THE RELATIONSHIP BETWEEN COMPUTER USE AND ACADEMIC ACHIEVEMENTS

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Computer technology has been used in education for years, and the government budgets large amounts of money to foster technology. However, it is still a debated whether computer technology makes a difference in students' learning outcomes.

The purpose of this study is to find if any relationship exists between computer use by teachers and students and the students' academic achievement in math and reading for both traditional populations and English language learner (ELL) tenth graders. Computer use in this study included the computer activities by students and teachers, in terms of the time, frequency, activities types, the places students use computers, teachers' computer activities, and the training teachers received.

This study used data gathered from tenth grade students from the dataset Education Longitudinal Study of 2002 (ELS:2002) of the National Center for Education Statistics (NCES). Fifteen thousand, three hundred and sixty-two students were randomly selected to represent all U.S. tenth-graders attending schools in 2002.

The findings showed diverse relationships consistent with the literature. Based on the findings, some suggestions were made to teachers and parents about the quality of school work and computer use by students and teachers.

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CHAPTER 1

INTRODUCTION

Context of the Problem

Computer technology has been used in education for years, and the U.S. government budgets large amounts of money to foster technology. However, it is still a debated question whether computer technology makes a difference in students' learning outcomes.

The purpose of this study is to find the relationship between computer use of teachers and students and the students' academic achievement in math and reading. The literature review of research studies on both sides of this issue will be discussed.

This study will explore the dataset Education Longitudinal Study of 2002 (ELS:2002) from the National Center for Education Statistics of Department of Education. The dataset ELS:2002 is a national education longitudinal study started with tenth-grade students from 2002, and is still gathering follow-up information. This study will focus on the tenth-grade students and their math and English teachers, as well as the sub-group of tenth-grade students whose first language was not English (ELL students) to determine whether a relationship exists between computer activities and academic achievement, as well as the difference between all students and the ELL students.

Student and teacher surveys will be used to gather information. The study will contain two parts in three aspects. The first aspect will be the users; it will include the computer activities of the tenth-grade students, and the computer activities of the tenth-grade students' math and English teachers. The second aspect will be students'

academic achievement; it will include both math and reading standard tests scores from the tenth graders. The third aspect will deal with the language skills; it will include the analysis of all tenth-grade students in the data set and a sub-group of the tenth-grade students whose first language was not English. A comparison between them will be made to identify if there is any difference in relationship because of language skills.

Problem Statement

Computer use by teachers and students is getting more and more common every year. Students and teachers use computers for different tasks and reasons; they are tools in today's academic environment. The U.S. government budgets for the training and technology to foster computer use and try to benefit students.

However, the research studies show conflicting findings regarding the relationship between computer use and academic achievement. The findings show positive, no relationship, and negative relationships. This study uses a large sample of the ELS:2002 data by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education, and better understands any such relationships among this data set.

The computer is more and more popular at schools and at homes. The impact of computer use by students can not be overlooked. The study tried to identify those activities that showed a negative relationship with academic achievement and a list of activities that showed a positive relationship with academic achievement, so teachers and parents or students can benefit from the data and make the best use of computer technology.

Purpose of the Study

The purposes of this study were (a) determine if there was a statistically significant relationship between the computer use of tenth-grade students and their academic performance in math and reading, (b) determine if there was a statistically significant relationship between the computer use of math/English teachers and the academic performance in math and reading of their students, and (c) determine if there was a statistically significant relationship for the same questions above for the students whose first language was not English.

Two surveys and data from the ELS:2002 study by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education are used in this study: the students' survey and the teachers' survey from math and English teachers. Multiple regressions are used to analyze any relationships, and a summary of all the results will be discussed for further study suggestions.

Research Hypotheses

H01: There is no relationship between the standardized math exam scores and computer activities of tenth-grade students.

H02: There is no relationship between the standardized reading exam scores and computer activities of tenth-grade students.

H03: There is no relationship between students' standardized math exam scores and computer activities of their math teachers.

H04: There is no relationship between students' standardized reading exam scores and computer activities of their English teachers.

H05: There is no relationship between the standardized math exam scores and

computer activities of tenth-grade students who are non-native-speakers.

H06: There is no relationship between the standardized reading exam scores and computer activities of tenth-grade students who are non-native-speakers.

H07: There is no relationship between the students' standardized math exam scores and computer activities of their math teachers of tenth-grade students who are non-native-speakers.

H08: There is no relationship between the students' standardized reading exam scores and computer activities of English teachers of tenth-grade students who are non-native-speakers.

Limitations of the Study

This study used a quantitative method to analyze the ELS:2002 data gathered by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education. No contact with participants was possible.

Another limitation of the study is that students and teachers might not have answered the survey questions correctly for various reasons. As with most other studies, it is assumed that teachers and students answered the survey questions with sufficient knowledge and honesty. However, the ELLs may have experienced some difficulty because of the English language proficiency.

Significance of the Study

This study is significant to education for several reasons. Computer use by teachers and students is very important and this study was trying to find the relationship between computer use and academic achievement, so the educational department and parents can make the best use of the computer resources in schools or at their homes.

The literature review showed diverse results of computer use and academic achievement, some positive, some negative, and some with no relationship. This study is trying to find the reason for those diversities and to determine valued recommendations for better use of computers to enhance students' academic achievement. The computer is an effective tool; it can do good things or bad things, depending on the person who uses it. This study tried to find from the statistical analysis a better use of the computer in terms of who, when, where, how, and what. The ELS:2002 study includes data on more than 15 thousand tenth-grade students in the sample; this also increases the significance of the study.

Definitions and Terms

ELL, English language learner

Research studies referred to non-native English speaking students as limited English proficiency (LEP), English as a second language (ESL), English for speakers of other languages (ESOL), or English as a foreign language (EFL). This report uses ELL to refer to students whose native language was not English.

Computer Use

Computer use in this study includes all the computer-related questions in ELS:2002 teachers' and students' surveys. Questions covered the time, frequency, location, activities, and purpose of computer use by teachers and students.

Academic Achievement

In this study, the academic achievement is measured by the students' scores on standardized math and reading tests, which took place in the spring semester of their 10^{th} grade year.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

This chapter is divided into three sections. The first section looks at computer use in education, and research about the relationship of computer technology and students' learning, especially in math and reading. Section 2 looks at computer use among English language learners (ELL) and the possible impact of computer technology on ELL students, the students whose first language is not English. Section 3 concludes with a summary of the findings from the literature review.

Computers in Education

The use of technology has been shown to help middle school students in their math achievement and help educators manage resources for students who need extra support (Jenkins, 2005). Worthen, Van Dusen, and Sailor (1994) did a national study and found that students using a computer integrated learning system were more actively engaged in learning tasks than students in the regular classrooms.

Ravitz, Mergendoller and Rush (2002) did a study in Idaho to find the relationships between student computer use and academic achievement. They reported the following findings from their study:

1. Using student percentage as a measure, there is a negative effect between uses of computers by students at school and school-wide achievement. That is because a greater percentage of students in smaller, lower performing schools,

and a smaller percentage of students in larger, higher performing schools, use computers at school. It is important to control school size and income to understand accurately the relationship between computer use and student achievement.

2. Students who score better on standardized achievement tests are those who use computers more often at home, and less at school. This suggests that home use, not school use is associated with greater achievement.
3. Family income is related to the use of computer at home and school size.
4. Within schools, students who have higher software capability scored higher on tests and also gained more score improvement.
5. Residual gains on test scores were also related to their computer capability. Those characterized as having higher software capability gained more, on average, than others within their school.

They also pointed out the importance of home computing for students because of the substantial relationship between home use and test scores after they controlled for the factor of family income. They also concluded that students' software capability showed a positive relationship to student test scores and test score gains.

Wenglinsky (1998) reported the findings from a national study of the relationship between different uses of educational technology and student achievement in math. The data were drawn from the 1996 National Assessment of Educational Progress (NAEP) in math by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education, consisting of national samples of 6,227 fourth graders and 7,146 eighth graders. The study found that computers related

to math achievement, not in how often they were used, but in the ways in which they were used. When used properly, computers can serve as important tools for improving students' mathematics proficiency and overall learning.

McKinnon, Nolan, and Sinclair. (1997) did a study of ninth graders in New Zealand about the extensive use of computers and an enquiry-based approach that explored Maori and European cultures while integrating math, history, and language arts skills. They found more positive attitudes toward computer use than those in the traditional school program. Academic achievements were also higher in English, math and science for the students who used the computer technology.

Morse (1991) mentions that computer use in education is not limited to computer-assisted instruction (CAI). Computers may also be used as an educational strategy to improve overall learning and computer achievement. Many teachers are currently using computers to make tests and worksheets, while some science teachers also use computers for laboratory activities. The conclusion was that there were positive effects associated with microcomputer use in science education applications. Higher achievement and more positive attitudes were observed in a high school biology course that was "computer-loaded." Computer programs help develop inquiry skills while also increasing scientific knowledge even when strong "misconceptions" were present at first.

