Confidence Interval for B</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficients</td>
<td>SE</td>
<td>Beta</td>
<td>t</td>
</tr>
<tr>
<td>Model 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-1.334</td>
<td>1.327</td>
<td>-1.024</td>
<td>.307</td>
</tr>
<tr>
<td>CSTICR</td>
<td>3.888</td>
<td>.610</td>
<td>.314</td>
<td>5.492</td>
</tr>
<tr>
<td>TALOCP</td>
<td>.677</td>
<td>.145</td>
<td>.267</td>
<td>4.424</td>
</tr>
<tr>
<td>TPCV</td>
<td>.246</td>
<td>.086</td>
<td>.195</td>
<td>2.803</td>
</tr>
<tr>
<td>TCAT</td>
<td>.302</td>
<td>.118</td>
<td>.177</td>
<td>2.454</td>
</tr>
<tr>
<td>TRTCH</td>
<td>-.003</td>
<td>.090</td>
<td>-.002</td>
<td>.209</td>
</tr>
<tr>
<td>LOCIS</td>
<td>-.088</td>
<td>.075</td>
<td>-.059</td>
<td>-1.212</td>
</tr>
</tbody>
</table>

R = .652, $R^2 = .425$, $\text{Adj.}R^2 = .411$, SE = 2.456.
The regression model constructed was:

\[ \hat{Y}_{TEOCUICI} = 4CSTICR + .7TAOCP + .3TCAT + .3TPCV - 1.3. \]

The coefficients shown in the linear regression equation suggest that classroom student-to-instructional computer ratio contributes most to the prediction of teachers’ extent of computer use for classroom instruction, followed by teachers’ attained level of computer proficiency (computer skills), teachers’ perceived computer value in education, and teachers’ computer attitude respectively. Like any other regression model, the reliability and generalizability of this regression model depends on the fulfillment of certain specified conditions. The conditions include, tenability of the prescribed regression assumption, absence of collinearity, and the values of descriptive statistics are within the expected range.

**Multicollinearity Diagnostics**

The magnitudes of the means and the standard deviations were within the range of the expected values. The results in Tables 4.3 and 4.15 revealed high intercorrelations between some of the predictor variables. The variables with high correlations were TPCV versus TCAT \((r = .65)\), TPCV versus TRTCH \((r = .58)\), and TCAT versus TRTCH \((r = .59)\). Such high correlations may be an indication that the predictability of the regression equation might be vulnerable to multicollinearity. According to Stevens (1999), multicollinearity is problematic for three reasons. (1) It severely masks the size of Cronbach’s alpha because the predictors compete for the same variance of the criterion,
(2) it makes determination of the importance of a given predictor difficult because of the compounding correlations, and (3) it increases the variances of the regression coefficients and the higher variances undermine the regression equation.

Table 4.15.

**Correlations and Descriptive Statistics of the Variables**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEOCUICI</td>
<td>41**</td>
<td>.49**</td>
<td>.45**</td>
<td>.444**</td>
<td>.38**</td>
<td>.01</td>
<td>9.63</td>
<td>3.2</td>
</tr>
<tr>
<td>1. CSTICR</td>
<td>-</td>
<td>.20**</td>
<td>.13*</td>
<td>.10</td>
<td>.15*</td>
<td>-.04</td>
<td>.148</td>
<td>.26</td>
</tr>
<tr>
<td>2. TALOCP</td>
<td>-</td>
<td>.44**</td>
<td>.44**</td>
<td>.47**</td>
<td>.002</td>
<td>5.98</td>
<td>5.98</td>
<td>1.26</td>
</tr>
<tr>
<td>3. TPCV</td>
<td>-</td>
<td>.65**</td>
<td>.58**</td>
<td>.20**</td>
<td>15.29</td>
<td>2.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. TCAT</td>
<td>-</td>
<td>.59**</td>
<td>.22**</td>
<td>11.81</td>
<td>1.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. TRTCH</td>
<td>-</td>
<td>.07</td>
<td>15.45</td>
<td>2.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. LOCIS</td>
<td>-</td>
<td></td>
<td>10.90</td>
<td>2.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $\rho < .05$; **$\rho < .001$  

TEOCUICI: Teachers’ extent of computer use in classroom instruction; CSTICR: Classroom student-to-instructional computer ratio; TALOCP: Teachers’ attained level of computer proficiency; TPCV: Teachers’ perceived computer value; TCAT: Teachers’ computer attitude; TRTCH: Teachers’ resistance to change; and LOCIS: Location of computers in the school.
Multicollinearity also masks the regression coefficient ($R$) to the extent that the potential value of $R$ would be unattainable and, subsequently, the predictive power of the regression model would be diminished greatly. Green and Salkind (2003), and Stevens (1999) recommend examinations of the simple correlations among the predictors in the correlation matrix, and the variance inflation factor (VIF). Stevens defined VIF as $(1/(1-R^2))$ which indicates any strong linear association between a predictor and all the other remaining variables. Examination of the correlations among predictors is limited because it does not tell for certain, the presence of or the existence of multicollinearity in the regression analysis. For the VIF, these researchers and research literature in general do not provide the baseline or benchmark magnitude of VIF, below or above which a researcher should be concerned.

Leech, et al. (2005) recommend ordering multicollinearity diagnostics to obtain tolerance value $(1-R^2)$ for assessing the condition of multicollinearity in the analysis. Because Adjusted $R^2$ was used in explaining the overall variance in the multiple regression equation in this study, the tolerance value for this study was defined as $(1-$ Adjusted $R^2$), where Adjusted $R^2 = .41$. Therefore, the tolerance value obtained was ($r_{nv} = 1-.41 = .59$). The variables with high correlations were TPCV versus TCAT ($r = .65$), TPCV versus TRTCH ($r = .58$), and TCAT versus TRTCH ($r = .59$). By comparing all the three high intervariable correlations with the regression analysis’ baseline tolerance value of ($r_{nv} = .59$), only the correlation for TPCV versus TCAT ($r = .65$) was above the benchmark tolerance value. This suggests that only the correlation between TPCV and TCAT could be problematic, while those for the other variables did not indicate any
collinearity. Tabachnick (1989) stated that unless the suspect correlations were equal to
or higher than the tolerance value of .70, multicollinearity should not be a concern
because the correlations obtained were less than the tolerance value of .70.

Regression Analysis with Highly Correlated Items Removed

Inter-item analysis revealed that items TRTCH1, TRTCH4, TCAT4, TPCV3, and
TCAT2 had high correlations. Specifically, the correlation between TRTCH1 and
TCAT4 was .658, between TRTCH4 and TCAT4 was .531, while the one between
TPCV3 and TCAT2 was .527. The highly correlated items mentioned here were removed
and the modified variables were renamed TCATB, TRTCHB, and TPCVB, respectively.
These high correlations among items may mask the overall multiple correlation
coefficient. Similar results were obtained when the multiple regression analysis was done
with the correlated items removed (Table 4.16).

The linear combination of the six revised predictors was significant with $R = .655$,
$R^2 = .429$, Adjusted $R^2 = .416$, $F (6, 249) = 31.224$, $p = .001$. Based on these results,
about 42% of the variance of teachers’ extent of computer use for classroom instruction
was explained by the regression equation. As in the previous analyses, LOCIS and
TRTCHB were not significant predictors of the criterion, TEOCUICI. The linear
regression model obtained was:

$$\hat{Y}_{TEOCUICI} = 3.8CSTICR + .75TALOCP + .44TPCVB + .43TCATB - .89$$
Table 4.16.

Regression of Data with Highly Correlated Items Removed

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Coefficients</th>
<th>Standardized Coefficients</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized</td>
<td>Standardized</td>
<td></td>
</tr>
<tr>
<td>Constant)</td>
<td>-0.887</td>
<td>1.315</td>
<td>.690</td>
</tr>
<tr>
<td>CSTICR</td>
<td>3.808</td>
<td>.609</td>
<td>.312</td>
</tr>
<tr>
<td>TALOCP</td>
<td>.748</td>
<td>.141</td>
<td>.296</td>
</tr>
<tr>
<td>TPCVB</td>
<td>.440</td>
<td>.109</td>
<td>.235</td>
</tr>
<tr>
<td>TCATB</td>
<td>.426</td>
<td>.172</td>
<td>.143</td>
</tr>
<tr>
<td>TRTCHB</td>
<td>.009</td>
<td>.100</td>
<td>.005</td>
</tr>
<tr>
<td>LOCIS</td>
<td>-.092</td>
<td>.075</td>
<td>-.062</td>
</tr>
</tbody>
</table>

$R = 655, R^2 = .429, \text{Adjusted } R^2 = .416, \ F(6, 249) = 31.224, p = .001.$

Comparing the two regressions results, the difference between the two values of Adjusted $R^2$ ($\text{Adjusted } R^2$ with the correlated items included minus the value of Adjusted $R^2$ obtained from a regression with correlated items removed, = .42-.41 = .01) was very small. This suggests that multicollinearity was not a problem in this study.

Assumptions of Regression Model

In a linear multiple regression analysis, the power and generalization of the prediction model or equation also depends on fulfillment of the assumptions of the linear
regression analysis. The regression assumptions state that the variables are independent of each other, are normally distributed in the population with homogeneous variances, and are linearly correlated with the criterion and are not highly correlated with each other (Stevens, 1999). Unless these assumptions were met, a regression equation would not be of any value or use. For this reason, assessment of the tenability of these assumptions in this study was very important. The assessment was achieved by generating, then examining histograms, scatterplot, and residuals of the regression variables. Leech, et al. (2005), Green and Salkind (2003), and Stevens, (1999), state that assumptions of linear regression analysis are tenable when the residuals scatter randomly around the line with the mean value of zero in the scatterplot matrix of the residual analysis.

A scatterplot matrix of the standardized regression residuals (Y-Ŷ) versus the standardized predicted residual (Ŷ) was generated and the results shown in Appendix I. The results show the dots do not form a pattern, which would have been an indication that residuals were not normally distributed, or that they were correlated with the independent variables, and the variances of the residuals were not constant. Under such circumstances, the assumptions would have been violated and the prediction model would be useless. Because the dots scattered randomly around line with the mean value of zero, this indicated that the data for this study meet the assumption of the errors being independent of each other and are normally distributed with constant variance (Leech, et al., 2005; Green & Salkind, 2003; Stevens, 1999).

Tenability of the liner relationship assumptions between the criterion and the six independent variables was assessed by generating a scatterplot of the criterion,
TEOCUICI(Y) versus regression standardized predictor value (Ŷ) as shown in Appendix J. The results indicated that the predictor variables in this study were linearly correlated with the criterion. Normal distribution of the criterion in the population was assessed by plotting frequency of the criterion versus residuals, and the results are shown in Appendix K. Similar results were obtained for each of the six independent variables, which indicated that the variables were normally distributed in the population. Analyses of the data has shown that the assumptions of linear regression analysis tenable in this study. The results further suggest normal distribution of the variables in the population of study. Tenability of these assumption means the predictors and the criterion are linearly correlated and the variables are independent of each other and homogeneous in the population.

