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TECHNOLOGY USE IN SECONDARY MATHEMATICS EDUCATION: IS THERE A SOCIO-ECONOMIC STATUS DIVIDE?

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Abstract

The increase in standardized testing in light of No Child Left Behind begs the question of how testing affects instructional decisions. This is especially true in subjects like mathematics, a primary focus of state standardized testing. This article examines whether there are differences in instructional technology choices in Pennsylvania secondary mathematics education based on school poverty-level and pressure to succeed on state standardized assessments. The author conducted a survey of mathematics department heads in Pennsylvania public high schools, in which she asked the department heads to report about technology use in mathematics education at their schools. Findings indicate that affluent schools report using software programs more than their disadvantaged counterparts, possibly to explore higher-order tasks. Urban schools report using calculators more than suburban or rural schools, possibly to compensate for low computation skills. Finally, this article proposes that urban schools may be using computers more than suburban or rural schools for remediation for state standardized tests, based on reports of increased importance of computers for test preparation. Overall, this article suggests that there may be some instructional differences in technology use in Pennsylvania secondary mathematics education based on school poverty level and locale.

TABLE OF CONTENTS

Abstract……………………………………………………………………………………....i
Table of Contents…………………………………………………………………………….ii
Acknowledgments……………………………..…………………………………………iii

Chapter 1. LITERATURE REVIEW……...……………………………………………………1
Introduction……………………..……………………………………………………….1
Types of Technology……………………………………………...………………3
Instructional Practices Using Technology……………………………………….….6
The Potential for Differences in Technology Use……………………………………12
Technological Differences in Affluent and Disadvantaged Schools……………….…13
Research Question……………………………………………………………….…16

Chapter 2. METHODS……………………………..………………………….……..….18
Participants…………………………………………………………………………18
Measure……………………………………………………………………………..19
Procedure…………………………………………………………………………...19

Chapter 3. RESULTS………………………………………………………………..……...23
Technology and Software Use Subscales…………………………………….….23
Use of Computer Test Preparation…………………………………………………25
Reported Use of Technology and Software…………………………………………...25
Reported Importance of Computers and Calculators in Test Preparation……………..…26
Secondary Analysis: Access to Computers in Home………………………………….28

Chapter 4. DISCUSSIONS……………………………………………………………………30
Reported Use of Technology and Software…………………………………………...30
Reported Importance of Computers and Calculators in Test Preparation……………..…31
Secondary Analysis: Access to Computers in Home……………………………….…32
Limitations……………………………………………………………………………33
Educational Implications…………………………………………………………...34
Suggestions for Further Research……………………………………………………..35

Appendix A……………………………………………………………………………...…36
Appendix B…………………………………………………………………………………39
Appendix C………………………………………………………………………………....40
Bibliography………………………………………………………………………….…42

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Literature Review

Introduction

One of the most significant innovations in high school mathematics education has been the development and use of technology. When employed in teaching mathematics, technology may have great effect on how teachers choose to instruct and on how students come to understand mathematics (National Council of Teachers of Mathematics (NCTM), 2000). Technology is manifested in many ways, with the most common being calculator use and computer use. These technological tools create the potential to explore mathematics in more abstract ways due to the capacity of technology to simplify certain events (Hollebrands, 2007). But in light of this plethora of resources, a few questions surface. Do all schools use technology for mathematics education? Are there any differences in what kinds of technology schools choose to use or how they implement it? Because of the effect of teaching decisions on curriculum content, these are important issues to consider (Ellington, 2003). More specifically, one might inquire: what kinds of patterns emerge in the different ways that schools use technology for mathematics education? Do schools serving students from different socio-economic backgrounds differ in the way they use technology? This paper will explore these questions in depth within the scope of Pennsylvania public secondary schools.