Akçay, Durmaz, Tüysüz, and Feyzıoğlu (2006) did research using the students from Dokuz Eylul University to examine the effects of computer based learning on students' attitudes and achievements towards analytical chemistry. They concluded that the attitudes and grades of the students are better with technology. And, a multimedia application for graphs and questions is more attractive than traditional

teaching, especially the use of animation and sound effects. Their study showed that simulation saved money and time; it also showed that students who hesitate to study with computers abstain from business life after university education.

However, Pedró (2005) concluded that technology didn't really help education based on the study of the ICT tool. ICT is a university tool that helps students learn more information efficiently. Pedró (2005) compared traditional and ICT-enriched university teaching methods, and found that ICT did not have a positive influence on students, but it is just a luxury.

Hunley, Evans, Delgado-Hachey, Krise, Rich, and Schell (2005) did a study to investigate the relationship between adolescent computer use and academic achievement. They used questionnaires and seven-day time logs to gather data from 101 tenth-grade students in three high schools in southwestern Ohio. The results showed no statistically significant relationship between time spent on the computer at home and grade point average, nor were there significant relationships between grade point average and the amount of time spent on homework or going out with friends.

Yildirim and Fakültesi (2006) did a study on second-year pre-service teacher education students in Turkey to find the impact of hypermedia authoring on knowledge acquisition and retention. Forty-eight second-year pre-service computer teachers who enrolled in "Instructional Technology and Material Preparation" participated in this study. Their results showed that the use of hypermedia as a cognitive tool resulted in a similar level of student achievement as those who were enrolled in traditional instruction. They concluded that Turkish students had been exposed to traditional teaching for a long time. They were not used to the technology way of teaching.

Johnson (2000) used the data from the 1998 National Assessment of Educational Progress (NAEP) database by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education to analyze the influence of computers on academic achievements for fourth, eighth and twelfth-grade students. Johnson then reported that students with at least weekly computer instruction by well-prepared teachers did not perform any better on the NAEP reading test, and concluded that computer usage was negatively related to academic achievement and computers had little effect on teaching practices or classroom activities.

However, Hedges, Konstantopoulis, and Thoreson (2003) argued that there were some weaknesses in the design of the NAEP database, thus influencing the analysis. The measurement of key variables in the NAEP database is weak and NAEP is a one-point-in-time cross-sectional survey. They recommended that the question design of NAEP database should be improved and they should consider developing teacher questionnaire items that would obtain information about the specific computer software and hardware used.

Fuchs and Woessmann (2004) claimed that students who use computers a lot at school have worse math and reading performance. They analyzed the set of data obtained by the Organization for Economic Cooperation and Development (OECD) Program for International Students Assessment (PISA) conducted in 2000 by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education. Even though the analyses show a positive correlation between students' achievement and the availability of computers both at home and at school, the authors argued that once family background and school characteristics are

controlled, the relationship turns negative. Fuchs and Woessmann stated that the mere availability of a computer at home distracts students from learning. And they argued that schools with more computer access also possess other resources, which leads to the wrong conclusion that computers were the cause of the positive effect. So, the correlation becomes almost zero once they control for other school characteristics.

Bielefeldt (2005) studied the relationship between technology use and student achievement using year 2000 data from the Program for International Student Assessment (PISA 2000) by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education. The findings showed no significant effect on math and reading for computer access in school, and a negative effect on achievement for computer access at home. Although a positive effect was found for Internet use and educational software at home, people who used computers at home were found to have a disadvantage at reading and math skills, and the conclusion was made that computer use at school does not really have any effect on students' learning.

Dynarski, Agodini, Heaviside, Novak, Carey, Campuzano and Means (2007) did a study on the effectiveness of reading and math software products on elementary first and fourth grades students and found that the students' test scores were not significantly higher in classrooms using selected reading and math software products and teachers were not very well trained about the software they were using.

A federal study finds no edge for students using technology-based reading and math products (Trotter, 2007). The $10 million study of 15 educational software products is the most extensive federal study, but the study showed students who used

technology had no significant difference in math and reading achievement compared to other kinds of teaching practices. The study raised many questions about the impact of computer technology on students' learning on both sides of opinions.

The Software and Information Industry Association (SIIA), the principal association of the software and digital content industry, debated that this study does not diminish the critical role that technology plays as an essential skill set for the twenty-first century (eSchool News, 2007). SIIA indicated that most teachers from the study said they would like to continue to use the products. They also learned from the study that implementation of educational software is crucial to the success of any technology. There is a need for an appropriate match of technology design to the local curriculum.

Computers in ELL

For ELL students specifically, most studies found a positive relationship between computer use with achievement. Computer technology can facilitate auditory skills development of LEP (Limited English Proficiency, the term used in the original study) by integrating visual presentation with sound and animation (Bermudez & Palumbo, 1994). Through computer technology, LEP students can learn in a rich linguistic environment and find opportunities to interact with the multicultural world through the Internet (Padron & Waxman, 1996). They can greatly benefit from individualized, student-centered computer collaborative learning, extend their language skills, and reduce embarrassment (Lee, 2000).

Perez (1984) did a review to identify the most appropriate and effective work on promoting the acquisition of English by limited-English-speaking students via the use of computers. Perez concluded there is promising evidence that academic achievement

for ELL students and their reading and writing skills can be improved via the use of computers.

Mustafa (2001) examined the factors involved in using multimedia in foreign language instruction and concluded that there are variations in effects of using multimedia as a teaching aid in improving the oral skills in a foreign language. The influences were irregular for the factors including academic achievement in English at school, general grade point average at the university, and academic achievement in oral courses taught in the traditional method. The influences were positive for the factors including the extent of students' computer use and their attitude towards its use and their socio-economic class. The study also recommended that students be given enough training in using computers before incorporating multimedia as a teaching and learning aid in the English courses, so the influences can be increased.

Summary

There are many studies that suggest positive effects for students who use computer technology. Means and Olson (1994) stated that multimedia software could connect the classroom learning to real life situations and thus enhance students' learning.

However, even though many studies showed positive results using the computer to facilitate classroom teaching, the impact has been very limited (Inkpen, 1999). Some studies even found negative results using computers in education. Angrist and Lavy (2002) did a quasi-experimental study, and they found that computer use might actually decrease student learning.

This study will focus on school computer activities of students and teachers and a

few home computer activities of students, then analyze their relationship with students' academic achievement. The study will include two parts: the first part will use the whole dataset; then, the second part will use the data of students whose first language is not English. The goal is to discover the relationship between computer activities of students and teachers and the academic achievement in tenth-grade students and the relationship in ELL students.

CHAPTER 3

METHODOLOGY

Introduction

This chapter of methodology is divided into seven sections. It starts with the section describing the subjects in the study, then research hypotheses, instruments, procedure**,** research design, data analysis, and then ends with a summary about the methodology.

Subjects

This study used the base-year data of the Education Longitudinal Study of 2002 (ELS:2002). ELS:2002 is sponsored by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education. Over 15,000 high school sophomores were surveyed and assessed in the spring term of 2002 by the NCES, in a national sample of 752 public and private high schools with tenth grades. Their parents, teachers, principals, and librarians were surveyed as well. In addition, cognitive tests in math and reading were administered to these students.

The ELS:2002 schools were selected from a file of approximately 25,000 public and private 10th-grade schools across the United States. For the 752 public and private schools with 10th grades that were sampled and agreed to participate in ELS:2002, approximately 25 students per school were randomly selected. There were totally 15,362 student participants to represent about 3 million 10th-graders attending schools in 2002.

Research Hypotheses

The purpose of the study was to determine whether there is a relationship

between computer use and academic performances on math and reading standardized exams. The computer use included the students' and teachers' computer activities. Then the same research questions were asked for the students who are non-native-speakers to find any relationship.

The following null hypotheses were formed:

H01: There is no relationship between standardized math exam scores and computer activities of tenth-grade students.

H02: There is no relationship between standardized reading exam scores and computer activities of tenth-grade students.

H03: There is no relationship between the students' standardized math exam scores and computer activities of their math teachers.

H04: There is no relationship between the students' standardized reading exam scores and computer activities of their English teachers.

H05: There is no relationship between standardized math exam scores and computer activities of tenth-grade students who are non-native-speakers.

H06: There is no relationship between standardized reading exam scores and computer activities of tenth-grade students who are non-native-speakers.

H07: There is no relationship between the students' standardized math exam scores and computer activities of their math teachers of tenth-grade students who are non-native-speakers.

H08: There is no relationship between the students' standardized reading exam scores and computer activities of their English teachers of tenth-grade students who are non-native-speakers.