*Analysis of Regression Outliers*

Regression equation minimizes the variance of the residual (squared errors or residuals) but not every residual of each case falls on or close to the equation line; some of those farthest from such line could be outliers. For example, the cases numbered in Appendix I and Appendix J could be potential outliers and could adversely affect the regression equation or model. To determine if any of the points farther away from the equation line were potential outliers, a casewise diagnostics analysis of the residual was conducted. The findings indicated that case number 190 was the only one that was most likely an outlier. However, close examination of the data for this case revealed no data entry errors or any unusual magnitude of the various values; therefore, the case was not deleted.
Validation of Regression Model

A regression equation is useful when applied to an independent sample population, and its predictive power does not shrink drastically (cross-validity). If the shrinkage is large, then it means the equation does not predict well on other samples. As a result, its usefulness is limited; therefore, it does not meet the purpose for which it was developed. Because there was no additional data set available to assess shrinkage or cross-validity of the regression equation obtained for this study, Stein’s formula (Stevens, 1999), was used to cross-validate the multiple regression equation.

Adjusted $R^2$ obtained in this study was because it gives better estimate of the multiple regression coefficient of the population than the $R^2$ usually reported in most regression studies. The $R^2$ often over estimates the multiple regression coefficient of the study population (Stevens 1999). Stein’s formula was chosen instead of simply reporting the Adjusted $R^2$ because Stein’s formula is the most stringent approach for validating the strength of the multiple regression model (cross-validity) compared with Wherry’s formula used for computing the Adjusted $R^2$ (Stevens ). Using Stein’s formula, Adjusted $R^2$ was used in the cross-validation, to show the reliability of the regression equation derived in this study. The Stein’s formula is:

$$\rho_c^2 = [1 - \{(n-1)/(n-k-1)\} \{(n-2)/(n-k-2)\} \{(n+1)/(n)\} (1 - R^2)].$$
Where \( n \) is the sample size = 256, \( k \) is the number of predictors = 6, and \( \rho_{cs}^2 \) is the cross-validity or multiple correlation coefficient of the population sample, where \( R = .652, \ R^2 = .425 \) and \( Adjusted R^2 = .411 \).

(i) When \( R^2 = .425 \):

\[
\rho_{cs1}^2 = 1 - \{(255/249) (254/248) (257/256) (1-.425)\} = .3969.
\]

Therefore, \( \rho_{cs1}^2 \approx .40 \)

The margin of error between the \( R^2 \) obtained using Stein’s formula and the Adjusted \( R^2 \) reported by SPSS was .01, or one percentage point—a very small shrinkage. It suggests that if \( R^2 \) were reported instead of the Adjusted \( R^2 \), the population variance of extent of computer use in classroom instruction in Ohio public high schools would have overestimated by only 1%. Because the shrinkage between the Adjusted \( R^2 \) and the \( R^2 \) obtained using Stein’s formula is small, this suggests that the regression model is reliable and has good generalizability in similar populations.
Research Question 3

What do you consider the main obstacles to your daily use of computers for classroom instruction?

This question was presented to the teachers in order to know from teachers’ points of view the major obstacles teachers confront in their use of computer technology for classroom learning on a regular basis. The question aimed at getting an insight into what obstacles teachers in Ohio public high schools encounter in their endeavor to integrate computer technology into classroom learning. Knowing the factors teachers themselves see as the major obstacles to their daily use of computers in classroom learning is very critical in the integration of computer technology into school curricula, because it helps in strategic planning of training and CTPD. The responses to the question were categorized and summarized in Table 4.17.

The summary in Table 4.17 shows six factors cited by teachers as main obstacles to their use of computers for classroom instruction and learning, but when examined closely, only three can be considered major obstacles. In total, the participants mentioned seven obstacles: include lack of computers in the classrooms, lack of time, classroom student-to-computer ratio, age of computers, location of computers in the schools, computer downtime, and lack of training/computer skills. Lack of computers in the classrooms and inadequate computers in the classroom or classroom student-to-instructional computers ratio mean the same thing. Based on the analysis of the comments of the participants, age of the computers, computer downtime, and lack of training were not major problems to the majority of the teachers in the state. In addition,
the comments of the participants on the factors suggest that the factors are not mutually exclusive.

Table 4.17.

*Barriers to Classroom Integration of Computers in Ohio Public High Schools*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of computers in the classroom</td>
<td>179</td>
<td>69.1</td>
</tr>
<tr>
<td>Lack of time</td>
<td>24</td>
<td>10.2</td>
</tr>
<tr>
<td>Location of computers in the school</td>
<td>22</td>
<td>9.6</td>
</tr>
<tr>
<td>Age of computers</td>
<td>15</td>
<td>6.5</td>
</tr>
<tr>
<td>Computer downtime</td>
<td>7</td>
<td>3.1</td>
</tr>
<tr>
<td>Lack of training for computer skills</td>
<td>3</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>230</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Lack of Computers in the Classroom*

As the results show, nearly 7 out of 10 or 179 respondents, cited lack of computers or inadequate computers in their classrooms as the major obstacle to their integration of computers into their school curricula. One participant stressed that:

*Availability of adequate computers for all students to use in the classroom when needed is important. I only have two computers in my classroom, but there are twenty computers in the computer lab to which I have no access when I need to use them. This respondent has stressed two important issues: lack of adequate computers in the classrooms and*
location of the computers in the computer labs and their accessibility to teachers and their students.

Another respondent, an art teacher, commented, “Too few computers in the classrooms and none of the software for art, such as Photoshop and Freehand, are available in the computer lab.” Once again, these respondents see high classroom student-to-computer ratio and lack of adequate computers or appropriate software as major obstacles to their routine integration of computer technology in classroom learning. Yet another teacher, who indicated she had five computers in her classroom (she must be one of the lucky few), wrote, “There are not enough computers in my classroom.” The emphasis on lack of computers in the classrooms for students to use during classroom learning stresses the importance of having sufficient access to computers in the classrooms as opposed to computers in computer labs.

Access to computers in the classrooms is expressed as classroom student-to-computer ratio. About 20 respondents indicated that classroom student-to-instruction computer ratio was a major obstacle to their greater use of computers in classroom instruction to a large extent. Several respondents wrote, “There are not enough computers in the classrooms for students to use,” another added, “I only have one computer in my classroom.” Availability of adequate computers in the classrooms is a critical factor for widespread integration of computer technology into school curricula. Yet the findings of this study suggest that availability of computers in Ohio public school classrooms is scanty at best, where only 12% of the teachers had an average of five to ten or more computers in their classrooms compared with 62% who worked in classrooms with only
one computer or no computer at all for classroom learning. In addition, about 70% of the participants cited lack of computers in their classrooms as a major obstacle to their regular use of computers in their classroom instruction.

*Location of Computers in the School*

The importance of location of computers in the school as a limiting factor to teachers’ use of computers in classroom learning was highlighted by 22 respondents besides those who mentioned it along with lack of computers in the classrooms. These comments specifically highlight the importance of computers in the classrooms as opposed to location of computers in the computer lab. A math teacher in this study underscored the importance of location of computers in the classroom by commenting. “We are fortunate to have a dedicated math computer lab, but sharing it with eight other teachers, limits the use of the computers.” Yet another respondent wrote, “I have only one computer in my classroom. The labs are always full and it is difficult to get on the schedule.” The respondents have expressed how location of computers in computer labs limits their use of those computers for instruction and learning due to inaccessibility of computer labs. Nearly all participants stated that they have computer labs in their schools and are adequate computers as shown by the 1:1 student computer ratio. However, their emphasis on lack of computers in the classrooms in spite of the availability of adequate computers in computer labs, under scores the importance of location of computers in the school. Here the location of computers in the classrooms is critical, as this respondent has clearly explained. “More computers in the classrooms are needed for subject areas—foreign languages, art and history.”


*Lack of Time*

According to the responses of the participants, lack of time was the second most mentioned barriers to teachers’ use of computers for classroom learning. Twenty-four participants or 10% cited lack of time was a major obstacle to their regular use of computers in classroom instruction. However, teachers’ views on lack of time are varied. For example one teacher wrote “Lack of preparation time to get exposed to new software applications,” while another stated “Lack of time for in-service training.” A psychology teacher wrote “Lack of time to get knowledge of what is available in the technology market.”

Lack of time because of short class periods was commonly cited as one teacher wrote, “I would love to do more computer based assignments, but there is no enough time.” Another participant stated “Not enough time to prepare lesson plans.” Yet another adds “Lack of time to plan and prepare to keep current with technology use in the classroom.” Furthermore, one participant commented, “I need time to improve my computer skills as a teacher.” As demonstrated by the various comments about the effects of lack of time on teachers’ use of computers for classroom instruction, time is a multifaceted or a complex factor affecting teachers’ use of computers for classroom instruction and learning.
Age of Computers, Down Time and Training

These factors are not major obstacles for computer use in classroom learning because only a small proportion of the participants named them as obstacles to their use of computers in classroom learning. Age of computers is important only because of funding that schools are unable to replace computers as often due to lack of money. However, participants expressed their frustration in having to use old computers for classroom instruction as a limiting factor. One teacher states, “The computers are slow”, and another simply said “My computers do not work!” “Computers that work are hard to find, and if they do, they are slow,” adds another teacher.” It is no secret that there are old or obsolete computers, which should not be in the classrooms. Such computers may not be efficient in classroom learning. As a result, it can be frustrating for teachers who may have current software for teaching yet hindered by the slow and old computers in many classrooms. However, it is encouraging to see few teachers now mentioning computer age as problem because it means many computers in the schools classrooms are not old or obsolete.

Computer downtime is the period during which the computers do not work and thus not available for teaching and learning. The downtime could be due to hardware or software malfunction. About 3.1%, a significantly smaller fraction of the participants cited this as an obstacle to their use of computers in their classroom instruction. One participant wrote, “It is frustrating when one eventually gets the chance to use the computers and they stop working in the middle of class activities.” Another teacher wrote, “It is even more frustrating when the computers go down during classroom
activity after one has waited for a long time to get access to the computers in the computer lab.”

Based on the responses of the participants in this study, lack of training or lack of computer technology (CTPD) professional development was not an obstacle to computer use in classroom instruction in this study. Only a small proportion (1.3%) of the participants mentioned lack of training or professional development for computer proficiency as an obstacle to their integration of computers into the school curriculum. These results concur with those found in earlier analyses of teachers’ responses on training and level of preparation to integrate technology into their classroom instruction. About 77% of the participants stated that they proficient to integrate computers into classroom instruction, and 83% stated that they were proficient in computer technology use for learning.

Other Responses

Certainly, teachers have different opinions on the factors that they consider obstacle to their use of computers for classroom instruction. However, some responses were hard to place, whether they were comments, complain, or obstacles. For example, a music teacher wrote, “There is no computer lab for music teachers and the academic classes always get first priority.” Another respondent, an agricultural science teacher states “Number of computers in the classroom is the main obstacle because with 43 minute-class-period, by the time I give instructions, get out laptops, log off and put away the computers, that only gives about 25 minutes of using the computers.” A French teacher writes, “Technology is merely a means to an end, and when teachers or schools
allow the technology to become the end in itself, they begin to fail as a teacher.” “I think students get overdosed on computers, so I let other teachers do the computers and I use time-tested traditional methods in my classroom,” comments another participant.