For the purposes of this research, the author defined disadvantaged schools and affluent schools in specific ways. Disadvantaged schools were defined as schools that serve a significant population of students from low-income families. This was operationally defined as those with 25% or more students qualifying for free or reduced lunch, which is a commonly used definition (Natriello, McDill, & Pallas, 1990). Affluent schools were defined as schools that a small portion of students from low-income families. This was operationally defined as schools with fewer than 25% of students receiving free or reduced lunch.

For the purposes of this research, the author defined urban schools, suburban schools, and rural schools in specific ways. The school demographic variable of urban, suburban, and rural classification was identified using the National Center for Education Statistics (NCES) urban-centric locale codes (Phan & Glander, 2008).

The author defined rural schools as those that NCES identified as schools in towns or rural locations. Towns are divided into fringe, distant, or remote towns. A fringe town is operationally defined by NCES as a territory inside an incorporated community less than or equal to 10 miles from a urbanized area, a distant town is operationally defined by NCES as a territory inside an incorporated community between 10 and 35 miles from a urbanized area, and a remote town is operationally defined by NCES as a territory inside an incorporated community more than 35 miles from a urbanized area (Phan & Glander, 2008). Rural areas are divided into fringe, distant, or remote rural territories. A fringe rural territory is operationally defined by NCES as a “census-defined rural territory” that is either less than or equal to 5 miles from a urbanized area or less than or equal to 2.5 miles from an incorporated community, a distant rural territory is operationally defined by NCES as a “census-defined rural territory” that is either between 5 and 25 miles from a urbanized area or between 2.5 and 10 miles from an incorporated community; and a remote rural territory is operationally defined by NCES as “census-defined rural territory” that is both more than 25 miles from a urbanized area and more than 10 miles from an incorporated community (Phan & Glander, 2008, p. 10).

The author defined suburban schools as those that NCES identified as schools in suburbs. Suburbs are divided into large, midsize, or small suburbs. A large suburb is operationally defined by NCES as a "territory outside a principal city" and within a urbanized area with a population of 250,000 or more, a midsize suburb is operationally defined by NCES as a "territory outside a principal city" and within a urbanized area with a population between 100,000 and 250,000, and a small suburb is operationally defined by NCES as a "territory outside a principal city" and within a urbanized area with a population less than 100,000 (Phan & Glander, 2008, p. 10).

The author defined urban schools as those that NCES identified as schools in cities. Cities are divided into large, midsize, or small cities. A large city is operationally defined by NCES as a territory inside a urbanized area and "inside a principal city" with a population of 250,000 or more, a midsize city is operationally defined by NCES as a territory inside a urbanized area and "inside a principal city" with a population between 100,000 and 250,000, and a small city is operationally defined by NCES as a territory inside a urbanized area and "inside a principal city" with a population less than 100,000 (Phan & Glander, 2008, p. 10).

Types of Technology

There are a number of types of technology that can be used in today's secondary mathematics classes**,** the broadest categories are calculator use and computer use. Within each of these categories, there is also a significant range in how the technology can be used to direct and support instruction (Hollebrands, 2007; NCTM, 2000). For instance, students can use calculators to perform simple computations, create graphic and symbolic representations of functions, or evaluate integrals (Becker, 2000a; NCTM, 2000). Students can use computers to type reports in word processors, compile data in spreadsheets, or simulate a projectile motion. We will explore these uses in more detail below.

Calculators. One of the first pieces of technology that one may think of in terms of mathematics education is the calculator. Calculators have allowed students to save time on long or tedious calculations by providing answers to basic mathematical operations in an instant. Over time, calculators have evolved, becoming both faster and capable of a wider variety of increasingly sophisticated tasks. Texas Instruments has been the lead producer of graphing calculators that has led to one of the most frequent uses of computers in high school mathematics (Trotter, 2007). In addition to simple computation, graphing calculators can plot points and generate equations for lines and curves of best fit, draw functions on a coordinate plane and shade inequalities on the display screen (Tuttle, 2007). These capabilities allow students to interact with graph and function shapes and characteristics (Tuttle, 2007).