Instruments

The data collection instruments for this study include three questionnaires (student, math teacher, and English teacher) and two achievement tests, assessments in reading and math from the Education Longitudinal Study of 2002 (ELS:2002) base year.

Student Questionnaire

The student questionnaire is divided into seven sections: (1) basic information, (2) school experiences and activities, (3) plans for the future, (4) non-English language use, (5) money and work, (6) family, and (7) beliefs and opinions about self. This study used the information from the second section about school experiences and activities, and the fourth section about non-English language use.

The basic information section primarily gathered information needed for future follow-up. It included some of the standard classification variables: date of birth, sex, ethnicity, and race.

The section of school experiences and activities is the longest section of the student questionnaire. The section inquired about school climate, student recognition, school disengagement behaviors (tardiness, class-cutting, etc.), perception of high school program placement (academic, general, or vocational track), attitudes toward school and motivation for attending school, learning environment of the math class, use of computer technology, receipt of special services, time spent on homework, importance of grades to the student, school-sponsored activities (sports and extracurricular activities), time spent in reading and outside activities (including television viewing and video games), and use of the library media center.

The third section of the student questionnaire concerns plans for the future.

Questions included students' personal expectations for highest level of education to be completed and their planning for postsecondary education, such as plans for taking the Scholastic Assessment Test (SAT), American College Test (ACT), or other tests, and where students obtain information about various colleges. Other items ask about their desired job after high school (if going directly into the labor force) or job/occupation at age 30, when most cohort members will have completed their postsecondary education and most will have assumed occupational roles.

The fourth section on language use is aimed at students for whom English is not their native language. Items attempted to identify the native language and to address issues of language acquisition, usage, and the extent to which students' limited English skills affected academic achievement, aspirations, and opportunities.

The fifth section on money and work provided information to identify the type and amount of work that sophomores were engaged in after school and on weekends. Questions were asked about employment type, hours worked, wages earned, participation in work-based learning programs, how students got their job, and whether the job is related to what they would like to do in the future.

The sixth section on the family contained questions that rendered information about the student's family background and characteristics. Questions included the education and occupation of students' parents. A number of items asked about parental monitoring, as perceived by the student, including checking on homework, limiting of television viewing time, requirements such as chores, limitation of amount of time going out with friends on school nights, and so on.

The final section of the student questionnaire was a module on beliefs and opinions

about self. Included were a number of psychological scales: (1) instrumental motivation (utility interest); (2) intrinsic interest (specific to math and to English); (3) general control beliefs and expectations concerning the student's abillity to perform a task; and (4) self-efficacy (specific to math and to English), peer relations and friends' behaviors, dropout propensities, and values.

Teacher Questionnaire

The teacher questionnaire was to be completed by the English teacher and the mathematics teacher of each ELS:2002 sophomore. The teacher questionnaire was designed to illuminate questions of the quality, equality, and diversity of educational opportunity by obtaining information in two content areas: Teacher Evaluations of Students and Teacher Background.

Teacher evaluations of students. The teachers assessed students' school-related behavior, academic performance, and educational and career plans and goals. Respondents completed this section with respect to the sample members they instructed in a particular subject. Teacher evaluations were elicited along a number of dimensions of student motivation and performance. Teachers were asked to rate how hard the student worked for good grades in the class; whether homework assignments were typically completed; and how often the student was absent, tardy, attentive, or disruptive. Other questions inquired into communications with the student's parents and degree of parental involvement. Teachers were asked how far in school they expected the student to get. English teachers were asked to rate the student's compositional skills.

Teacher background. The teacher background section included information about the teacher's background and activities (i.e., academic training, subject areas of

instruction, years of teaching experience, and participation in professional growth activities). The section inquired about the teacher's social and educational background, professional experience, on-the-job training, and social networks. Items collected included basic teacher demographics (gender, race, date of birth), years in teaching and at the school, full-time versus part-time and certification status, academic degrees, field of study, job satisfaction, and attributions of student success and the teacher's experience with computers and other aspects of technology.

The teacher questionnaire was designed to provide data that can be used in analyzing influences on student sample members.

Mathematics Assessments

The ELS:2002 math tests contained items in arithmetic, algebra, geometry, data/probability, and advanced topics and were divided into process categories of skill/knowledge, understanding/ comprehension, and problem solving. The math tests placed a great emphasis on practical applications and problem solving. Ninety percent of the math questions were presented in multiple-choice format and ten percent were open-ended questions scored as right or wrong, with no partial credit awarded.

Reading Assessments

The ELS:2002 reading tests consisted of reading passages of one paragraph to one page in length, followed by three to six questions based on each passage. The reading passages included literary material as well as topics in the natural and social sciences. Several passages required interpretation of graphs. Questions were categorized as reproduction of detail, comprehension, or inference/evaluation. All of the reading questions were presented in multiple-choice format.

Procedure

Student data collection of the Education Longitudinal Study of 2002 (ELS:2002) began in schools on January 21, 2002, and ended in the schools in June 2002. Telephone interviews with non-responding students ended on August 4, 2002. Data collection from school administrators, library media center coordinators, and teachers ended in September 2002. The completion rate was 87.3% for the student questionnaire, 91.6% for the teacher questionnaire, and 95.1% for the student assessment.

Prior to the questionnaire and test administration, consent letters were sent to parents to notify them about the study. Parental consent letters were available in English and Spanish. A version of the consent letter was translated into Mandarin, Vietnamese, Korean, and Tagalog. An English version of the letter and brochure was sent with the Asian language translations to parents of all students who had been identified as Asian by their schools. Only students who had returned signed permission forms were allowed to participate in the study.

The students were first given a timed test in math and reading. After completing the routing tests, the students completed the student questionnaire. All participating students were offered a $20 gift certificate.

The teacher questionnaire was designed to obtain teacher reports of information. Teacher data collection was conducted via a mailed questionnaire. Questionnaire packets were prepared for each teacher, and all of the packets were mailed to the school coordinator for distribution. Each packet contained a lead letter, a brochure explaining the study, the ELS:2002 Uses of Data booklet, a list of sampled students for

that particular teacher, the teacher questionnaire, and a postage-paid return envelope. Teachers were sent a reminder postcard that asked them to complete the questionnaire and return it. Prompting telephone calls were made to non-responding teachers through September 2002.

Incentives were offered to responding teachers, based upon the number of students that each teacher was asked to report on. Incentives offered were: $10 to teachers reporting on 1-5 students, $20 to those reporting on 6 to 10 students, $30 to those reporting on 11 to 15 students, and $40 to teachers reporting on 16 or more students.

Research Design

This study examined the survey for students and reading and math teachers from the base-year data of the Education Longitudinal Study of 2002 (ELS:2002). The dependent variables were the students' standardized math and reading exam scores. The independent variables were the students' computer use in math and English classes, and math/English teachers' computer use. The students' computer use was divided into four kinds of variables: students' computer activities, when the students used computers, where the students used computers, and the students' home access to computers. The teachers' computer use was divided into two kinds of variables: teachers' computer activities and teachers' computer training received. The details of variables are listed below.

Independent Variables of Students' Computer Use in English Classes

Independent variables of students' computer use in English classes included the following four types of variables:

1. Variables about students' computer activities: Included '"How often uses computer for fun," "How often uses computer for school work," "How often uses computer to learn on own," "Hours/day on computer for school work," "Hours/day on computer other than for school," "Hours/day plays video/computer games on weekdays," and "Hours/day plays video/computer games on weekends."

2. Variables about when the students used computers: Included "Used computer in ninth grade fall math," "Used computer in ninth grade spring math," "Used computer in tenth grade fall math," and "Uses computer in tenth grade spring math."

3. Variables about where the students used computers: Included "How often uses computer at home," "How often uses computer at school," "How often uses computer at public library," "How often uses computer at friend's house," and "How often uses computer at another place."

4. Variables about the students' home access to computers: Included "Family has a computer" and "Family has access to the Internet."

Independent Variables of Students' Computer Use in Math Classes

Independent variables of students' computer use in math classes including all the independent variables of students' computer use in English classes plus the following variables about students' computer activities: "How often uses computers in math class," "How often uses computers to review math work," "How often uses computers to solve math problems," "How often uses computers for graphing in math class," "How often uses computers to practice math drills," "How often uses computers to analyze data in math class," "How often uses computers to apply learning in math class," "How often math teacher uses computer to instruct one-on-one," and "How often math teacher

uses computer to show new topics."