In contrast to the views already discussed, two teachers presented interesting viewpoints. A history teacher wrote, “over use of filtering is an obstacle because many resources are blocked out which present no danger to students.” In contrast, another teacher, a physical science teacher who appears to have less filtering in his class or the computer lab comments, “monitoring students browsing the Internet during classroom learning is a major obstacle to use of computer for classroom learning.” Many respondents have pointed out various factors already discussed as the hindrances to their regular use of computers for classroom instruction. Based on the participants’ responses, the major obstacles include lack of computers in the classroom, lack of time, location of computers in the classroom and, classroom student-to-computer ratio respectively.

Software Use in Classrooms

Another open-ended question asked the teachers what software they commonly use in their classrooms on regular basis. The responses were corded and summarized in Table 4.18. The results show that 52% of the respondents used Microsoft office suite (Word, Excel, and PowerPoint). According to the results, Internet is the next popular with 22% (43 respondents) teachers indicating using it for classroom learning. Math Lab, Progress Notebook and Photoshop are some of the software widely used in the classrooms. Although not many respondents indicated using SmartBoards in their
classrooms, many respondents expressed both their desire to use it and lack of SmartBoards in their classrooms.

Table 4.18.

*Software Used in Classroom Instruction in Ohio Public High Schools*

<table>
<thead>
<tr>
<th>Software</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Office suite</td>
<td>101</td>
<td>51.8</td>
</tr>
<tr>
<td>Internet Browsers</td>
<td>43</td>
<td>22.1</td>
</tr>
<tr>
<td>Math Lab software</td>
<td>19</td>
<td>9.7</td>
</tr>
<tr>
<td>Progress Notebook</td>
<td>16</td>
<td>8.2</td>
</tr>
<tr>
<td>Photoshop</td>
<td>14</td>
<td>7.2</td>
</tr>
<tr>
<td>SmartBoard</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td>PageMaker</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>195</td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

The results show that 52% of the respondents used Microsoft office suite (Word, Excel, and PowerPoint). According to the results, Internet is the next popular with 22% (43 respondents) teachers indicating using it for classroom learning. Math Lab, Progress Notebook and Photoshop are some of the software widely used in the classrooms. Although not many respondents indicated using SmartBoards in their classrooms, many respondents expressed both their desire to use it and lack of SmartBoards in their classrooms.
Internet Availability in Ohio public School Classrooms

According to the data analyses in this study, majority of the teachers surveyed (85.2%), reported having at least one student computer with Internet connectivity in their classrooms. Although 14.8% of the teachers reported having no student computers in their classrooms, each respondent has a teacher computer connected to the Internet in his or her classroom. Based on the data collected, Internet access in Ohio public school classrooms has generally reached the 100% mark.

Additional Analyses

Analysis of Data with Nondiscretionary Teachers Included

Additional analyses were conducted using the dataset with nondiscretionary teachers (business and computer technology teachers) included. These teachers have more computers in their classrooms than their discretionary counterparts. For example, the classroom student-to-instruction computer ratio from the nondiscretionary data was 1:1. When these data were included in the computation of the average classroom student-to-instructional computer ratio for the study, the ratio improved from 8:1 to 5:1. Comparatively, the overall student computer ratio in the computer labs was even much better at 1:1 compared with the 8:1 in the classrooms. The results of the multiple regressions summarized in Table 4.19, show that the linear multiple regression was significant with $R = .719$, $R^2 = .518$, $Adjusted \ R^2 = .507$, $F (6, 272) = 48.63$, $p = .001$. Fifty-one percent (the value of $Adjusted \ R^2$) of the variance of teachers’ extent of computer use for classroom instruction is, explained by the linear combination of the six predictors.
The linear regression equation for this analysis is:

\[ \hat{Y}_{\text{TEOUCIC}} = 3.2\text{CSTICR} + .76\text{TALOCP} + .33\text{TPCV} + .32\text{TCAT} - 2.9. \]

As indicated in the regression model classroom student-to-instruction computer ratio (CSTICR) contributed most to the equation, followed by teachers’ attained level of computer proficiency (TALOCP), teachers’ perceived computer value in education (TPCV) and teachers’ computer attitude towards computer use in education (TCAT) contributes to the total variance. However, location of computers in the school (LOCIS) and teachers’ resistance to computer use in education (TRTCH) were not significant predictors of the criterion.
Table 4.19.

*Regression Analysis with Nondiscretionary Teachers Included*

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>-2.944</td>
</tr>
<tr>
<td></td>
<td>TPCV</td>
<td>.328</td>
</tr>
<tr>
<td></td>
<td>TCAT</td>
<td>.324</td>
</tr>
<tr>
<td></td>
<td>TRTCH</td>
<td>-.002</td>
</tr>
<tr>
<td></td>
<td>LOCIS</td>
<td>-.082</td>
</tr>
<tr>
<td></td>
<td>CSTICR</td>
<td>3.226</td>
</tr>
<tr>
<td></td>
<td>TALOCP</td>
<td>.759</td>
</tr>
</tbody>
</table>

Another multiple regression analysis was conducted using computer lab student computer ratio (Table 4.20) show that the linear regression combination of the factors investigated was significant with $R = .586$, $R^2 = .343$, Adjusted $R^2 = .327$, $F(6, 249) = 21.69$, and $p = .001$. 
Table 4.20.

Regression Coefficients from Analysis of Data with Computer Lab Student Ratio

<table>
<thead>
<tr>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>B</td>
</tr>
<tr>
<td>Constant)</td>
<td>-1.300</td>
</tr>
<tr>
<td>TALOCP</td>
<td>.804</td>
</tr>
<tr>
<td>TPCV</td>
<td>.265</td>
</tr>
<tr>
<td>TCAT</td>
<td>.294</td>
</tr>
<tr>
<td>TRTCH</td>
<td>.016</td>
</tr>
<tr>
<td>LOCIS</td>
<td>-.106</td>
</tr>
<tr>
<td>LABSTCR</td>
<td>-.468</td>
</tr>
</tbody>
</table>

\( R = .586, \ R^2 = .343, \ Adjusted \ R^2 = .327, \ F = 21.69, \ df_1 = 6, \ df_2 = 249, \ p = .001. \)

Once again, the results indicate that teachers’ resistance to change (TRCHB) and the location of computers in the school (LOCIS) were not significant predictors of the extent of teachers’ use of computers for classroom instruction in the computer lab. Surprisingly, although computer lab student-to-instructional computer ratio was 1:1, which was far better than the classroom student-to-instructional computer ratio, its contribution to the prediction was both small in magnitude (-.470), and inverse to the linear multiple prediction equation:

\[ \hat{Y}_{TEOCUICI} = 0.8TALOCP + 0.27TPCV + 0.29TCAT - 0.47LABSTCR - 1.3. \]
Analyses of Secondary Variables

In addition to classroom teaching, teachers also use computers for support services such as preparation of lesson plans, searching the internet for new learning and teaching methods and materials, class grading, class attendance and email communications on regular basis. In this study, the researcher hypothesized that teachers who use computers for non-instructional uses such as e-mail communication (EMTOOL), lesson planning (LPSTOOL), Internet search for new teaching methods (ISTOOL), and class record keeping (CMGTOOL) extensively, also use computers extensively in their classroom instruction. Descriptive statistics and percentages of teachers using the computers daily or at least three to four times a week are, summarized in Table 4.20.

Table 4.21.

Descriptive Statistics for Non-teaching Computer Uses (Variables)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Daily or three to four/Week</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEOCUICI</td>
<td>9.63</td>
<td>3.20</td>
<td>35</td>
<td>256</td>
</tr>
<tr>
<td>CMGTOOL</td>
<td>3.66</td>
<td>.819</td>
<td>88</td>
<td>256</td>
</tr>
<tr>
<td>EMTOOL</td>
<td>3.51</td>
<td>.849</td>
<td>82</td>
<td>256</td>
</tr>
<tr>
<td>LPSTOOL</td>
<td>2.72</td>
<td>1.109</td>
<td>52</td>
<td>256</td>
</tr>
<tr>
<td>ISTOOL</td>
<td>2.75</td>
<td>.940</td>
<td>55</td>
<td>256</td>
</tr>
</tbody>
</table>
The results in Table 4.21 indicate that Ohio public high school teachers are using computers for accomplishing non-instruction but important functions in the teaching profession. Majority of teachers (88%) use computers as a classroom management tool, followed by 82% who use it as a communication tool on regular basis. Comparatively, about half of the teachers, 52% and 55% use computers for creating lesson plans and searching the Internet for new teaching materials respectively. Although many teachers widely use computers for non-instructional uses these uses do not predict teachers’ use of computers for classroom instruction. The regression analysis was significant with $R = .232$, $R^2 = .054$, Adjusted $R^2 = .039$. F (4, 251) = 3.568, p = .01, but only Internet use for searching learning materials was the only significant predictor of TEOCUICI. This means that the secondary uses or non-instructional uses of computers are not significant predictors of the extent of computer use for classroom instruction.

Summary

The main objective of this study was to determine teachers’ extent of computer technology use for classroom instruction by high school teachers in Ohio public schools, examine factors that predict such use, and barriers or hindrances to such use. Sample size use in the study was 256 randomly selected teachers from eighteen randomly selected schools across the state. The analyses indicated that majority of teachers in Ohio public high schools were highly prepared (77%) and proficient (83%) to integrate computer technology into classroom learning on a regular basis. The results suggest a widespread lack of computers in Ohio public high school classrooms, where only 12% of proficient teachers worked in classrooms with moderate computer access, compared with the 71%
who worked in classrooms with no computers or had one to four computers in the classrooms. On average, 88% of the teachers never or rarely use computers for teaching their students academic skills, while only 12% used computer in their classroom on regular basis. Comparatively, access to computers in the computer labs, in Ohio public schools is better with an optimal student computer ratio of 1:1, than in the classrooms.

Regarding teachers’ extent of computer use for classroom learning, Ohio high school teachers’ use of computers for teaching their students averaged 1.8 times a week, meaning the teachers only use computer technology once or twice a week on a regular basis. The regression analysis indicated that classroom student-to-instructional computer ratio, teachers’ attained level of computer technology proficiency, teachers’ attitude towards computer use in classroom instruction, and perceived value of computers in instruction, were predictors of the extent of teachers’ computer use for classroom instruction in Ohio Public high schools. Resistance to change and location of computers in the school were not predictors of teachers’ extent of computer use in classroom intrusion in Ohio public high schools. Secondary variables or the non-teaching uses of computer examined in this study were not predictors of teachers’ extent of computer use in classroom instruction. In addition, majority of teachers use computers for classroom management and email communications to greater extent than for classroom instruction.

Analysis of the view and comments of the participants on factors they consider major obstacle to their integration of computers into classroom teaching shed more light on the factors teachers in Ohio public schools consider major barriers. According to the results, lack of computers in the classroom, lack of time and location of computers in the
school were major obstacles to computer technology integration respectively. Age of the computers, computer downtime and lack of computer training, though mentioned, were not major obstacles to computer integration based on the frequency each factor was mentioned.
CHAPTER 5: IMPLICATIONS AND CONCLUSIONS

Discussion of Major Study Findings

Chapter Overview

The major objectives of this study were to determine the extent to which teachers in Ohio public high schools use computer technology in classroom instruction, to examine possible predictors of teachers’ extent of computer use in classroom instruction, and to cite other factors teachers consider major obstacles to their regular use of computers in classroom instruction. The focus of this chapter is the logical discussion of the main findings of the study, guided by the research questions. The fundamental research questions addressed were (1) To what extent do teachers in Ohio public high schools use computers in their classroom instruction on a regular basis? (2) Does location of computers in schools (LOCIS), classroom student-to-instructional computer ratio (CSTICR), teachers’ attained level of computer technology proficiency (TALOCP), teachers’ attitudes towards computer use in classroom instruction (TCAT), teachers’ perceived value of computers in instruction (TPCV), and teachers’ resistance to change (TRTCH) predict use of computers in classroom instruction (TEOCUICI) by Ohio public high school teachers? (3) What do teachers in Ohio public high schools consider the main obstacles to their use of computer technology in classroom instruction on a regular basis?