Computer algebra systems (CAS) have also ushered in a new era of calculators with dynamic capabilities similar to computer software (Heid & Edwards, 2001). For instance, they can perform tasks previously handled by programs like Excel or Geometer's Sketch Pad (Heid & Edwards, 2001). These systems enable people to skip simplification procedures, explore patterns, generate examples, and do computations with abstract components (Heid & Edwards, 2001). CAS systems such as the TI-Nspire can also connect to computers, which allows for file creation and transfer, screen captures, and more. The developments in calculator technology are staggering, and the potential for mathematics education is great. However, implementation plays a large role in how all models of calculators are used in mathematics classrooms (Trotter, 2007).

Computers. Computer use in instruction has undergone a transformation similar to that of calculators. Computers in classrooms have expanded teachers' and students' opportunities for access to information, data manipulation and analysis, and instructional games and software.

Teachers' and students' ability to access information is one facet of the changes in computer use. Once a resource for simple word processing, computers have developed email and other world wide web capabilities that allow students to access a virtually unlimited stream of information in fractions of a second (Becker, 2000a; NCTM, 2000). Access to information can also include students retrieving data from the internet or sharing files through technology in order to use them for an educational purpose.

Computers also provide students with spreadsheets for data compilation and calculation (Becker, 2000a; NCTM, 2000). Using Excel, students can organize and analyze data. They can create formulas to calculate values of interest, count the number of entries that match specific conditions, sort cells by a specified set of criteria, and more (S. Karunakaran, personal communication in MTHED 427, October 28, 2008). Using other programs like Fathom and Minitab, students can compile data and then create graphs, charts, and other representations of their data (S. Karunakaran, personal communication in MTHED 427, October 28, 2008; "Fathom," 2009).

With the development of CD-ROMs and other external products for computers, people have been able to create games and interactive activities on every subject imaginable, and mathematics has been no exception. From skill mastery to analysis to simulations and explorations, the foci of these games and programs have varied greatly and have consequently employed computer technology in very different ways (Becker, 2000a; NCTM, 2005). Some online games and software programs offer remedial practice for students still trying to master different concepts (Becker, 2000a). Some programs offer dynamic capabilities like the TI-Nspire and other CAS calculators, such as the dynamic geometry program Geometer's

Sketchpad (Hollebrands, 2007). Students can use this program to explore shape and construction characteristics (NCTM, 2000).

All of these uses of technology provide some insight into what is out there in the field of mathematics education technology. It is apparent, however, that with these very different uses of technology come very different skills and levels of skills, suggesting the need to explore the level of learning that may occur with the different uses of technology.

Instructional Practices Using Technology

We discussed above the potential for a range of activities even within the sphere of one type of technology. Though technology presents great capabilities, it is up to the teacher to decide how to use technology and what kinds of tasks to ask students to explore (NCTM, 2000; Trotter, 2007). Let us look more closely at what kinds of tasks teachers typically ask students to complete using technology in secondary mathematics education. We will explore these different tasks in the contexts of calculator use and computer use.

Calculators. Calculators are designed for three main purposes of use: computation, graphing, and dynamic algebraic explorations. Each of these uses can be associated with different instructional tasks and intellectual processes.

The use of calculators for computation can serve different instructional roles. Sometimes the computation itself is the purpose of the task. At other times, calculators can be used for computation as part of a larger instructional activity or task. In these cases, calculators allow teachers and students to save time with calculations and make more time for other often higher-level processes (NCTM, 2000). When used for this latter purpose, calculators are also associated with an increase in both computational skills and problem-solving skills (Brown, Karp, & Petrosko, 2007). An example might be if students are calculating derivatives of graphs at a certain value and the derivative formula involves large numbers or exponents. By using a calculator to perform the computation of the derivative at a given value, students can save time calculating the value and spend more time discussing what the derivative means in this context and exploring the concept of rate of change in general. This use of calculators thus frees up time from basic computation to allow students to pursue higher instructional processes such as comprehension, application, and analysis (Forehand, 2005).