Independent Variables of Math/English Teachers' Computer Use

Independent variables of math/English teachers' computer use included the following two types of variables:

1. Variables about the teachers' computer activities: Included "How often use computer to create materials," "How often use Web sites to plan lessons," "How often use model lesson plans from Internet," "How often use Internet for research on teaching," "How often take professional development courses on Internet," "How often use Internet for colleague discussions," "How often download instructional software from Internet," "How often use computer to give class presentations," "How often use computer for administrative records," "How often use computer for administrative records," "How often use computer to prepare multimedia presentations," "How often use computer to communicate w/colleagues," "How often use computer to communicate w/parents," "How often use computer to communicate w/students," and "How often use computer to post homework/information."

2. Variables about the teachers' computer training received: Included "Received basic computer training," "Received software applications training," "Received training in use of the Internet," "Received training in use of other technology," "Received training in integrating technology in curriculum," and "Received follow-up or advanced training."

All subjects were used to represent the tenth-grade students in general, and a subset of students whose native language was not English were retrieved to represent the tenth-grade students who are non-native-speakers. Regression analysis was used to analyze the data.

Data Analysis

The dependent variables were obtained from the students' math and reading standardized test scores. The independent variables were the computer use and activities by the students and teacher.

The computer use by the students was measured with the questionnaire about how, when, where, how much time, and the frequency of the computer use by the students, and their family access of computers. Regression analysis was used to find if there was a relationship between the students' computer use and their academic achievement.

Students for whom English is not their native language were retrieved as a subset to find if the same relationship existed between their computer use and academic achievement.

The computer use of the teachers was measured by the questionnaire about the job training activities and the frequency of ways that teachers used a computer in their job or teaching. Regression analysis was used to find if there was any relationship between the teachers' computer activities and the academic achievement of their students.

Summary

The purpose of this study was to investigate the relationship between the computer activities and students academic achievements. Both computer activities of teachers and students were investigated. The study also investigates the students for whom English is not their native language, and tried to find any relationship between their computer use and their academic achievement.

The 752 participating schools in the base year represent the approximately 25,000

public and private schools in the United States in 2002 that had a 10th grade. The 15,362 ELS: 2002 base-year student participants represent about 3 million 10th-graders attending schools in 2002. The schools and students samples were randomly selected from the population. Although it is not possible to use the whole population of the tenth graders in the United States for the study, it is believed that the sample can be generalized to the population.

The math and reading standardized test scores of the students were used to measure the academic achievement, the dependent variable. The student and teacher questionnaires were used to obtain the students' and teachers' computer activities. Multiple regression analyses were used to find if there were any relationship between the computer use of teachers and their students' academic achievement, as well as the relationships between the students' computer use and the academic achievement.

CHAPTER 4

RESULTS

Introduction

The purpose of this study was to determine if there is a relationship between the computer use of tenth-grade students/ teachers and the academic achievement on students' math and reading standard tests. Regression analysis was used to determine if there is a statistically significant relationship.

This chapter includes four sections. The first section provides a summary of the research participants in the study. The second section provides statistical analysis of results for all research questions. The third section provides a comparison for the results between tenth-grade students and the tenth-grade students whose first language is not English. The fourth section concludes the chapter with a brief summary.

Research Participants

This study examined the base-year data of the Education Longitudinal Study of 2002 (ELS:2002). The sample involved in this study was comprised of tenth-grade students and their math and reading teachers that were randomly selected from 752 public and private high schools in the United States with 10th grades.

There were approximately 25,000 public and private 10th-grade schools across the United States in 2002. About 25 students per school were randomly selected from 752 schools. There were a total of 15,362 student participants and about 2,500 teachers who participated in the ELS base-year study in 2002.

Statistical Analysis of Results

Data analysis was done utilizing Statistical Package for the Social Sciences ®

(SPSS) Version 14.0 (SPSS Inc., IL, www.spss.com).

Regression analysis was used to determine if there was a relationship between the computer use and academic achievement. The results showed statistically significant differences for all of the research hypotheses.

Hypothesis 1

The null hypothesis 1 stated that there is no relationship between the performance on standardized math exam scores and computer activities of tenth-grade students. The dependent variable was the standardized math test score; and the independent variables were the students' computer activities. The independent variables about the students' computer activities included four types: the computer activities, the semester of using computers, the location of using computers, and the home access of computers.

Five tables are provided with the results of the regression analysis. Table 1 below shows the students' computer activities that had a positive relationship with math achievement. Table 2 shows the students' computer activities that had a negative relationship with math achievement. Table 3 shows the relationship between the semesters that students used computers and math achievement in tenth grade. Table 4 shows the relationship between the locations that students used computers and math achievement. Table 5 shows the relationship between the students' home computer access and math achievement. The effect size is .207, and the R square is .209.

Table 1

Students' Computer Activities that Showed a Positive Relationships with Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	48.470	.224		216.501	.000
How often uses computers to analyze data in math class	.302	.106	.066	2.835	.005
How often uses computer for fun	.250	.077	.074	3.253	.001
How often uses computer for school work	.596	.073	.165	8.198	.000
Hours/day on computer for school work	.148	.056	.037	2.666	.008
Hours/day plays video/computer games on weekends	.209	.057	.059	3.698	.000

Dependent Variable: standardized math test score

Table 2

Students' Computer Activities that Showed Negative Relationships with Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often uses computers in math class	-.226	.037	-.058	-6.137	.000
How often uses computers to review math work	-.329	.111	-.069	-2.973	.003
How often uses computers to solve math problems	-.126	.051	-.028	-2.449	.014
Hours/day on computer other than for school	-.263	.049	-.075	-5.329	.000
Hours/day plays video/computer games on weekdays	-.267	.064	-.068	-4.154	.000

Dependent Variable: standardized math test score

Table 3

Relationship between the Semesters Using Computers and Math Achievement in Tenth Grade Spring

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Used computer in ninth grade math (fall)	.029	.077	.006	.382	.703
Used computer in ninth grade math (spring)	.481	.074	.107	6.477	.000
Used computer in tenth grade math (fall)	.424	.071	.095	5.967	.000
Uses computer in tenth grade math (spring)	-.014	.068	-.003	-.208	.835

Dependent Variable: standardized math test score

Table 4

Relationship between the Locations of Using Computers and Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often uses computer at home	.882	.069	.265	12.788	.000
How often uses computer at school	.042	.058	.012	.715	.475
How often uses computer at public library	-.319	.075	-.080	-4.275	.000
How often uses computer at friend's house	-.118	.077	-.031	-1.535	.125
How often uses computer at another place	-.596	.080	-.150	-7.492	.000

Dependent Variable: standardized math test score

Table 5

Relationship between the Home Computer Access and Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Family has a computer	.276	.098	.075	2.806	.005
Family has access to the Internet	.541	.099	.146	5.453	.000

Dependent Variable: standardized math test score

Hypothesis 2

The null hypothesis 2 stated that there is no relationship between the performance on standardized reading exam scores and computer activities of tenth-grade students. The dependent variable was the standardized reading test score, and the independent variables were the students' computer activities. The independent variables about the students' computer activities included four types: the computer activities, the semester of using computers, the location of using computers, and the home access of computers.

Tables 6 to 10 provide the results of the regression analysis. Table 6 shows the students' computer activities that had a positive relationship with reading achievement. Table 7 shows the students' computer activities that had a negative relationship with reading achievement. Table 8 shows the relationship between the semesters that students used computers and reading achievement in tenth grade. Table 9 shows the relationship between the locations that students used computers and reading achievement. Table 10 shows the relationship between the students' home computer access and reading achievement. The effect size is .216, and the R square is .217.

Table 6

Students' Computer Activities that Showed Positive Relationships with Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	48.236	.176		274.681	.000
How often uses computer for fun	.188	.076	.056	2.473	.013
How often uses computer for school work	.527	.072	.146	7.310	.000
Hours/day on computer for school work	.176	.055	.044	3.188	.001

Dependent Variable: standardized reading test score

Table 7

Students' Computer Activities that Showed Negative Relationships with Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Hours/day on computer other than for school	-.265	.049	-.076	-5.435	.000
Hours/day plays video/computer games on weekdays	-.281	.064	-.072	-4.406	.000

Dependent Variable: standardized reading test score

Table 8

Relationship between the Semesters Using Computers and Reading Achievement in Tenth Grade Spring

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Used computer in ninth grade English (fall)	.164	.070	.037	2.341	.019
Used computer in ninth grade English (spring)	.374	.067	.087	5.558	.000
Uses computer in tenth grade English (fall)	.310	.063	.072	4.953	.000
Uses computer in tenth grade English (spring)	.020	.060	.005	.328	.743

Dependent Variable: standardized reading test score

Table 9

Relationship between the Locations of Using Computers and Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often uses computer at home	.845	.068	.254	12.375	.000
How often uses computer at school	.035	.058	.010	.605	.545
How often uses computer at public library	-.285	.074	-.072	-3.865	.000
How often uses computer at friend's house	-.162	.076	-.042	-2.142	.032
How often uses computer at another place	-.575	.079	-.146	-7.294	.000

Dependent Variable: standardized reading test score

Table 10

Relationship between the Home Computer Access and Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Family has a computer	.417	.097	.114	4.284	.000
Family has access to the Internet	.489	.098	.132	4.976	.000

Dependent Variable: standardized reading test score

Hypothesis 3

The null hypothesis 3 stated that there is no relationship between the students' performance on standardized math exam scores and computer activities of their math teachers. The dependent variable was the standardized math test score, and the independent variables were the math teachers' computer activities. The math teachers' computer use included teachers' computer activities and teachers' computer training.