Sample Demographics

The findings discussed in this chapter were based on the data derived from 256 respondents from 18 randomly selected public high schools across Ohio. These respondents represent an overall response rate of 27%, of which 59% were female and
41% were male. These respondents also represent a wide range of educational backgrounds, disciplines, and teaching experience. With respect to educational background, 26.2% of the teachers in Ohio public high schools hold bachelor’s degree, 73.4% hold Masters degree, and .4% hold a doctoral degree (Table 4.4). The 256 respondents also teach a wide range of subjects (Table 4.6), with 68% specializing in the traditional academic subjects: 19% English, 20% in mathematics, 14% in sciences, and 15% in social sciences). A “special” group of about 3% of the teachers taught all the three traditional subjects (English, mathematics, and science). The remaining 32% teach minor subjects that include industrial arts, Agricultural science, physical education, music, special education, counseling, and foreign languages like Spanish, French, Greek, and German (Table 4.6).

There was also a wide range (1 to 37) in years of teaching experience found among the 256 respondents. The average number of years of teaching experience for the sample was 16 years—but 18% of the participants had taught for five years or less, 19% taught for 6 to 10 years, 20% have taught for 11 to 15 years, 11% taught for 16 to 20 years, and 32% had 21 to 37 years of service. See Table 5.5. These results match similar findings reported by eTech Ohio(2003) in which 5% of the teachers in Ohio were reported to one or less years of teaching experience, 19% had 2 to 5 years, 22% had 6 to 12 years, 20% had 13 to 20 years, and 33% had 21 or more years of service as of 2002. Barron, Kemker, Harmes, and Kalaydjian (2003) also reported similar findings at the national level.
Proficiency in Computers and Use for Classroom Instruction

This study examined the extent to which Ohio public high school teachers use computers in classroom instruction for teaching their students academic skills on a regular basis. The academic skills include, but not limited, to problem-solving, research and analytic skills. Available literature sometimes refers to these skills as computer technology literacy (Barron, et al., 2003) and entails teaching students to use computer technology as a research, communication, problem-solving, and analytical tool.

The analyses require knowledge of how prepared and proficient teachers in Ohio public high schools are to effectively use computers in their classroom instruction. This study found 77% of teachers in Ohio public high schools in this survey are well prepared, and 83% proficient to use computers in classroom for teaching their students academic skills. Comparatively, a report by eTech Ohio in 2002 found that only 45% of teachers in Ohio public schools were well prepared to integrate computer technology into their classroom instruction (eTech Ohio).

When asked how often they use computers for classroom instruction, about 36% of teachers in Ohio public high schools said they use computers for classroom instruction on a regular basis, while 65% of high school teachers said they rarely or never use computers for classroom instruction (Table 4.7). Of those teachers who indicated that they were well-prepared or proficient in computer technology, only 7%, of these teachers used the technology for teaching their students analytic, 11% use it for problem-solving, and 18% use it for research at least three to four times a week or daily on a regular basis (Table 4.7).
Conversely, about 9 out of 10 respondents in this study never or rarely use computers for teaching their students analytic and problem-solving skills, while 8 out 10 teachers said they never or rarely use computers for teaching their student research skills. On average, 12% of the teachers in Ohio public high schools use computers for instilling academic skills to their students on a regular basis, while the majority (88%) never or rarely used computers in classroom instruction.

Analysis of teachers’ level of computer proficiency, in conjunction with extent of computer use, for teaching specific skill categories produced a net decrease. The proportions of computer proficient teachers using computer technology for teaching their students problem-solving and research skills, dropped from 11% and 18% to 10% and 17% respectively. Meanwhile, the proportion of those teaching analytic skills interestingly increased from 7% to 11%. These results actually show that lack of computer proficiency seriously curtails individual teachers’ extent of integration of computers into his or her school curriculum.

*Access to Computers and Use for Classroom Instruction*

Whereas access to computer technology in the classroom is a critical factor in the integration of the technology into school curricula, this study found that only 12% of teachers in Ohio public high schools teach in classrooms with five or more computers, and three-fifths of the teachers work in computer-technology deficient classrooms. These figures are surprising because available literature (Education Week: Technology Counts, 2008) indicates that in Ohio access to computers in the public schools is widespread as
indicated by the high average classroom student-to-instructional computer ratio of 3.5:1 yet the findings of this study suggests the contrary.

The contradiction may be due to plausible ways the state or its agencies collect data on availability of computers in the public schools. Analysis of availability of computer technology in Ohio public schools often used data obtained from predominantly technology coordinators and computer technology teachers. Such data may also include computers used by non-discretionary teachers in business and technology classrooms, computers used by administrators, as well as computers in the computer labs. Moreover, the surveys by the state agencies were state mandated, in which case this could place pressure on school and district technology coordinators as well as school administrators, which, in turn, could influence the outcomes. Given an average classroom size of 21 students derived from this study, every classroom in the Ohio public school system should have at least seven student computers. On the contrary, data on access to computers in Ohio public high schools for this study are based on computers available for student use, excluding computers available in business, computer technology centers, and computer labs.

Cross-tabulation analysis of access to computers in the classrooms and teachers’ extent of computer use for classroom instruction revealed that a smaller proportion (5%) of the teachers work in classrooms with five or more student computers and use computers three to four times a week or daily. Conversely, nearly half of respondents work in technology-deficient classrooms. Moreover, a cross-tabulation analysis between access to computers and teachers’ extent of computer use for teaching students research,
analytic, and problem-solving skills indicated that 4%, 3%, and 3% of the participants with access to computers in the classroom use computers for teaching their students academic skills three to four times a week or daily. On average, only 3% of teachers with access to computers in their classroom use computers on a regular basis to teach their students academic skills. These findings suggest that lack of access to a sufficient number of computers in the classrooms severely curtails teachers’ extent of integration of computer technology into school curricula in Ohio public schools.

To positively impact teaching practices and student academic achievement, the researcher expected teachers in Ohio public schools to use computers in their classroom instruction three to four times a week or daily. Otherwise any use of computers for classroom instruction below this level, for example, using computers only once or twice a week constitutes extreme underutilization of computer technology in Ohio public high schools. Certainly, teachers cannot effectively use a technology to which they have limited or no access at all, let alone integrating computers seamlessly into school curricula on a regular basis.

The findings of this study further shows that lack of access to adequate computers in the classrooms profoundly curtails teachers’ use of computers in classroom instruction in Ohio public high schools. These findings concur with what Martin and Shulman, (2006), reported. These researchers found that teachers, who had a higher number of computers available in their classrooms, regularly used the technology for classroom learning more than teachers with fewer or no computers in their classrooms. Like other policymakers across the nation, Ohio policy makers have been spends millions of dollars
on computer technology in the public schools every year (Trotter, 2007), yet the extent of computer use for classroom instruction is disappointingly low. In 2000, Ohio School Net (2000) reported that 80% of the teachers surveyed in Ohio public schools said they never or rarely used computers for classroom instruction. In 2007 and 2008 nearly 70% of teachers in Ohio public schools still do not use computers for classroom instruction on a regular basis (Education Week: Technology Counts, 2007, 2008). Other studies (NPEC, 2004; Combs, 2003; Becker, 2001) reported similar findings indicating that computer technology use in classroom is not yet widespread in the United States public schools.

Lack of adequate computers in the classrooms in Ohio public high schools seriously hampers teachers’ extent of computer technology for classroom instruction. Similarly, Norris et al. (2003) reported that teachers’ use of computer technology was adversely affected by lack of access to the technology in the classroom. The findings of this study have shown lack of access to computers in Ohio public high schools as a major limiting factor to teachers’ use of computers in classroom instruction, which, in turn, may affect student achievement.

*Prediction of Computer Technology Use for Classroom Instruction*

This study has shown that lack of computer technology corresponds to limited technology use among Ohio high school teachers. These similarities, however, do not provide a definitive link between instructional use of computers in the classrooms and access to the computer technology in the classrooms. Identification of possible predictors of computer use in classroom instruction was achieved through regression analyses. Although six factors were examined in this study, there was no specific rationale or clear
reason for selecting these particular factors over many other possible factors or sets of such factors (Norris, et al., 2003). The predictor variables examined in this study were simply chosen based on the literature review and the researcher’s curiosity about whether some or all of the possible predictors of technology use actually do predict such use of computers.

The results indicated that the linear multiple regressions were significant and all the six variables together explain 41% of the population variance in teachers’ use of computers for classroom instruction. The significant predictors, ordered by the magnitudes of their predicting power, are classroom student-to-instructional computer ratio, attained level of computer technology proficiency, and then teachers’ perceived computer value, and, finally, teachers’ computer attitudes. Resistance to change and location of computers in the school were not significant predictors of the extent of teachers’ use of computers for classroom instruction. Classroom student-to-instructional computer ratio is a major predictor of computer technology integration into classroom instruction (Norris, et al., 2003; Matthew & Guarino, 2002; Becker, 2001). Vannatta and Fordham, 2004, and Albejadi (2000) reported that teachers’ attained level of computer proficiency is a predictor of teachers’ integration of computers into classroom instruction and learning. Becker, and Albejadi also reported that teachers’ attitude toward computer use in learning was a predictor of teachers’ integration of computers into school curriculum. Vannatta and Fordham also reported that teachers’ perceived computer value was a significant predictor of teachers’ use of computers for classroom instruction.
The regression analysis using data with more computers in the classroom with an improved 5:1 classroom student-to-instructional computer ratio was significant, with 51% of the variance of the extent of teachers’ use of computer technology for classroom instruction explained by the regression equation or model. The findings of this study suggest that teachers working in classrooms with adequate computers were likely to use the computers for classroom learning than their colleagues with no or less computers in their classrooms. These findings concur with earlier studies (Becker, 2001; Smerdon, et al., 2000). According to Becker, high school teachers who had five to eight computers in their classrooms were twice as likely to give their students learning activities that involve use of computer during classroom activity than their counterparts with less than four computers in their classrooms. Although the findings seem to suggest that as the number of computers in the classroom increases, teachers’ extent of computer use in classroom instruction also increases this is not a causative effect.

This study has also found that there are sufficient computers in the computer labs as indicated by the 1:1 student-to-computer ratio in the labs, compared with the 8:1 student-to-classroom computer ratio. Nevertheless, the magnitude of teachers’ extent of computer technology use for classroom instruction predicted by the 1:1 computer-lab student-to-instructional computer ratio, was far smaller than the value predicted by the classroom student-to-instructional computer ratio (8:1). These findings seem to suggest that teachers in Ohio public schools underutilize computers in the computer labs for classroom instruction. In others words, the expected impact of computer integration into classroom learning through the economy of scale in the computer labs setup cannot be
realized. The ineffective utilization of the many computers in the labs is probably due to the tight lab schedules, which are often set up in advance, which severely restrict access to the computers. Therefore, placement of computers in a centralized place such as computer labs does not provide students with greater opportunity to acquire computer-based learning after all. According to Becker, having computers in computer labs is not cost-effective without any apparent economics of scale. The findings of this study support Becker’s findings and conclusion.