Graphing calculators are used for many different tasks related to graphing functions and equations. Many mathematics classes employ graphing calculators to help students observe shapes of graphs or functions (Tuttle, 2007). For example, students might alter base functions to observe how the graph is transformed. This can help students develop a better understanding of functions. Students can also use graphing calculators to make observations about the characteristics of specific graphs, such as values at a particular point, x- and y-intercepts, maximum and minimum values of the graph, and the rate of change of the graph at a particular point. By using a calculator to observe these values and characteristics, students can discuss the meaning of their answers, the implications in the given context, and why they think they acquire these particular results. A student might, for instance, discuss whether the value of a graph at a particular point makes sense in the context of the problem – an activity associated with the application of mathematical understanding. Students can also access tables that describe the values of a given function, generate regression equations to match an entered set of data points, and much more. All of these things enable students to engage in more difficult mathematical tasks and develop a better understanding of the topics (NCTM, 2000).

The final type of calculator is the Computer Algebra System (CAS). The CAS enables students to explore many tasks similar to those included in popular mathematical computer software programs. For instance, students can compile data in a spreadsheet page like in Excel, draw shapes and lines like in Geometer's Sketchpad, and model other "computer" capabilities (Heid & Edwards, 2001). In addition, teachers and students can transfer files between the calculator and a computer, making it possible for teachers to create entire assignments on the computer software and transfer them to students' calculators for class use (S. Karunakaran, personal communication in MTHED 427, October 28, 2008). Heid and Edwards (2001) cite four possible algebraic roles for the CAS in mathematics education: a "producer of symbolic results" to save time in calculations, a tool to help students "create and generate symbolic procedures" in order to recognize procedural steps, a method of "generating… examples from which they can search for symbolic patterns" in order to develop an understanding of a concept, and a way to "generate results for problems posed in abstract form" and let students explore generalizations (p. 130-132). Students could, for example, use the CAS to make observations about the expansion of binomials raised to powers in a "search for symbolic patterns," or they could "use the 'solve' feature of the CAS" to explore the general form of the quadratic equation (to obtain an answer for "problems posed in abstract form") (Heid & Edwards, 2001, p. 131-132). But despite the multitude of capabilities that the CAS offers, it has limited implementation in high school courses and college methods courses for future teachers; Heid and Edwards cite its "sheer power" as a possible reason, and they call for the preparation "that best enables educators to teach students meaningful, significant mathematics" with the CAS (Heid & Edwards, 2001, p. 135).

Computers. When considering the instructional processes for which computers are used in mathematics education, one must consider the variety of tasks that students and teachers explore using computers. Teachers and students use computers for information access, data manipulation and analysis, and instructional games and software, allowing them the opportunity to engage in a variety of mathematical tasks associated with each of these uses. These tasks bear important implications for student learning.

In general, information access has played a significant role in the use of computers in secondary classrooms. Teachers that frequently used computers in their class on average ranked the World Wide Web as the fourth most used software. It was used less frequently than word processing, CD-ROMs, and skill games but more often than simulations, spreadsheets, presentation software, and email (Becker, 2001). Of secondary mathematics teachers who participated in the Teaching, Learning, and Computing Survey in 1998, 16% reported using the World Wide Web in three or more lessons (Becker, 2000b).

Data manipulation and analysis comprise another component of technology use in mathematics education. Some of the tasks that students may engage in while using data analysis software are associated with the acquisition of lower level skills and basic knowledge. Students might, for instance, engage in the task of calculating the mean of each column of data. However, students and teachers can also use data analysis software to engage in tasks associated with higher-level processes. Teachers may ask students to interpret their results, explain which visual representation of the data is most useful in the given context, or explore the effects of outliers on various characteristics of the data set. These kinds of tasks probe students to think critically and conduct an analysis of their results. These tasks also display the potential impact of computer use for data analysis on student learning. The Teaching, Learning, and Computing Survey showed that 13% of mathematics teachers used databases and spreadsheets in three or more lessons (Becker, 2000b).