Three tables are provided with the results of the regression analysis. Table 11 shows the math teachers' computer activities that had a positive relationship with their students' math achievement. Table 12 shows the math teachers' computer activities that had a negative relationship with their students' math achievement. Table 13 shows the relationship between the math teachers' computer training and their students' math achievement. The effect size is .078, and the R square is .079.

Table 11

Math Teachers' Computer Activities that Showed Positive Relationships with Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	50.284	.213		235.776	.000
How often use computer to create materials (math)	.160	.078	.045	2.048	.041
How often use computer to give class presentations (math)	.246	.089	.054	2.760	.006
How often use computer to communicate w/parents (math)	1.020	.080	.247	12.776	.000

Dependent Variable: standardized math test score

Table 12

Math Teachers' Computer Activities that Showed Negative Relationships with Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often use Web sites to plan lessons (math)	-.307	.097	-.073	-3.168	.002
How often use model lesson plans from Internet (math)	-.351	.089	-.077	-3.928	.000
How often use Internet for research on teaching (math)	-.505	.096	-.111	-5.280	.000
How often use computer for administrative records (math)	-.190	.056	-.061	-3.413	.001

Dependent Variable: standardized math test score

Table 13

Relationship between the Math teachers' Computer Training and Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Received training in basic computer skills (math)	.029	.168	.005	.175	.861
Received training in software applications	.391	.167	.071	2.340	.019
Received training in use of Internet	.285	.126	.052	2.255	.024
Received training in use of other technology	.195	.146	.033	1.338	.181
Received training in integrating technology in curriculum	.291	.140	.051	2.079	.038
Received follow-up or advanced training	.114	.105	.020	1.090	.276

Dependent Variable: standardized math test score

Hypothesis 4

The null hypothesis 4 stated that there is no relationship between the students' performance on standardized reading exam scores and computer activities of their English teachers. The dependent variable was the standardized reading test score, and the independent variables were the English teachers' computer activities. The English teachers' computer use included teachers' computer activities and teachers' computer training received.

Three tables are provided with the results of the regression analysis. Table 14 shows the English teachers' computer activities that had a positive relationship with their students' reading achievement. Table 15 shows the English teachers' computer activities that had a negative relationship with their students' reading achievement. Table 16 shows the relationship between the English teachers' computer training and their students' reading achievement. The effect size is .065, and the R square is .066.

Table 14

English Teachers' Computer Activities that Showed Positive Relationships with Students' Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	50.457	.233		217.007	.000
How often use computer to create materials (English)	.417	.084	.132	4.980	.000
How often use Internet for colleague discussions (English)	.193	.084	.044	2.291	.022
How often use computer to communicate w/parents (English)	.877	.081	.224	10.892	.000

Dependent Variable: standardized reading test score

Table 15

English Teachers' Computer Activities that Showed Negative Relationships with Students' Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often access model lesson plans from Internet (English)	-.488	.077	-.125	-6.314	.000
How often use computer for administrative records (English)	-.279	.060	-.095	-4.614	.000
How often use computer to communicate w/colleagues (English)	-.341	.059	-.107	-5.765	.000

Dependent Variable: standardized reading test score

Table 16

Relationship between the Math Teachers' Computer Training and Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Received training in basic computer skills	.009	.141	.002	.066	.948
Received training in software applications	.034	.124	.007	.275	.783
Received training in use of Internet	-.018	.111	-.004	-.165	.869
Received training in use of other technology	.494	.120	.093	4.117	.000
Received training in integrating technology in curriculum	.250	.167	.048	1.501	.133
Received follow-up or advanced training	.240	.100	.046	2.400	.016

Dependent Variable: standardized reading test score

Hypothesis 5

The null hypothesis 5 stated that there is no relationship between the performance on standardized math exam scores and computer activities of tenth-grade students who are non-native-speakers. The dependent variable was standardized math test score of students who are non-native-speakers, and the independent variables were the ELL students' computer activities. The independent variables about the ELL students' computer activities included four types: the computer activities, the semester of using computers, the location of using computers, and the home access of computers.

Five tables are provided with the results of the regression analysis. Table 17 shows the ELL students' computer activities that had a positive relationship with math achievement. Table 18 shows the ELL students' computer activities that had a negative relationship with math achievement. Table 19 shows the relationship between the semesters that ELL students used computers and math achievement in tenth grade. Table 20 shows the relationship between the locations that ELL students used computers and math achievement. Table 21 shows the relationship between the ELL students' home computer access and math achievement. The effect size is .171, and the R square is .180.

Table 17

ELL Students' Computer Activities that Showed a Positive Relationship with Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	45.927	.469		97.920	.000
How often uses computers to analyze data in math class	.506	.203	.134	2.491	.013
How often uses computer for fun	.581	.155	.180	3.745	.000
How often uses computer for school work	.306	.141	.091	2.168	.030
Hours/day on computer for school work	.295	.107	.087	2.766	.006
Hours/day plays video/computer games on weekends	.314	.116	.100	2.713	.007

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Table 18

ELL Students' Computer Activities that Showed a Negative Relationship with Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often uses computers in math class	-.297	.076	-.083	-3.926	.000
How often uses computers to solve math problems	-.256	.113	-.069	-2.272	.023
Hours/day plays video/computer games on weekdays	-.410	.131	-.117	-3.121	.002

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Table 19

Relationship between the Semesters ELL Students Used Computers and Math Achievement in Tenth Grade

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Used computer in ninth grade math (fall)	-.101	.164	-.027	-.617	.537
Used computer in ninth grade math (spring)	.434	.160	.119	2.716	.007
Used computer in tenth grade math (fall)	.609	.174	.163	3.501	.000
Uses computer in tenth grade math (spring)	-.229	.170	-.062	-1.350	.177

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Table 20

Relationship between the Location ELL Students Used Computers and Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often uses computer at home	.845	.131	.267	6.456	.000
How often uses computer at school	-.104	.131	-.030	-.791	.429
How often uses computer at public library	-.249	.164	-.067	-1.514	.130
How often uses computer at friend's house	-.366	.152	-.099	-2.403	.016
How often uses computer at another place	-.746	.174	-.200	-4.295	.000

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Table 21

Relationship between the ELL Students' Home Computer Access and Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Family has a computer	.105	.173	.035	.606	.544
Family has access to the Internet	.340	.175	.111	1.948	.051

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Hypothesis 6

The null hypothesis 6 stated that there is no relationship between the performance on standardized reading exam scores and computer activities of tenth-grade students who are non-native-speakers. The dependent variable was standardized reading test score of students who are non-native-speakers, and the independent variables were the ELL students' computer activities. The independent variables about the ELL students' computer activities included four types: the computer activities, the semester of using computers, the location of using computers, and the home access of computers.

Tables 22 to 26 provide the results of the regression analysis. Table 22 shows the ELL students' computer activities that had a positive relationship with reading achievement. Table 23 shows the ELL students' computer activities that had a negative relationship with reading achievement. Table 24 shows the relationship between the semesters that ELL students used computers and their reading achievement in tenth grade. Table 25 shows the relationship between the locations that ELL students used computers and their reading achievement. Table 26 shows the relationship between the ELL students' home computer access and their reading achievement. The effect size is .139, and the R square is .145.

Table 22

ELL Students' Computer Activities that Showed a Positive Relationship with Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	45.774	.355		128.989	.000
How often uses computer for fun	.397	.145	.133	2.743	.006
How often uses computer for school work	.309	.132	.100	2.341	.019
Hours/day on computer for school work	.263	.099	.085	2.646	.008

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Table 23

ELL Students' Computer Activities that Showed a Negative Relationship with Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Hours/day plays video/computer games on weekdays	-.313	.123	-.097	-2.553	.011

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Table 24

Relationship between the Semesters ELL Students Used Computers and Reading Achievement in Tenth Grade Spring

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Used computer in ninth grade English (fall)	.102	.143	.031	.719	.472
Used computer in ninth grade English (spring)	.313	.138	.095	2.264	.024
Uses computer in tenth grade English (fall)	.103	.131	.031	.786	.432
Uses computer in tenth grade English (spring)	.016	.126	.005	.127	.899

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Table 25

Relationship between the Location ELL Students Used Computers and Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often uses computer at home	.768	.122	.264	6.284	.000
How often uses computer at school	-.199	.122	-.063	-1.628	.104
How often uses computer at public library	-.387	.153	-.113	-2.530	.011
How often uses computer at friend's house	-.383	.142	-.112	-2.702	.007
How often uses computer at another place	-.435	.162	-.127	-2.684	.007

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Table 26

Relationship between the ELL Students' Home Computer Access and Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Family has a computer	.216	.162	.077	1.337	.181
Family has access to the Internet	.347	.163	.123	2.126	.034

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Hypothesis 7

The null hypothesis 7 stated that there is no relationship between the students' performance on standardized math exam scores and computer activities of their math teachers of tenth-grade students who are non-native-speakers. The dependent variable was the standardized math test score of students who are non-native-speakers, and the independent variables were the math teachers' computer activities. The math teachers' computer use included teachers' computer activities and teachers' computer training received.