Analysis of Secondary Variables

Analysis of teachers’ secondary uses or non-teaching functions of computers found that 88% of the teachers use computers as a classroom management tool, 82% use them as a communication tool and 55% use them as lesson planning tool on regularly basis. Comparatively, 42%, 37%, and 25% of teachers in Ohio public schools used computer for management, communication and lesson planning respectively (eTech Ohio, 2003).

Regression analysis of the secondary variables showed that the secondary uses of computers were not significant predictors of teachers’ extent of computer technology use in classroom instruction. Subsequently, researcher’s hypothesis that teachers who use computer technology widely for non-teaching functions also extensively use computers for classroom instruction was rejected.

Barriers to Integration of Computers in Classroom Instruction

Examination of the extent to which teachers in Ohio public schools are using computer technology for classroom instruction and learning would not be complete
without knowing what the teachers consider the main obstacles to their use of computers for classroom learning. The respondents named lack of computers in the classrooms, lack of time, location of computers in the school, classroom student-to-instructional computer ratio, age of computers, computer downtime, and lack of computer skills as primary barriers to their use of computers in classroom instruction.

*Lack of Computers in the Classroom*

Availability of computers or access to computers in classrooms in Ohio public high schools is a critical factor in teachers’ integration of computer technology into classroom instruction and learning. Sixty percent of the respondents indicated that lack of computers in their classrooms was the number one obstacle to their widespread use of computers on a regular basis. Ten percent noted the inaccessibility of computers in the computer labs, and 9% expressed it in terms of high classroom student-to-instructional computer ratio.

*Classroom Students-to-Instructional Computer Ratio*

Classroom student-to-instructional computer ratio is a strong indicator of student access to computers in the classrooms and a strong predictor of teachers’ extent of computer use for classroom instruction and student learning in Ohio public schools. This study has shown that students and teachers in Ohio public high schools do not have access to adequate computers in their classrooms. Lack of computers in the classrooms is indicated by the low (8:1) classroom student-to-instructional computer ratio, an indication that there are no adequate computers in the classrooms in Ohio public high
schools. This ratio is far lower than the 3.5:1 state average classroom student-to-computer ratio (Education Week: Technology Counts, 2008).

The perfect level of computer availability in the classroom is when the ratio of classroom student-to-instructional computer ratio is 1:1. Availability of computers in the classroom at the level of a 1:1 ratio means each student has unlimited access to computers during classroom learning. At this level of student access to computer technology, the learning field in the classrooms is level for all students. It means no student wastes time waiting for his or her turn to use a computer during classroom activity and that all students participate fully in learning activities to the best of their abilities. In such a classroom setting, teachers’ use of computers for classroom instruction, at least three to four times a week or daily, would be enhanced greatly, and seamless integration of computer technology into school curricula would be possible and ubiquitous. Learning in classroom with a 1:1 classroom student-to-instructional computer ratio provides a constructivist learning environment in which students learn at their individual pace and this would certainly impact the student academic performance positively (NPEC, 2004; Barron, et al., 2003; Norris et al., 2003).

Availability of adequate computers in the classroom as a precursor to widespread integration of computer technology into classroom instruction is underscored by comments of the participants. For example, one respondent wrote, “I have only one computer in my classroom; the labs are always full and it is difficult to get on to the schedule.” This statement also underscores the inaccessibility and underutilization of computers located in the computer labs for classroom instruction and learning. When the
classroom student-to-computer ratio improved from 8:1 to 5:1 when teachers with more computers in their classrooms were included in the analysis there was an apparent increase in teachers’ level of computer technology use in classroom instruction. The findings seem to suggest that teacher with adequate number of computers in their classrooms were more likely to use computers for classroom learning regularly than teachers with an inadequate number of computers in their classrooms. These findings are consistent with those reported in prior studies by other researchers (Norris, et al., 2003, Becker, 2001). Smerdon, et al., 2000), reported that 98% of all teachers who had computers in their classrooms use computers for classroom learning on a regular basis to a large extent, but nearly all teachers who reported having no computers in their classrooms hardly used computers for classroom learning on regular basis. In another similar study, Lanahan and Shieh, (2002) reported that 65% of teachers with computers and the Internet available in their classrooms regularly used computers for classroom instruction compared with 38% of teachers who had no computers in their classrooms.

*Location of Computers in the Schools*

This study has shown that there are adequate computers in the computer labs as indicated by the high (1:1) student-to-instructional computer ratio compared with less or no computers available in the classrooms indicated by the low classroom student-to-instructional computer ratio of 8:1. Although in the regression analysis the location of computers in the schools was not significant, 10% of teachers cited location of computers in the school as the main obstacle to their regular use of computers in their classroom instruction. In addition, 60% of the teachers who emphasized the importance of location
of computers in the classroom also underscored the importance of location of computers in a school.

The percentages are important because when taken together, 70% of teachers are saying that location of computers in the classroom so that teachers can easily access the computers any time as opposed to location of computers in the labs, to which access is limited, is highly influential in the utilization of computer technology in learning. Importance of computer location in the classroom is further evidenced by the high predicting power of classroom student-to-instructional computer ratio, compared with the low and negative predicting power of computer lab student-to-instructional computer ratio. Generally, 79% of the respondents stated that lack of adequate computers in their classrooms was a major barrier to their use of computers in classroom instruction and learning. These findings are similar to those reported by Norris et al. (2003) and Becker (2001).

Analysis of this study indicated that teachers were more likely to report using computers regularly in their classroom practices if they had access to an adequate number of computers in their classrooms than if they only had access to computers in the computer labs. Moreover, teachers with few or no computers in their classrooms were more likely to “Agree” or “Strongly Agree” that lack of computers in the classroom was a major obstacle to computer technology integration into classroom curricula. These findings concur with similar findings reported by Martin and Shulman (2006).
Lack of Time

As reported in earlier studies (Norris, et al., 2003; CEO Forum 2001a, 2001b; Albejadi, 2000) lack of time is a major hindrance to teachers’ widespread use of computers in classroom teaching. This study is not an exception because 10% of the teachers named lack of time as a major factor that hinders their use of computers in classroom instruction to a greater extent. It is worth noting that lack of time is a complex and multifaceted factor that affects teachers’ integration of computers into classroom learning. Lack of time for teachers’ integration of computers into classroom instruction is a complex factor to explain based on teachers’ perspectives. In their explanation of time as one of the limiting factors to their use of computers for classroom instruction, different teachers mentioned a different aspect of “lack of time”. For example, the 10% of the teachers who cited lack of time as a major obstacle to their use of computers for classroom instruction includes those who cited “lack of time” due to the short class period, lack of time of exposure to new software, or lack of time to prepare learning materials.

Lack of time, as teachers see it, is compounded by the fact that teachers are busy during the day teaching, and understanding non-teaching functions such as grading papers, preparing lesson plans, communicating with parents, or even counseling students. This busy schedule leaves teachers with no free time to devote to enhancing their computer skills for use in classroom learning. Such apparent lack of time, coupled with lack of computers in the classrooms, culminates in the low level of computer use in classroom learning on a regular basis.
Age of Computers and Downtime

Age of computers is a hindrance to regular use of computers because old computers are slow and may not be able to handle newer software requiring faster computers. Because schools cannot afford to replace computers, every couple of years or so most schools end up having older and nearly obsolete computers in the classrooms and computer labs. Integration of computers into school curricula greatly diminishes without access to adequate faster multimedia computers in the classrooms. Computer downtime is inevitably associated with computer age as older computers are more prone to breaking down than new and versatile computers. It can be frustrating to teachers, when computer networks break down and no technical support is at hand. However, findings in this study indicate that only a small percentage (3%) of teachers cited computer downtime as a major obstacle to their widespread use of computers in classroom instruction. These findings suggest that schools and school districts in Ohio have made inroads in mitigating computer downtime (eTech Ohio, 2003).

In addition, schools have technology technicians to ensure that the computers in the schools run smoothly all the time; the high level of computer technology skills teachers now possess enable them to troubleshoot computer problems when computers fail to work during class period (eTech Ohio). The large number of teachers with high levels of computer skills could be the reason why a low number of teachers mentioned computer downtime and lack of time as barriers to computer use for classroom learning. This could also be the reason why lack of technical support was not among the barriers cited to affect teachers’ extent of computer technology use in classroom instruction.
The good news emerging from these findings is that lack of CTPD was not named as one of the obstacles to teachers’ integration of computers into classroom learning in Ohio public schools. Only 1.3% of teachers mentioned lack of CTPD as a hindrance to their use of computers in classroom instruction, compared with 77% of the teachers who said they received appropriate training in computer technology and 83% who said they are currently proficient to use computer technology in their classrooms.

*Computer Technology Professional Development*

The role of CTPD in the integration of computer technology into instruction to enrich student learning and teaching practices is critical (MacDonald, 2008; Ringstaff & Kelley, 2002). Professional development helps teachers acquire computer skills necessary to integrate the technology into their practices. Yet effective CTPD has to be continuous (Hogarty, et al., 2003) and sustained over a long period if it is to help teachers acquire computer skills and to know when and how to integrate the technology into school curricula. Although this study did not find lack of CTPD in Ohio, other studies (CEO Forum, 2001a, 2001b; Smerdon, et al., 2000), have cited lack of CTPD as one of the major obstacles to widespread integration of computers in classroom instruction. Cuban (2001) and Tearle (2003) argue that lack of CTPD is not the main obstacle to teachers’ extent of computer use in classroom instruction, but that it is the pressure to integrate and sustain computer technology in the classrooms.

To meet the needs of individual teachers, CTPD in Ohio has been offered at various levels of proficiency—novice and practitioner levels at the district levels. Although one-day workshops and coursework are still used for delivering professional
development, these methods are ineffective because they do not provide continuous CTPD (MacDonald, 2008). In Ohio, the online model is the new addition to the traditional list of CTPD models used.

In 2002, about 52% of teachers in Ohio public schools had received CTPD in general computer use, 46% in Internet use, 43% in software application, 45% in computer technology integration into instruction, and 21% in multimedia peripherals (eTech Ohio, 2003). The same report also indicated that, 65% of the computer technology-novice teachers in Ohio received CTPD training in computer use as a productivity compared with 8% of the practitioner teachers who received CTPD in advanced computer technology uses.

The analysis also demonstrated that this population of teachers had been exposed to a wide range of methods by which the participants acquired their computer technology skills. The most common methods were, self-training though which 85% of teachers received their computer skills; 65% were taught through peer training, 49% through CTPD, and 38% through college training. This study, however, found that 77% of the participants said that they were prepared or highly prepared to use computers in classroom instruction effectively, and 83% indicated that they were proficient or highly proficient in using computer technology in classroom instruction and learning. Moreover, only 1.3% of the respondents stated that lack of CTPD was an obstacle to their routine integration of computers into their classroom instruction.