Instructional games and software present many options for instructional use in mathematics education. These options engage students in perhaps the widest variety of instructional processes of any of the types of computer use.

One main use of instructional games and software is for drill and practice and remediation of skills. In the 1998 Teaching, Learning, and Computing Survey, 25% of mathematics teachers reported using skill practice games for three or more lessons (Becker, 2000b). This was the highest percentage of any of the core academic classes. The Computer Assisted Instruction (CAI) curriculum has been used particularly often for skill practice (Means, Roschelle, Penuel, Sabelli, & Haertel, 2003). CAI has also been used to practice skills and develop automaticity (The National Mathematics Advisory Panel, 2008). Overall, CAI programs focus primarily on basic skills rather than range of skills to develop problem solving (Panel on Educational Technology, 1997). Another key source of skill practice is the use of instructional games on the internet. The World Wide Web offers access to various pretests and quizzes, but according to Tuttle (2007), these sometimes lack constructive feedback. As a result, they are not very effective at enhancing student learning. According to Becker (2000b), the decision to use technology for drill and practice is observed more often in schools serving poorer students.

Some software programs that review skills, however, actually offer feedback through artificial intelligence. Two examples are PUMP's GeometryTutor, which requires students to prove geometry conjectures, and AlgebraTutor, which helps students practice algebra skills and review concepts (Means, et. al., 2003). Both offer feedback through their programmed artificial intelligence systems (Means, et. al., 2003). Other similar programs try to "diagnose and 'debug' the student's misapprehensions and erroneous conceptual models" (Panel on Educational

Technology, 1997, p. 32). By offering students feedback regarding their understanding of certain topics, these programs help the students develop their metacognition.

Another use for computer software and games is to assess student progress relative to state standards. Companies such as Lightspan have capitalized on the standards-based movement by creating assessments to measure students' preparedness for state standardized tests (Means, et. al., 2003). Lightspan's program eduTest includes internet tests for teachers to use during class in order to gather mid-year reports of their students' progress towards meeting adequate yearly progress in accordance with NCLB (Means, et. al., 2003). The marketing of such products concerns some, raising issues about "teaching to the test" (Means, et. al., 2003, p. 163).

Computer software can also be used for an interactive study of mathematical topics, including investigations and explorations. In the 1998 Teaching, Learning, and Computing Survey, 18% of responding mathematics teachers cited the use of analytic software for simulations and explorations in three or more of their lessons (Becker, 2000b), and 10% claimed to use these kinds of software in at least 10 lessons per year. One of the most well-known software programs is Geometer's Sketchpad (GSP), a dynamic software program. Users can create constructions and then drag portions of the construction to see how the entire construction changes (Hollebrands, 2007). Teachers can engage students in the exploration of similar figures (Hollebrands, 2007); translations and transformations of points, lines, and shapes (Hollebrands, 2007); and construction of shapes that would maintain a specific set of criteria after being dragged or moved (NCTM, 2000). These kinds of explorations provide a geometric example of the kinds of conceptual understanding associated with higher-level instructional processes like analysis and synthesis. Thus these uses of technology create many opportunities for enhanced student learning and understanding.

It is clear that schools have a variety of options to choose from when selecting and employing technology in their classrooms. Both calculators and computers offer a range of uses that challenge students to engage in a range of instructional processes (NCTM, 2000). Many of these processes bear significant implications for the learning benefits that a student may experience by using this technology.

The Potential for Differences in Technology Use

The wide variety of technological uses and processes seems to beg the question: do all schools use the same resources, or does it vary from school to school? Are there systematic differences between certain types of schools? There are a few reasons to ask this question: there seem to be distinct differences in access to technology, and there are also differences in the way technology is employed. It is reasonable to think that these differences might present trends in technology use based on certain factors.