Three tables are provided with the results of the regression analysis. Table 27 shows the math teachers' computer activities that had a positive relationship with ELL students' math achievement. Table 28 shows the math teachers' computer activities that had a negative relationship with ELL students' math achievement. Table 29 shows the relationship between the math teachers' computer training and ELL students' math achievement. The effect size is .029, and the R square is .037.

Table 27

Math Teachers' Computer Activities that Showed Positive Relationships with ELL Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	47.506	.473		100.412	.000
How often use computer to communicate w/parents (math)	.855	.183	.241	4.674	.000

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Table 28

Math Teachers' Computer Activities that Showed Negative Relationships with ELL Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often use model lesson plans from Internet (math)	-.370	.166	-.098	-2.230	.026

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Table 29

Relationship between the Math Teachers' Computer Training and ELL Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Received training in basic computer skills	-.786	.416	-.162	-1.891	.059
Received training in software applications	.994	.467	.207	2.127	.033
Received training in use of Internet	.458	.335	.095	1.364	.173
Received training in use of other technology	.209	.323	.041	.646	.519
Received training in integrating technology in curriculum	-1.004	.333	-.206	-3.015	.003
Received follow-up or advanced training	.012	.187	.003	.063	.950

a Dependent Variable: standardized math test score

b Selecting only cases for which English is student's native language = No

Hypothesis 8

The null hypothesis 8 stated that there is no relationship between the students' performance on standardized reading exam scores and computer activities of their English teachers of tenth-grade students who are non-native-speakers. The dependent variable was the standardized reading test score of students who are non-native-speakers, and the independent variables were the English teachers' computer activities. The English teachers' computer use included teachers' computer activities and teachers' computer training received.

Three tables are provided with the results of the regression analysis. Table 30 shows the English teachers' computer activities that had a positive relationship with ELL students' reading achievement. Table 31 shows the English teachers' computer activities that had a negative relationship with ELL students' reading achievement. Table 32 shows the relationship between the English teachers' computer training and ELL students' reading achievement. The effect size is .025, and the R square is .033.

Table 30

English Teachers' Computer Activities that Showed Positive Relationships with ELL Students' Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	47.274	.487		97.116	.000
How often use computer to communicate w/parents (English)	1.074	.176	.344	6.120	.000

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Table 31

English Teachers' Computer Activities that Showed Negative Relationships with ELL Students' Reading Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
How often access model lesson plans from Internet (English)	-.663	.175	-.215	-3.793	.000
How often use computer to prepare multimedia presentations (English)	-.358	.167	-.111	-2.145	.032
How often use computer to communicate w/colleagues (English)	-.312	.132	-.125	-2.357	.019

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Table 32

Relationship between the Math Teachers' Computer Training and ELL Students' Math Achievement

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Received training in basic computer skills	.484	.291	.115	1.661	.097
Received training in software applications	-.076	.277	-.018	-.274	.784
Received training in use of Internet	.035	.297	.009	.118	.906
Received training in use of other technology	.458	.232	.109	1.977	.048
Received training in integrating technology in curriculum	-.142	.333	-.034	-.425	.671
Received follow-up or advanced training	-.197	.197	-.047	-.998	.318

a Dependent Variable: standardized reading test score

b Selecting only cases for which English is student's native language = No

Comparison between Students

This section compares the differences of the results between general tenth-grade students and the tenth-grade students whose first language is not English. The tables below show the comparisons. The "+" sign represents a statistically significant positive relationship; the "-" sign represents a statistically significant negative relationship, while "X" represents no statistically significant relationship.

The tables list only items where there are differences in the findings between ELL and all general students. Table 33 compares ELL and all tenth-grade students' relationship between computer activities and performance on standardized math exam scores. Table 34 compares ELL and all tenth-grade students' relationship between computer activities and performance on standardized reading exam scores. Table 35 compares ELL and all tenth-grade students' relationship between math teachers' computer activities and students' performance on standardized math exam scores. Table 36 compares ELL and all tenth-grade students' relationship between English teachers' computer activities and students' performance on standardized reading exam scores.

Table 33

The Comparison of ELL and All Tenth-grade students' Relationship between Computer Activities and Math Achievement

Computer Activities of the Students	Math, tenth-grade students	Math, tenth grade ELL Students
How often uses computers to review math work	-.329	X
Hours/day on computer other than for school	-.263	X
How often uses computer at public library	-.319	X
How often uses computer at friend's house	X	-.366
Family has a computer	+.276	X
Family has access to the Internet	+.541	X

+: statistically significant positive relationship

-: statistically significant negative relationship

X: no statistically significant relationship.

Table 34

The Comparison of ELL and All Tenth-grade students' Relationship between Computer Activities and Reading Achievement

Computer Activities of the Students	Reading, tenth-grade students	Reading, tenth grade ELL Students
Used computer in ninth grade fall English Classes	+.164	X
Used computer in tenth grade fall English Classes	+.310	X
Hours/day on computer other than for school	-.265	X
Family has a computer	+.417	X

+: statistically significant positive relationship

-: statistically significant negative relationship

X: no statistically significant relationship.

Table 35

The Comparison of ELL and All Tenth-grade students' Relationship between Math Teachers' Computer Activities and Students' Math Achievement

Math Teachers' Computer Activities of the Students	Math, tenth-grade students	Math, tenth grade ELL Students
How often use computer to create materials	+.160	X
How often use Web sites to plan lessons	-.307	X
How often use Internet for research on teaching	-.505	X
How often use computer to give class presentations	+.246	X
How often use computer for administrative records	-.190	X
Received training in use of Internet	+.285	X
Received training in integrating technology in curriculum	+.291	-1.004

+: statistically significant positive relationship

-: statistically significant negative relationship

X: no statistically significant relationship.

Table 36

The Comparison of ELL and All Tenth-grade students' Relationship between English Teachers' Computer Activities and Students' Reading Achievement

English Teachers' Computer Activities of the Students	Reading, tenth-grade students	Reading, tenth grade ELL Students
How often use computer to create materials	+.417	X
How often use Internet for colleague discussions	+.193	X
How often use computer for administrative records	-.279	X
How often use computer to prepare multimedia presentations	X	-.358
Received follow-up or advanced training	+.240	X

+: statistically significant positive relationship

-: statistically significant negative relationship

X: no statistically significant relationship.

Summary

This study examined the base-year data of the Education Longitudinal Study of 2002 (ELS:2002). The sample involved 15,362 10th-grade students and 2,500 of their Math and English teachers randomly selected from public and private high schools in the United States with 10th grades in 2002.

Eight research questions were formed to find the relationship between the teachers' and students' computer use and the students' academic performance on standard math and reading tests. The results showed statistical significances for all the research questions. Both positive and negative relationships were found from the analyses. The result of difference between general tenth-grade students and the tenth-grade students whose first language is not English was included to compare the relationship.

Those relationships that were statistically significant led to further discussion and conclusions in the next chapter, and also connected to the literature review in chapter two.

CHAPTER 5

DISCUSSION

Introduction

The purpose of this study was to determine if any relationship exists between computer use and academic performance. Academic performance included the standardized math and reading tests results. Computer use included the computer activities by students and teachers, in terms of the time, frequency, activities type/purpose, the places they use computers, the training teachers received, etc. The study also used a sub-group study of students whose first language is not English for the same research questions.

Chapter 1 presented the background information, subjects and the problems addressed. Chapter 2 was a literature review for research studies on the research topic, and computer use in ELL education. Studies showed various findings about the relationship between computer use and the academic achievement. Chapter 3 explained the methodology of data analysis and variables. Chapter 4 presented the data and statistical results. Statistically significant differences were found in both negative and positive directions, which reflected the diverse findings from the literature review in chapter two.

This chapter is divided into four sections discussing the findings from chapter 4, and compares the results for all students and ELL students to offer some suggestions for teachers and parents. Section 1 discusses the students' computer use and academic achievement. Section 2 discusses the teachers' computer use and their students' academic achievement. Section 3 draws some suggestions for future

research and section 4 concludes the study.