Becker (2000) and Smerdon, et al. (2000) reported that lack of training in computer technology was the major hindrance in teachers’ integration of computer
technology into their routine classroom instruction. In spite of the high computer proficiency and computer skills possessed by four-fifths and three-fourths of the respondents, respectively, only about 35% of the teachers said they use computers in their classroom instruction on a regular basis. The findings of this study, however, point to the contrary suggesting that the low extent of computer use in classroom instruction in Ohio public high schools has more to do with lack of adequate computers in the classrooms than teachers’ lack of computer skills and professional development.

Resistance to Change

Resistance to change, or deliberate failure to adapt to teaching using computer technology as an instructional tool, was worth investing in this study because it negatively affects teachers’ extent of computer use in classroom instruction. Analysis of the data in this study found that teachers’ resistance to computer use in classroom instruction was not a predictor of teachers’ extent of computer use in classroom instruction. Resistance to computer technology use is an outward expression of internal traits, such as negative attitude and low perceived computer value in learning. In this study, both these traits were significant predictors of teachers’ extent of computer technology use in classroom instruction and learning. This finding suggests that the two constructs were positive, which was probably the reason why resistance in this analysis was not a predictor of teachers’ use of computers in classroom learning. This finding is contrary to the one reported by Vannatta and Fordham (2004) that resistance to change was a major obstacle to effective use of computers in classroom learning and instruction.
Teachers may resist computer integration for a number of reasons, including lack of training, which in turn may elicit fear (Rogers, 2003) or because the technology or innovation does not fit well with teachers’ pedagogical beliefs (Martin & Shulman, 2006) or the daily responsibilities and demands of the teaching profession. Therefore, to overcome such resistance required a technology-resisting teacher to make a deliberate concerted effort to undertake pedagogical adjustments to use computers in classroom learning. In this study, the majority of the teachers say they are well trained and proficient to use computers in classroom learning. As more teachers use computers, and those who resist see the usefulness of the computer as a learning tool, they develop positive attitudes towards computer use in learning, which, in turn, reduces resistance towards computer use in classroom learning. This may be the reason why resistance to computer use in the past was reported to be an obstacle to integration of the technology in classroom learning.

Implications

Practical Implications

In this study, the majority of the teachers fall under the category of non-computer users. This group is comprised of teachers who do not use the technology in their classroom instruction at all (non-users) and those who seldom or only occasionally use the technology for classroom instruction (novices). The study has shown that only a tiny proportion (3%) of teachers have embraced and fully integrated computers into classroom instruction at least three to four times a week or daily. Generally, teachers in Ohio public high schools do not regularly use computer technology for classroom
instruction and for teaching specific skills such as problem solving, research communication, and analytic skills to their students. Subsequently, the impact of computer technology on student academic performance is yet to be realized. Other researchers, such as Hennessy, Ruthven, and Brindley (2005), have reported that few teachers have embraced and integrated computer technology in ways that make a difference in student learning.

Majority of teachers in Ohio public schools have received the necessary training, and have attained high levels of computer technology proficiency. They also have positive attitudes toward computer use in education, positive perceived computer value, and low or no resistance to or against computer use in classroom learning. Because all these factors favor computer use in classroom instruction, the low extent of teachers’ computer use in classroom instruction could be attributed to the severe lack of access to adequate computers in Ohio public high schools rather than internal characteristics. More teachers indicated that they are well prepared and proficient to integrate computer technology than those reported in earlier by eTech Ohio (2003). This suggests that the pragmatic approaches to address teachers’ needs for CTPD appear to be working. Therefore, policymakers in Ohio should stay focused on sustaining improved teachers’ training and professional development in the state. This is because, as this study and others (Norris, et al., 2003; Barron, et al., 2003) have shown, attained level of computer skills or computer proficiency is a serious limiting factor to widespread computer technology integration into school curricula.
However, this study has revealed that teachers in Ohio public schools are not fully using computer technology for classroom instruction and learning. Only 3% of all the proficient teachers use computers at the expected level of at least three to four times a week or daily on a regular basis. Since teachers who regularly use computer technology for classroom learning on a regular basis are a minority, the expected positive impact of computer technology on teaching practices and student achievement may not be realized. A disproportionately large number of teachers in Ohio public high schools, who have access to computers, use computers on a regular basis for non-teaching functions, such as class management, lesson planning, and communication.

Comparatively, in this study, 88% of the teachers use computers for managing class records and grades, 82% use the technology for e-mail communication with colleagues and students’ parents, 50% use computers for creating lesson plans, while 55% use the technology for searching the Internet for new learning methods or materials. A national study (NPEC, 2004) reported that 39% of all high school teachers with access to computers and the Internet in their classrooms use the computers for creating learning materials, while 10% use the technology for preparing lesson plans on a regular basis. eTech Ohio (2003) reported similar findings of a widespread use of computers for accomplishing non-teaching functions at a higher level than using the computers for instruction in the classroom among teachers in Ohio public high schools.

Computer technology proficiency, positive computer attitudes, and perceived computer value are important internal factors that greatly influence a sustained high level of computer technology use in classroom learning. Therefore, appropriate plans must be
put into place to sustain the high level of CTPD already attained in the state. Because of a severe lack of an adequate number of computers in Ohio public high schools, resources should be geared toward improving access to computers in the classrooms across the state. In addition, unless there are adequate computers in the public school classrooms, to the level of 1:1 classroom student-to-instructional computer ratio, ubiquitous and seamless integration of computers into school curricula may never be realized. In addition, improvement of student academic achievement will not occur due to the severe lack of computers in Ohio public schools.

Policy Implications

Widespread use of computers by teachers in classroom instruction requires development of policies that address teachers’ needs for computer technology use in classroom learning. Such informed policies depend on a body of empirical research in computer technology integration in the public schools. The information on availability and integration of computer technology in Ohio public schools comes from state-mandated studies. Such studies have often reported ready access to computers or availability of adequate computers in Ohio public K-12 classrooms. On the contrary, the current study has shown that there is a severe lack of access to adequate computers in Ohio public high schools. As this study suggests, policymakers need to re-examine data collection procedures for state-sponsored studies on computer technology integration in Ohio public schools. This is because the data on computer technology integration in Ohio public schools include computers used in business and computer technology classrooms, computers used by administrators, as well as computers in the computer labs can give a
false level of computers available in the classrooms. Although this study has shown that there are adequate computers located in the computer labs (averaging 20 to 25 computers in a lab) in the public high schools in Ohio, these computers are not readily available for class use whenever teachers wanted to use them because of the scheduling of computer labs well in advance. Therefore, policymakers and school administrators need to re-evaluate the long-term and short-term economies of scale for using computer labs.

This study has contributed to the body of literature from which policymakers may draw key information to make informed decisions regarding computer technology use for learning and instruction in the schools. The study provides current information on access to computers in the classrooms, availability of computer technology, and general status of computer technology use in Ohio public schools. The findings of this study may help Ohio educators and policymakers to look seriously into the question of why the majority of teachers in Ohio public high schools are not widely using computers in classroom learning. Based on the findings of this study, policymakers and educators in Ohio ought to focus on improving availability of computers in the classrooms to the level of a 1:1 classroom student-to-computer ratio. This level of computer availability may lead to widespread use of computers for classroom instruction, and perhaps the impact of computer technology on student achievement may begin to emerge.

This study has shown that teachers in Ohio are not optimally utilizing computers for implementing school curricula at a level that can influence learning outcomes. The extent of computer technology use at which the researcher expected teachers in Ohio high schools to operate, and one that is considered sufficient to impact student learning, is
teachers’ use of computers daily, or at least three to four times a week on a regular basis. Obviously, teachers with adequate computers in their classrooms use computers more frequently for classroom instruction than teachers with few or no computers in their classrooms. Having adequate computers in the classrooms to a level of one student per computer would level the learning playing field, which may lead to effective use of computer technology for better student academic performance. This study has shown that schools have sufficient computers in computer labs as indicated by the low student-to-instructional computer ratio of 1:1 in the labs, compared with the 8:1 classroom student-to-computer ratio determined in this study. However, the small predicting power of computer lab student-to-computer ratio refutes the premise that placement of computers in a central place, such as the computer labs, leads to effective utilization of the computers by all teachers.

Because billions of dollars have been invested in computer technology integration in the public schools, the findings of this study are of great interest to policymakers and Ohio educators. The extreme lack of widespread use of computers in the public schools means the billions of public tax money may be spent on underutilized technology. The meager use of the technology suggests that taxpayers in Ohio are not getting sufficient return on their tax money invested in computer technology in the public schools. When people know that their hard-earned money is spend on computer technology without sufficient return, their support of school levy approval may diminish; yet such sources of local school funding, especially during tough economic times, is critical.
Recommendations for Future Research

By no means are the factors analyzed in this study the only ones influencing teachers’ extent of computer technology use in classroom instruction. More research studies are needed in order to identify additional factors that influence teachers’ decisions to use or not to use computers in classroom instruction. Moreover, more studies that investigate the underlying dynamics of internal and external factors that affect teachers’ computer technology use would provide critical information on computer technology integration in the classroom.

Future research should also look at the best ways of promoting available, reliable, and effective methods of computer professional development, such as self-training and peer-training methods at both school and district levels. These methods can be effective in equipping teachers with the appropriate computer technology skills if the training was tailored to meet the individual teacher at his or her points of technology need. Another factor regarding more research is the lack of time. Future studies should focus on how the various facets of “lack of time” directly or indirectly affect teachers’ extent of computer use in classroom instruction. Studies are needed which track teachers’ extent of computer technology use in relation to improvement of access to computers in the classroom from current average of 8:1 to the ideal 1:1 classroom student-to-high-speed computer ratio, and how this would translate into student academic achievement.

Lessons Learned

In addition to the academic lessons gained from the research process, there are some other lessons, which the researcher learned during the course of this research. The
early stages of data collection process involved seeking permission from the principals of the selected schools. This was the most trying moment of the entire research process. It was difficult to get in touch with the school principals because they were either in a meeting, not ready to take the call, or out of the office. Whenever the researcher did not get hold of the principal, a message was left in the principal’s voice mail. In addition, a follow-up e-mail explaining the purpose of the phone call was sent to the principal. Yet, the researcher quickly learned that school principals generally did not return the calls even when a message was left on their answering machines or email. The researcher also quickly learned the best time to call school principals was between 9 and 11 a.m., and soon after the end of the school day.

Some schools principals were receptive while others would not even give the researcher a chance to explain the purpose of the study and its potential benefits to the school. Others refused to have their teachers participate in the research because the teachers were taking part in a state-mandated technology survey, were about to take it, or had just taken the survey.

The researcher, however, found it odd and surprising to find that school principals were not receptive to research on computer technology use in their schools because participating schools stand to benefit from these studies. School principals would know how they measured up in terms of computer technology access and integration in their own schools compared with the other schools.

In spite of all obstacles, the researcher was determined and focused on obtaining permission without which he could not go any further in this research. Permission was
eventually obtained from 59 school principals. For me, persistence, patience, and prayers were the pillars of my internal driving force to pursue and complete this research study regardless of whatever came my way. The other important lessons came through the way some respondents presented their own dilemma in becoming seasoned computer technology users or practitioners. One such inspiration lesson came from a teacher who wrote, “My lack of knowledge of how to use computers, and the ease of using and setting up computers for class instruction is my major obstacle to integrating computers for learning in my classroom.” This candid response is commendable because it requires a lot of courage to be that honest, especially when one’s reputation is on the line. This particular respondent could just have easily put the blame on someone or something else. Such a teacher deserves all the assistance available from the school to help that teacher gain the necessary computer skills to be an effective computer technology practitioner in the classroom. For me, this participant’s honesty challenged me to ask myself if I would have been that courageous and honest in that situation.