Access to technology. Overall, 12% of mathematics teachers have at least one computer for every four students in a given mathematics class (Becker, 2000b). This statistic leaves one wondering about the other 88% of mathematics teachers and their access to technology. Becker (2000b) also discovered an interesting link between computer access and instructional tasks: secondary mathematics teachers that had at least five computers in their room were more likely to pursue certain kinds of instructional tasks, such as spreadsheet and database programs. This combination of evidence regarding access differences and a possible link to instructional differences probes us to investigate further. Do different schools use technology to focus on different instructional processes?

Instructional uses of technology. The Panel on Educational Technology (1997) reports that socioeconomic status of the student body is found to be "predictive of the manner in which computers are used in school, with certain groups participating in constructivist applications… or in other 'higher order' learning and problem-solving activities while others use technology primarily for… drill-and-practice" (p. 68). In schools serving poorer students, the use of computers for remediation is almost double that of other schools (Becker, 2001). Becker also found an increased use of technology in general in math classes of schools serving poorer students (Becker, 2001). Moreover, the Panel on Education Technology (1997) acknowledges the potential of new computing and networking technologies to empower historically disadvantaged groups of Americans," with an admonition; their report states that "...the ways in which educational technologies are actually employed and used will determine whether they serve to narrow these historical disparities or widen them even further" (p. 68).

Technological Differences in Affluent and Disadvantaged Schools

Given the expenses of technology and the different kinds of tasks associated with different kinds of technology, it seems reasonable to wonder specifically about schools with student bodies that differ by socio-economic status. Can all schools afford the same technology? Do schools serving affluent and disadvantaged students have the same goals with their technology use? What are the trends in differences of instructional processes in relation to low socioeconomic schools and secondary mathematics instruction?

Access to technology. The literature does not present much information about differences in access in schools based on socioeconomic status; most readings state that computer density is a much smaller issue than it used to be (Panel on Educational Technology, 1997). They cite less home access and consequent unfamiliarity with technology as a possible challenge for students in disadvantaged schools (Panel on Educational Technology, 1997), concerned that students may be less prepared to use technology for a variety of academic tasks, such as data analysis or graphing, if they do not regularly do so at home. Becker (2000b) refers to computer and internet access as “necessary, but not sufficient” (p. 66). Again, then, we are probed to take a closer look at the ways in which secondary teachers are using technology. Since much of the literature has pointed to socio-economic status as a key indicator of different instructional processes, we will now look at the use of technology in secondary mathematics education and any differences based on socio-economic status.

Instructional uses of technology. The literature presents various trends in instructional process differences based on the socio-economic status of the school and based on the increased pressure to conform to the requirements outlined by No Child Left Behind. Becker (2000b) conducted most of his research regarding technology use in education in 2000 and 2001, directly preceding the passing of NCLB in 2002. He still noticed that 10% of secondary mathematics teachers used computer software for remediation in more than 10 lessons per academic year. He also noted patterns in technology use based on socio-economic status. He noted that schools in general were not implementing more sophisticated uses of technology, but that this trend was particularly true for disadvantaged schools (2000b).

With the passage of No Child Left Behind in 2002, many general accountability patterns have emerged. NCLB calls for student proficiency levels in relation to state standards (NCLB, 2002). This includes demonstration of Adequate Yearly Progress (AYP) for all students as well as across certain demographic groups (NCLB, 2002). NCLB also imposes new, refined requirements on teacher qualifications (NCLB, 2002). Schools that fail to meet these requirements could be subjected to federal funding cuts, and schools which continue to fail can experience school closings, job losses, and the de-licensure of teachers and administrators (NCLB, 2002). This pressure is pushing underperforming schools to find ways to increase their test scores before the state takes over the school.