Students' Computer Use and Academic Achievement

This section examines the relationship between the computer activities of tenth-grade students and their performance on standardized math and reading exams. Four hypotheses, 1, 2, 5, and 6, addressed the relationship between the computer activities of tenth-grade students and their performance on standardized math and reading exams. Hypotheses 1 and 5 focused on the math exam; hypothesis 1 looked at the whole dataset and hypothesis 5 only looked at the tenth-grade students who are non-native-speakers. Hypotheses 2 and 6 focused on the reading, but hypothesis 2 looked at the whole dataset and hypothesis 6 only looked at the tenth-grade students who are non-native-speakers. The findings showed very similar relationships whether or not the students are non-native English speakers, so the author discusses their findings together.

The results were consistent with the literature. It depends on the people who are using the computer that makes it good or bad for the students. The results showed the relationship, not the cause-effect; however, all educators, parents, and students might want to consider the findings and discussion in this section when they try to make the best use of the computer.

The discussion is in four parts: types of computer activities, the semester when they used computers in relationship to tests in the spring of tenth grade, the places they used computers, and the access to computers at home.

For the computer activities, the findings showed both positive and negative relationships with students' academic performance. The factors that made no

statistically significant relationship to the academic achievements included using computers to graph, drill practices, show new topics, apply learning and to learn on their own or instruct one-on-one in math class. Most teachers and students use the graphic calculators. The calculators are more accessible and teachers provide them in class for graphing purpose. So, they should be a better tool than computers for this purpose. Math is a subject that demands a deep understanding of the content. Computers will not make a difference in students' learning without their fully understanding the topic. Just providing students with drills and practice or providing them a computer to let students learn on their own and apply their learning, did not show a positive relationship in learning their math.

The same finding occurs reading achievement. Using computers for students to learn on their own does not show a significant relationship to students' reading performance on exams. Teachers need to explain the subject and guide the students through the computer activities, not just let them use the computer on their own without proper guidance.

The following factors showed a statistically significant negative relationship to students' academic performance: how often they use computers in math class, review math work (only general students), use computers to solve math problems and use computers for non-school work for both math and reading. It is not surprising that using computers for non-school work had a negative relationship with the students' academic performance on both math and reading. The time at school is quite limited already; if students spend their learning time at school for non-school activities, when and how can they be expected to learn what they are supposed to learn? Teachers should be aware

of what students are doing in front of the computer when they are at school. Using computers appears to be most beneficial when the activity is designed to enhance student understanding rather than complete some work.

It would be helpful to know the cause of these relationships. Why there is a negative relationship between students' use of computer in math class and their score on the math exam, and the negative relationship between using computers to review math work and to solve math problems with students' math performance. It is interesting that many colleges have math and computer science in the same department, and students talented in computer science tend to be also good at math. However, the data in this study showed math teachers used computers in class much less than English teachers. The common use of graphic calculators might have a relationship with those negative findings. We are supposed to make good use of tools based on their capabilities and accessibilities; teachers do not need to have students use computers just because they are available. Wenglinsky (2005) indicated that the quality of computer work was more important than the quantity and frequency. Math teachers might want to implement computers in other ways, such as data analysis and assigning some higher level homework.

The following factors showed statistically significant positive relationships to students' academic performance: using computers to analyze data in math class, the frequent use of computers for fun, for school work and the hours/day on computers for school work. The findings showed that the computer is a good tool to analyze data in math class, and using computers frequently and spending longer time on the computer for school work, all showed positive relationships with academic achievement in both

math and reading. However, the frequency of using a computer for fun showed a positive relationship while the hours/day on the computer for non-school work showed a negative relationship. Teachers might want to be cautious about the length of time allowed for students to use computers for fun at school. We will discuss further the time and length of using computers at home later in the chapter.

The findings showed for computers to show a positive relationship for computers use to students' learning, it took place at least one semester before the exam. The use of computers in the same semester of the exam did not show a relationship to academic achievement. We conclude that learning takes time. We must be prepared at least one semester ahead of the tests for computers to be beneficial for students' learning. The finding showed that using computers in the spring of ninth grade and the fall of tenth grade, prior to their exams in spring of tenth grade, showed positive relationship with both reading and math achievements.

This part of the discussion examines the relationship of where the students used computers and their academic achievement. The study showed no statistically significant relationship between how often students use computers at school and their academic performance on either math or reading; however, there was a significant positive relationship between using the computer at home and the achievement in both math and reading. This finding aligns with Wenglinsky's 2005 study. Wenglinsky suggested that the quality of school work using computers made a difference in students' leaning. However, because high-quality school work using computers demanded more time, this can only happen outside the schools. Wenglinsky suggested that teachers should not plan their lessons around computers. Instead, they should

assume students will use computer technology to address their learning tasks and prepare their students with a technology-rich work environment after their graduation.

Students can access computers almost anywhere; we discussed the computer use at school and home. How about other locations? These findings showed a statistically significant negative relationship between academic performance and the use of computers at the public library, friend's house, and other places. Because students were not supervised in those locations, we assumed they are not going to use computers for school-related work; so there was a negative relationship with academic performance.

We learned from the study that high quality school work using computers showed positive relationships, while computer games showed a negative relationship. The study did find a negative relationship between playing video/computer games on weekdays and academic achievement; however, it showed that playing video/computer games on weekends had a positive relationship with math achievement, and no relationship with reading achievement. Parents surely want to take this into consideration. Since it is almost "a mission impossible" to forbid playing video/computer games, why not let your children play them on weekends. Then you have a reason to restrict them playing on weekdays.

Finally, we discussed the relationships between academic achievement and the students' home access to computers. The study showed significant positive relationships with students' academic achievement when the family has a computer and also when the family has access to the Internet. The high quality of school work using computers should explain this finding. However; for the ELL students, it only showed

positive relationships between reading achievement and if the family has access to the Internet; it showed no relationship between math achievements for both having computers at home and having Internet access at home and also no relationship for ELL students for reading achievement and having computers at home. The study suggests that the ELL students got less benefit from computer use than the general students. However, many studies in literature review did show positive effects of using computers in ELL education. Some of these studies, (e.g., Bermudez & Palumbo, 1994, Perez, 1984, Lee, 2000) all suggested positive effects of using computers in ELL education. Bermudez and Palumbo (1994) did a study of using multimedia computer technology to facilitate auditory skills development of ELL students, and concluded that ELL students improved their auditory skills by integrating visual presentation with sound and animation. Perez (1984) also found that there is promising evidence showing that academic achievements and reading and writing skills of ELLs can be improved via the use of computers. Lee (2000) suggested that computer based learning is more individualized, student-centered, greatly extending ELL students' language skills, and reducing their embarrassment.

Further study comparing ELL and general students using computers can provide a better understanding of these conflicting findings. Future studies need to consider other variables that may impact ELL students. For instances, in this study no effort was made to control for various cultural variables: socio-economic status, family value, presence of sibling role models, etc.

Teachers' Computer Use and Students' Academic Achievement

This section discusses the relationship between the math and English teachers'

computer activities and their students' performance on standardized math and reading exams. There were four hypotheses, 3, 4, 7, and 8, intended to find this relationship. Hypotheses 3 and 7 looked at the relationship between the math exam scores and the math teachers' computer activities. Hypothesis 3 looked at the whole dataset. Hypothesis 7 only looked at the scores of ELL students. Hypotheses 4 and 8 looked at the relationship between reading exam scores and English teachers' computer activities. Hypothesis 4 looked at the whole dataset. Hypothesis 8 only looked at the scores of ELL students.

The results showed diverse findings similar to those studies in the literature review. The discussion was separated into two parts: teachers' computer activities and teachers' training in computer technology.

The findings showed that the following teachers' computer activities did not have statistically significant relationships with the students' academic achievement: taking professional development courses via the Internet, downloading instructional software from the Internet, using the computer to communicate with students, and posting homework information. Teachers' taking professional development courses via the Internet is a professional activity but not necessarily related to their teaching, and there was no relationship with the students' academic performance. The computers at school are generally protected from installing any software by teachers, which would prevent teachers from taking advantage of even good software available online.

Using computers to communicate with students and post homework information are both ways of communicating with students about what they are supposed to do. The analysis showed no statistical significance. However, a statistically significant positive

relationship was associated with the teachers' computer use to communicate with parents. As an educator, the best way to keep students on track is to communicate often with their parents. If parents are informed about what their children need to do and how they are doing at school, the parents will be more likely to know what to watch for in their children. This finding should be considered by teachers and parents, and email is the best way for them to carry on the communication.