Conclusions

The study found that the majority of teachers in Ohio public high schools were proficient in computer skills, but availability of adequate number of computers in the classrooms is adversely lacking. According to the study, only 12% of teachers work in classrooms with five or more computers for student use, compared with 50% of the teachers who work in computer technology-deficient classrooms. This study presents a more realistic picture of computer access in Ohio public high schools because data on computers available in the classrooms did not include computers used in business and
technology classrooms, computers used by school administrators, and computers for teachers’ use.

In addition, data from computer technology coordinators and school administrators, who are the main sources of the data for state-mandated studies on computer technology in the public schools. Because of lack of access to adequate computers in the classrooms, only 3% of the teachers (all the computer-proficient teachers) used computer technology for classroom learning on regular basis. Therefore, lack of computers in classrooms is a severe limiting factor for seamless computer technology integration into classroom instruction. Although it is not causative, as the number of computers in the classroom increases, teachers’ use of computers for classroom learning seems to increase. Such an increase could possibly continue until the ratio of classroom student-to-instructional computer ratio reaches 1:1, then, it possibly levels off. The ratio of one student per computer is the ideal level of access to computer technology, one that levels the learning ground, where students can equally participate in learning with the technology, with the teacher as a facilitator.

According to the study findings, classroom student-to-instructional computer ratio, teachers’ attained level of computer proficiency, teachers’ perceived value of computers in education, and teachers’ attitudes toward computer use in classroom instruction are significant predictors of teachers’ use of computers for classroom instruction. Each of these factors had some impact on teachers’ use of computers in classroom learning, but interaction among these factors greatly influence teachers’ use of computers for classroom learning.
Furthermore, teachers with adequate computers in their classrooms use computer technology more routinely for classroom instruction than teachers who had no computers in their classrooms or only have access to computers in the labs. Until teachers in Ohio public schools have adequate computers in the classrooms, not only will the extent of computer use for classroom instruction remain minimal at best, but also the potential impact of the technology on teaching practices and student achievement may not be fully realized. Computers located in the computer labs in Ohio public schools are underutilized in classroom learning because of the restricting nature of computer lab scheduling. Finally, teachers in Ohio public schools view lack of time, age of computers in the classrooms, and lack of computers in the classrooms as major barriers to widespread integration of computer technology into classroom learning.
REFERENCES


http://main.edc/newroom/features/mhtestimony.asp

http://www.iste.org/Content/NaverMenu/Publications/


APPENDIX A: Focus Group Discussion Questions
Focus discussion questions

What is your definition of technology?
How do you (the teacher) define technology integration?
Is technology changing teaching and learning?
How is it changing your way of teaching, learning and communicating?
What are your own experiences, opinions and observations with technology?
What barriers do you face in the use of technology as a teaching tool?
How are you using technology?
How frequent do you use it in class?
How frequent do you use technology at home?
For what purpose?
Are you using technology in your teaching?
If yes-what motivates you to use it?
If not – what hinders you from using it?
What do you believe is the future of technology?
What steps do you suggest Ohio Department of Education should do to improve integration of the technology in the curriculum?
What do you envision the role of technology in teaching and learning five years from now?
What do you envision your use of technology five or so years from now?
What would you define as effective use of technology for teaching and learning?
Is technology being used effectively?
Are you concerned that technology is not being used effectively to improve achievement?
APPENDIX B: Research Questionnaire
Questionnaire Instrument

Directions
This survey asks you questions about your use of computers in your classroom teaching practices. In this survey, computer or Computer technology refers to up-to-date functioning desktop and laptop computers (hardware and software) with Internet connectivity, plus computer peripherals such as printers, scanners and projectors. Please select your response based on your first impression of each item, and answer all the items even though some may seem redundant.

(For each of the following items, please write your responses in the spaces provided).

1. What is your highest level of education? (Circle one that best applies to you)
   - Bachelors
   - Masters
   - Masters Plus 30
   - Doctorate (Ph.D)

2. Including the current year, how many years of teaching experience do you have?
   Years. _________

3. What grade level(s) are you teaching this year? (List all of them) _______________

4. What subject(s) are you teaching this year? ________________________________

5. Your Gender (circle one)
   - Male
   - Female

6. On the average, how many students do you have in your regular class? _______

In number (7) below, state the number of computers that are available for you to use for teaching your student in your classroom. If you do not have computers in your classroom but use computer located in a computer lab, state their quantity (number) in the space provided in 7(b) below.

7(a) How many computers you use for classroom instruction are located in your classroom? ______________

(b) How many computers you use for classroom instruction are located in a computer lab? ______________

(c) Are all computers in your classroom connected to the Internet? ______________
The following statements (8-25) relate to computer use in classroom teaching. For each statement, indicate whether you strongly disagree (SD), disagree (D), agree (A), strongly agree (SA) with the statement by shading the circle associated with your choice.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>SD</th>
<th>D</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Computer use in classroom teaching equips students with the skills necessary to succeed in the information age.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>My teaching practices are increasingly dependent on my computer use in class learning.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>Using computers in classroom teaching allows me to teach my students in practical and creative ways.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11.</td>
<td>Knowing how to use computers in classroom teaching is a must-have skill for every teacher.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12.</td>
<td>Computer use in classroom learning does not improve students’ academic achievements.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13.</td>
<td>Schoolteachers ought to use computers in their classroom instruction on daily basis.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14.</td>
<td>I enjoy using computers for teaching my students.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15.</td>
<td>I like using computers for classroom teaching when they have the software I need.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16.</td>
<td>I am reluctant to use computers in classroom teaching because computers make my teaching job harder.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17.</td>
<td>I do not use computers in classroom teaching because they take too much of my time.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18.</td>
<td>Using computers for classroom teaching forces teachers to abandon effective time-tested teaching methods.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19.</td>
<td>I teach more effectively without using computers.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20.</td>
<td>I do not use computers in my classroom teaching because they are a distraction to my students.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21.</td>
<td>When searching for new instructional materials and methods, I often look for the ones that require little change</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22.</td>
<td>Location of computers in the school does not affect the extent to which I use computers for classroom instruction</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23.</td>
<td>I think computers located in a computer lab less used than those located in the classroom.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24.</td>
<td>Having computers available in my classroom promotes my daily computer use for classroom teaching.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25.</td>
<td>Lack of computers in my classroom impedes my level of computers use for teaching</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Teachers acquire their computer technology skills and competence through different training methods. For the following training methods, select the response that BEST reflects your situation by shading the circle associated with your choice.

26. How has each of the following training methods prepared you to use computers in your classroom instruction?

<table>
<thead>
<tr>
<th>Training Method</th>
<th>Not prepared</th>
<th>Minimally prepared</th>
<th>Prepared</th>
<th>Highly prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>a). Professional development workshops and seminars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b). Peer training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c). Personal effort/self- training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d). College training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

27. Generally, how prepared are you to use computers in classroom instruction?

Teachers’ ability to use computer technology in classroom is classified into four levels: Non-user, Novice, Intermediate, and Practitioner in this survey.

Non-user: I am aware of availability of computer technology in my school but I do not use it in my classroom instruction. I am still learning the basics.

Novice: I have some basic computer skills and can use computers in my classroom instruction in a limited way.

Intermediate: I have gaining some confidence in using computers for classroom instruction to some extent for doing specific tasks, but I am not yet able to integrate computers fully into all phases of my classroom teachings.

Practitioner: I am confident to use computer technology fully in many applications for my classroom teaching. I even look out for new software to use in classroom teaching.
What is your current proficiency level to integrate computer technology into your classroom instruction?

<table>
<thead>
<tr>
<th>Non-user</th>
<th>Novice</th>
<th>Intermediate</th>
<th>Practitioner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Teachers use computer technology in their classrooms for teaching and other related uses. In the following items, select the choice, which truly reflects your current level of computer use.

28. How regularly do you use computers for teaching your students in your classroom?

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to Four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

29. How regularly do you use computers for teaching your students to develop skills in the following academic skills?

<table>
<thead>
<tr>
<th>(a) Problem solving</th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(b) Research using the Internet</th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(c) Data analysis</th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(d) Information dissemination</th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

30. How regularly do you use the following software for teaching your students?

<table>
<thead>
<tr>
<th>(a) Drill and practice software</th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(b) Simulation and software</th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>
32. How regularly do you use computers for:

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>One to two times a week</th>
<th>Three to four times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) E-mail communication with students’ parents, and colleagues</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Creating lesson plans</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Internet searching for new information on new teaching method</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keeping class grades and attendance records</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

33. What do you consider the main obstacles to your daily use of computers for classroom instruction?

34. What software do you use in your classroom teaching on regular basis? (List all that apply to you).

Thank you very much for your time. I could not have done this research without your help.
APPENDIX C: List of Items Adapted From Other Instruments
<table>
<thead>
<tr>
<th>Adapted Questionnaire Items</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Computer use in classroom teaching equips students with the skill necessary to succeed</td>
<td>Cater &amp; Leeh, 2001</td>
</tr>
<tr>
<td>in the information age.</td>
<td></td>
</tr>
<tr>
<td>9. My teaching practices are increasingly dependent on my computer use in class learning.</td>
<td>Cater &amp; Leeh, 2001</td>
</tr>
<tr>
<td>10. Using computers in classroom teaching allows me to teach my students in practical and</td>
<td>McFarlane, Hoffman, &amp;</td>
</tr>
<tr>
<td>creative ways.</td>
<td>Green, 1997</td>
</tr>
<tr>
<td>11. Computer use in classroom learning does not improve students’ academic achievement.</td>
<td>Young, 2000</td>
</tr>
<tr>
<td>12. Knowing how to use computers for classroom teaching is a must-have skill for every</td>
<td>McFarlane, Hoffman, &amp;</td>
</tr>
<tr>
<td>teacher.</td>
<td>Green, 1997</td>
</tr>
<tr>
<td>13. Schoolteachers ought to use computers in their classroom instruction on daily basis.</td>
<td>Cater &amp; Leeh, 2001</td>
</tr>
<tr>
<td>15. I like using computers in classroom instruction when they have the software I need.</td>
<td>Young, 2000</td>
</tr>
<tr>
<td>16. I am reluctant to use computers in classroom teaching because computers make my</td>
<td>Hogarty, Lang, &amp; Kromrey,</td>
</tr>
<tr>
<td>teaching job harder.</td>
<td>2003</td>
</tr>
<tr>
<td>17. I do not use computers in classroom teaching because they require too much of my</td>
<td>Knezek &amp; Christensen,</td>
</tr>
<tr>
<td>time.</td>
<td>1997</td>
</tr>
<tr>
<td>18. Using computers for classroom teaching forces teachers to abandon effective</td>
<td>Cater &amp; Leeh, 2001</td>
</tr>
<tr>
<td>time-tested teaching methods.</td>
<td></td>
</tr>
<tr>
<td>20. I do not use computers in my classroom teaching because they are a distraction to</td>
<td>Knezek &amp; Christensen, 1997</td>
</tr>
<tr>
<td>my students.</td>
<td></td>
</tr>
<tr>
<td>21. When searching for new instructional materials and methods, I often look for the</td>
<td>Vannatta &amp; Fordham, 2004</td>
</tr>
<tr>
<td>ones that require little change.</td>
<td></td>
</tr>
<tr>
<td>22. Location of the computers in the school does not affect the extent to which I use</td>
<td>Ravitz, Wong, &amp; Becker,</td>
</tr>
<tr>
<td>computers for classroom instruction.</td>
<td>1998</td>
</tr>
<tr>
<td>23. I find computers located in a computer lab less used than those located in the</td>
<td>Smerdon et al 2000</td>
</tr>
<tr>
<td>classroom.</td>
<td></td>
</tr>
<tr>
<td>24. Having computers available in my classroom promotes my daily computer use for</td>
<td>Knezek &amp; Christensen, 1997</td>
</tr>
<tr>
<td>classroom teaching.</td>
<td></td>
</tr>
<tr>
<td>25. Lack of computers in my classroom impedes my level of computers use for teaching.</td>
<td>Knezek &amp; Christensen, 1997</td>
</tr>
</tbody>
</table>
APPENDIX D: IRB Ohio University Approval Letter
A determination has been made that the following research study is exempt from IRB review because it involves:

Category 2 research involving the use of educational tests, survey procedures, interview procedures or observation of public behavior.