Interestingly, teachers' use of model lesson plans from the Internet showed a statistically significant negative relationship to students' academic achievement. The teachers need extra time to become familiar with the model lesson plans when they use them from the Internet. They also need time to customize the lesson plan for better fit in their own class, and it might need quite a few adjustment of the original lesson from the Internet. Teachers should not just rely on Internet lesson and just use it without personalize it for their own class.

The math teachers using web sites to retrieve lessons and using the Internet for research on teaching showed statistically significant negative relationships with the students' math achievement. This is probably due to the same factors discussed above about the time and extra effort teachers need to put in foe their ownership and customization in order to implement the research or lesson plan for their class.

Downloading lesson plans doesn't consider the quality of the lessons selected, even excellent lesson plans that are not understood by the teachers will not influence student achievement. There is no substitute for well planned teachers, using lesson plans they understood and approve.

Using computers for administrative records also showed statistically significant

negative relationships with the students' achievements at both math and reading. Because using computers for administrative records takes teachers extra time, sometimes more than doing it by hand for some teachers, it may prevent them from spending time on remediating instruction when their students need it. More and more school districts are requiring teachers to manage records with technology; therefore a good and efficient training system should be in place to save the teachers' time doing administrative records. Perhaps, using technology also de-humanizes the evaluation process.

It is surprising that English teachers using the computer to prepare multimedia presentations showed statistically significant negative relationships with the ELL students' reading achievements. This is contradictory to the findings in the literature review and the belief of the author. Further research might be needed to find out the reason.

As mentioned earlier in this section of the discussion, teacher communicating with students via technology did not have statistically significant relationships with students' achievement, while communicating with their parents showed statistically significant positive relationship. But, math teachers' communication with colleagues via technology did not appear to relate to students' math achievement, whether communicating with colleagues through email, or using the Internet for math teachers' colleague discussions. However, some relationships exist between reading achievement with network communications. A negative relationship was found for the students' reading achievement with the English teachers using email to communicate with colleagues, but a positive relationship was found for students' reading achievement

with English teachers using the Internet for colleague discussions. When English teachers participate in discussion lists with colleagues, the discussions probably target their teaching tasks, but teachers' communication with colleagues through email may more likely be for social reasons. These also take the teachers' time from preparing their lessons. Future research is needed to understand why the difference only showed on the reading, but not the math achievement.

Teachers using computers to create instructional materials like handouts, syllabi, and tests showed positive relationships with the students' academic achievements in both math and reading. As teachers can save documents and easily enhance documents in the future by using the computer, their time is saved and also their teaching is enhanced by making modifications when needed. This way, teachers are able to customize their instructional material and have better attention to achieve appropriate curriculum.

Using computers for giving multimedia presentations in math class also showed a positive relationship with students' math achievement. Multimedia computer technology can facilitate auditory skills development by integrating visual presentation with sound and animation, thus enhancing the ELL students' language learning (Bermudez & Palumbo, 1994); however, there was no statistically significant relationship for English teachers giving multimedia presentations and their students' reading achievement. It may because the multimedia takes the students' time away from reading. Future research is required to find out if special designs are needed for the multimedia presentation to show the positive impact on students' academic performance.

Now, we will discuss the relationship between the teachers' training received in the

last three years and their students' academic achievements.

There was no statistically significant relationship between the students' academic performance and the teachers' training in basic computer skills. It is understandable that just the training for basic computer skills won't necessarily make the teachers apply the computer technology to their class. Teachers should also take advanced computer training to better use the technology.

The training in software applications for math teachers showed statistically significant positive relationships with the students' math achievement; while the training for English teachers in the use of other technology, such as wireless web or interactive video, showed statistically significant positive relationships with the students' reading achievement.

The training in the use of the Internet and the training in integrating technology in curriculum also showed statistically significant positive relationships with the general students' math achievement, but no relationship with the reading achievement. However, follow-up or advanced training showed statistically significant positive relationships with the general students' reading achievement, but no relationship with the math achievement. Further studies may conduct to explain this interesting finding.

There is a difference between the kinds of training received by the math and English teachers in relationship to their students' achievement. Math and English teachers seem to benefit from different training. Why is there a difference between them? Further research is suggested to find out the answer to this question.

Comparison between Students

The differences in findings between the ELL and general tenth-grade students are

listed in the comparison tables from table 33 to table 36. From those tables, the relationships for ELL students show less strength on both positive and negative directions. The sample size for ELL students is about 2 thousands while the general students' sample size is about 15 thousands. The sample size for ELL students is quite smaller than the general students; this might cause the relationship to be weaker because of the sample size.

Also the family factor will also contribute to this difference. The ELL students generally get less support from the parents because of their parents' language capability and the family economic status. As the finding suggests positive relationship between the home computer accesses with academic achievement, the lack of family support in terms of finance and computer skills of the parents will weaken the relationship of computer use for ELL students.

Suggestions for Future Research

Just as with findings from many other research studies, computer use was shown to be related to the academic achievement in both positive and negative directions in this study. Several factors of students' and teachers' computer activities were found to be related to the students' academic achievement. However, the findings from this study produced some questions about the diverse relationships between computer use and academic achievement which need to be answered in further studies.

This study found that negative relationships existed between English teachers using the computer to prepare multimedia presentations and their ELL students' reading achievements. Because multimedia presentation provides the opportunity of putting animation accompanied by sound effects or voice explanation, it should support

comprehension. The literature review also indicated a positive relationship for the application of multimedia in ELL learning. What kind of multimedia presentation was used by the ELL English teachers here? Multimedia is also a powerful tool that provides effects to enhance students' learning when it is well designed; however, poor design of multimedia can distract students' attention or even cause misunderstanding. Further research is suggested to investigate the design of multimedia and its relationship to ELL English learning.

Findings from this study also suggest that the ELL students may get less benefit from computer use than the general students. Studies have been conducted to find if there are positive effects for computer use in ELL education; however, fewer studies were conducted to find out if the effects are stronger or weaker in ELL education. A comparison between the effects on general students and ELL students could provide some suggestions for the educational department when they budget the funding for computer technology.

The relationship between teachers email communicating with colleagues and their students' academic achievement only existed among reading, not math teachers. The nature of two different subjects may require further study to corroborate this finding. It is suggested that future research be designed to examine the different types of discussions in which teachers of different subjects participate.

It was also found in this study that there is a difference between the math and English teachers' training and the students' achievement. Are there some kinds of training for teachers which tend to benefit students' math achievement, and others that support reading achievement? These questions can be answered by further research

studies.

The location where students used computers was related to the academic achievement in both positive and negative directions. Students might be doing different tasks in different locations; future studies can look at the tasks that students do in different locations to find out why the relationships tend to vary in two extreme directions.

There were some computer uses not found to be related to academic achievement at all in this analysis. Those factors might be not statistically significant because there was not enough of a time period for the computer use to show the effects since learning does take time. It is suggested future study to examine those factors in a longer time to find if there is any relationship to be found.

Future studies might also analyze the computer use in terms of frequency, hours of use, weekday or weekend use, locations, purpose, and activities for students and teachers. They would also show the training teachers received, teachers' experience, learning and teaching style, subject differences, and the administrative jobs they were required to do on the computers.

Conclusions

Based on the findings, the author drew some practical suggestions and conclusions for the parents and teachers when they supervise computer use of their students or children as listed below:

1. Math teachers may have their students use computers to analyze data for enhance their learning.
2. For the computers to have a positive impact on students' achievement, it takes at least one semester. One year before the test should be a good

time period for computer to show the impact.

3. Teachers should assign high quality school work that students are able to use computers at home to complete, and spend more time on the computer for school work.
4. Parents might want to restrict video/computer games during weekdays, and have their children play on weekends instead.
5. A computer with Internet access at home was found to have positive relationships with the students' academic achievement. Parents should take this into consideration.
6. Students using computers at other locations such as a friend's house or public library was negatively related to academic achievement. Parents need to be aware of what their children play in public area and friend's house.
7. Teachers should use computers to create materials; this can save their time and make their material customized to their class.
8. Teachers need to use computers to communicate with parents as often as possible, email and web site information will be helpful.
9. Teachers need to be couscous about using model lesson plans from the Internet, and using web sites to plan lessons. They should spend some time to modify and make the lesson suitable for their own class.
10. Teachers might try not spending too much time on computers for keeping administrative records. They also need to avoid the technology use of just managing the record instead of humiliating their students' evaluation.

11. Teachers might try participating in discussion lists about their subjects to share information about teaching.
12. Education department should provide more teachers' training, because most training, with the exception of the training in basic computer skills, was found to be positively related to students' academic achievement.

These conclusions are suggested for the teachers' and parents' possible reference. As the study indicated relationships, it can ascribe cause and effect. Further designs of studies are suggested to determine any cause and effect relationships; however, the teachers and parents might still want to take these findings from this study into consideration.

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