Project Title: Integration of Computer Technology into High Schools in Ohio Public Schools

Project Director: Robin G. Wani Latio

Department: Educational Studies

Advisor: Teresa Franklin

Rebecca Cale, Associate Director, Research Compliance
Institutional Review Board

7/29/04

Date
APPENDIX E: Introductory Letter to School Principal
Dear [Principal Name],

Congratulations, your school has randomly been selected for an important study of computer use in classroom teaching and learning. The research will examine factors that influence the level of computer use in classroom instruction by high school teachers in Ohio public schools statewide. The findings of this study can provide educators and policy makers in Ohio with an insight into computer technology use in high schools classrooms across the state of Ohio; and help them make informed decisions based on empirical evidence. In addition, participating schools can compare access to and level of computer technology use in their schools with others schools across the state. All these have policy implication in realignment of computer use in the public schools for better teaching and learning outcomes.

I look forward to receiving your confirmation of your school’s participation in this study. All teachers in participating schools are required to participate. Could you please state the total number of teachers in your school, so that I can send the correct number of the questionnaires? The questionnaires will be sent to your school as soon as I receive your confirmation of your participation in this research study. The questionnaire takes about 10-15 minutes to complete. Ohio University’s Human Subjects Review Committee has already approved the study.

I am currently a graduate student pursuing a Doctoral degree in Instructional Technology, in the College of Education, at Ohio University. I will be more than willing to send you the summary of the survey if you would like to know the findings of the study.

Thank you in advance for allowing your school to participate in this study. If you have any questions about this study, feel free to contact me at (614)843-0886 or by e-mail at latio.robin@ohio.edu. You can also contact my Academic Advisor, Dr. Teresa Franklin by e-mail at franklit@ohio.edu or by phone at (740) 593-4561.

Yours Sincerely,

Robin Latio (Researcher)  
Dr. Teresa Franklin  
(Chair: Academic Advisor)
APPENDIX F: Letter of Instruction to the School Principal
Robin Latio

C/O Dr. Teresa A Franklin
313 D McCracken Hall
Athens, OH. 45701.

[School Principal Name]
[School address goes here]
[Researcher Address]

[Date]

Dear [Name of the School Principal]

Once again thank your very for allowing me to conduct my research study on computer technology use in your school. I request that the survey questionnaires be distributed to the mailboxes of all the teachers in the school. The teachers have been asked to complete and return their questionnaires within one week to the school Secretary. The school Secretary will then mail the returned questionnaires to me using the enclosed stamped self-addressed envelope. Please, I ask that you urge all your teachers to complete and return their questionnaires in time, as this study is important and participating schools stand to benefit from the findings of the study.

Thank you very much for your help in this study,

Sincerely,

Robin Latio
APPENDIX G: Consent Letter to Research Participants
Title of Research: EXAMINATION OF FACTORS THAT INFLUENCE COMPUTER TECHNOLOGY USE IN CLASSROOM INSTRUCTION BY TEACHERS IN OHIO PUBLIC HIGH SCHOOL

Principal Investigator: Robin G. W. Latio

Department: Educational Studies: Instructional Technology

Dear Participant,

Your school has randomly been selected for a statewide research study that examines the level of computer technology use in classroom instruction by high schools in Ohio. Ohio University’s Human Subjects Review Committee has approved the study, and your school Principal, to whom I am grateful, has granted the permission for the school to participate in this important study.

Presently I am a Doctoral candidate at Ohio University pursuing a Ph. D degree in Instructional Technology. My research interest is in effective use of computer technology for better learning and teaching outcomes. In this study, I want to examine computer technology use in Ohio high schools and the barriers that hamper teachers’ use of the technology. Findings of the study may provide educators with the data necessary for making informed decisions on the integration of computers into classroom teaching and learning in our schools.

Your participation in this survey is critical because teachers are the key to effective use of the technology in the classrooms, and helps me complete this important study. The study is survey-based, and there are no potential risks or discomfort that I know to which you, the participants will be exposed during the study. The survey questionnaire takes about 10-15 minutes to complete. The information collected is strictly confidential, and will be used solely for statistical analyses.

Federal and university regulations require a signed consent for participation in research involving human subjects. Please read and sign the statement below to indicate your consent to participate in this study voluntarily. Then complete the questionnaire and mail it together with the consent form, to the researcher using the self-addressed envelope.

If you have any questions about this study, feel free to contact me at (614) 843-0886, or by e-mail at latio.robin@ohio.edu. You can also contact my Academic Advisor, Dr. Teresa Franklin by e-mail at franklit@ohio.edu, or by phone at (740) 593-4561. Questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University at (740) 593-0664.

Once again thank you very much for taking time out of your busy schedule to complete the survey questionnaire. Sincerely,

Robin Latio
Researcher

Dr. Teresa Franklin
Academic Advisor
PARTICIPANT

I certify that I have read and understand this consent form and agree to participate as a subject in the research described. I agree that potential risks to which I may be exposed in by participating in this study have been explained to my satisfaction and I understand that no compensation is available from Ohio University and its employees for any injury resulting from my participation in this research. I certify that I am 18 years of age or older. My participation in this research is voluntary. I understand that I may discontinue participation at any time without penalty or loss of any benefits to which I may otherwise be entitled. I certify that I have read this consent letter and my signature here under indicates my consent to participate in this study voluntarily.

Signature_________________________________________ Date________________

Printed Name_____________________________________
APPENDIX H: Corrected Item-Total Correlations for Each of the Four Constructs
<table>
<thead>
<tr>
<th>Item</th>
<th>Scale Mean</th>
<th>Scale Variance</th>
<th>Corrected Item-Total Correlation</th>
<th>Squared Multiple</th>
<th>Cronbach’s Alpha If Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPCV1</td>
<td>50.27</td>
<td>38.803</td>
<td>.331</td>
<td>.236</td>
<td>.809</td>
</tr>
<tr>
<td>TPCV2</td>
<td>50.76</td>
<td>36.363</td>
<td>.528</td>
<td>.443</td>
<td>.796</td>
</tr>
<tr>
<td>TPCV3</td>
<td>50.35</td>
<td>37.334</td>
<td>.607</td>
<td>.487</td>
<td>.794</td>
</tr>
<tr>
<td>TPCV4</td>
<td>50.20</td>
<td>37.172</td>
<td>.460</td>
<td>.286</td>
<td>.801</td>
</tr>
<tr>
<td>TPCV5</td>
<td>50.39</td>
<td>37.392</td>
<td>.521</td>
<td>.367</td>
<td>.798</td>
</tr>
<tr>
<td>TCAT1</td>
<td>51.14</td>
<td>37.910</td>
<td>.450</td>
<td>.367</td>
<td>.802</td>
</tr>
<tr>
<td>TCAT2</td>
<td>50.38</td>
<td>37.210</td>
<td>.595</td>
<td>.506</td>
<td>.794</td>
</tr>
<tr>
<td>TCAT3</td>
<td>50.27</td>
<td>38.015</td>
<td>.518</td>
<td>.389</td>
<td>.799</td>
</tr>
<tr>
<td>TCAT4</td>
<td>50.21</td>
<td>38.373</td>
<td>.465</td>
<td>.507</td>
<td>.801</td>
</tr>
<tr>
<td>TRTCH1</td>
<td>50.30</td>
<td>37.460</td>
<td>.563</td>
<td>.563</td>
<td>.796</td>
</tr>
<tr>
<td>TRTCH2</td>
<td>50.37</td>
<td>38.735</td>
<td>.423</td>
<td>.311</td>
<td>.804</td>
</tr>
<tr>
<td>TRTCH3</td>
<td>50.61</td>
<td>37.369</td>
<td>.505</td>
<td>.481</td>
<td>.798</td>
</tr>
<tr>
<td>TRTCH4</td>
<td>50.22</td>
<td>38.142</td>
<td>.524</td>
<td>.461</td>
<td>.799</td>
</tr>
</tbody>
</table>

Note: The five items with low corrected item-total correlations are TPCV1 (r = .331), TRTCH5 (r = .333), LOCIS1 (r = .119), LOCIS2 (r = .012), and LOCIS4 (r = .124).
<table>
<thead>
<tr>
<th>Item</th>
<th>Scale Mean</th>
<th>Scale Variance</th>
<th>Corrected Item-total Correlation</th>
<th>Corrected Item-total Correlation Squared</th>
<th>Corrected Item-total Correlation Multiple</th>
<th>Cronbach’s Alpha if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRTCH5</td>
<td>50.31</td>
<td>39.400</td>
<td>.333</td>
<td>.184</td>
<td>.808</td>
<td>Deleted</td>
</tr>
<tr>
<td>LOCIS1</td>
<td>50.62</td>
<td>40.252</td>
<td>.119</td>
<td>.247</td>
<td>.825</td>
<td></td>
</tr>
<tr>
<td>LOCIS2</td>
<td>51.13</td>
<td>41.517</td>
<td>.012</td>
<td>.098</td>
<td>.831</td>
<td></td>
</tr>
<tr>
<td>LOCIS3</td>
<td>50.58</td>
<td>37.021</td>
<td>.452</td>
<td>.280</td>
<td>.801</td>
<td></td>
</tr>
<tr>
<td>LOCIS4</td>
<td>50.58</td>
<td>40.229</td>
<td>.124</td>
<td>.233</td>
<td>.824</td>
<td></td>
</tr>
</tbody>
</table>

Cronbach’s Alpha = .814, Items = 18, N = 256

Note: The five items with low corrected item-total correlations are TPCV1 ($r = .331$), TRTCH5 ($r = .333$), LOCIS1 ($r = .119$), LOCIS2 ($r = .012$) and LOCIS4 ($r = .124$).
APPENDIX I: Scatterplot for Residuals and Predicted Values of Criterion
APPENDIX J: Scatterplot for Standardised Predicted Values of the Criterion
Standardized Predicted Value ($\hat{Y}$) vs. TEOCUICI ($Y$)
APPENDIX K: Histogram of Frequency of the Scores and Regression Residuals
Dependent Variable EOCUICI

Regression Standardized Residual

Frequency

Mean = 7.29E-17
Std. Dev. = 0.988
N = 256