"Schools serving disadvantaged populations may respond differently to various state policies than those with more affluent students" because they "may have to invest their resources in bringing poor performing students up to a minimum level of proficiency" (Schiller & Muller, 2003, p. 314-315). The literature has already showed some evidence of specific software programs such as *eduTest* being used in the classrooms for remediation of skills for standardized tests (Means, et. al., 2003). There has also been a general increase in the use of technology in mathematics education (Becker, 2001). Considering these findings, it is possible that schools may use technology to deliver remediation related to state test performance, particularly those serving disadvantaged populations (e.g., Becker, 2000b).

Stevenson and Waltman (2005) conducted a study of the instructional changes related specifically to No Child Left Behind. As might be expected, middle and high school teachers cited the most significant changes in Language Arts and Math classes, both of which are main foci of the Pennsylvania State Standardized Assessment. In their study, they explored mathematical instructional changes on the most significant levels, as noted by responding mathematics teachers: "content, method of instruction, materials, and general reference" (Stevenson & Waltman, 2005, p. 29). Finally, they broke down the most significant changes within each level.

Stevenson and Waltman (2005) found that 56.3% of the middle and high school core mathematics teachers polled cited changes to content and student activities due to No Child Left Behind. Of these teachers, 24.7% indicated a significant change in instruction related to mathematical strategies, 1.8% noted a change in drill-and-practice, and 12.9% specified a feeling of teaching to the test.

About 11.3% of middle and high school core mathematics teachers also cited changes in materials (Stevenson & Waltman, 2005). Of these teachers, 50% saw a change in curricular materials, 14.7% saw a change in technology use, and 35.3% saw a change in calculator use. These statistics suggest that there was a more significant change in calculator use than in other technology (most likely referring to computers), with a total of 50% of the significant material changes relating to general technology (including calculators). The combination of instructional changes, content changes, and technology changes related to the test suggest a definite relationship between the pressure of standardized tests and the need for changes in current educational practices.

There is evidence of increased remediation, as well as increased technology use in mathematics instruction, in disadvantaged schools (Becker, 2000b). There is also evidence of changes in mathematics instruction in relation to state tests, including content and material changes such as technology use (Stevenson & Waltman, 2005). All of these facts leave something to be desired though. Mainly, we must consider whether these changes involve increased remediation and review of previously learned material and other lower-level instructional processes, and if these changes are exhibited more significantly in disadvantaged schools.

Research Question

There seems to be a focus on drill and practice and other low-order mathematical tasks particularly in schools serving disadvantaged populations. There is also evidence of a larger amount of technology use for mathematics instruction in schools serving disadvantaged populations. Since the majority of this literature was written, the influence of NCLB and the pressure that high-stakes tests put on disadvantaged schools (which often perform below the requirements) has increased. The questions now are:

1. Do high school mathematics teachers differ in this reported use of technology and software as related to the overall poverty level of students in their schools?

2. Do high school mathematics teachers from different kinds of schools (urban versus suburban versus rural and affluent versus disadvantaged) differ in the degree to which they use technology for low-level instruction related to accountability test preparation?

Methods

Participants

Participants in this study were Pennsylvania public high school mathematics department heads who reported anonymously about their high schools' use of technology in mathematics instruction. The author selected all Pennsylvania public high schools which were listed in the NCES School Search Database[1]. The author identified high schools as those schools that included twelfth grade instruction. They were recruited by mail, as described below in the Procedure section. A total of 561 department heads were surveyed, and 188 responded and completed all components of the survey.

Defining the socio-economic status of participating schools. The goal of this study was to investigate technology use differences as related to school demographics. Disadvantaged schools were operationally defined as schools with 25% or more students qualifying for free or reduced lunch, as described in the Literature Review. Affluent schools are those with less than 25% of students qualifying for free or reduced lunch, as described previously in the Literature Review.

Defining the locale of participating schools. The school demographic variable of urban, suburban, and rural classification was identified using the National Center for Education Statistics (NCES) urban-centric locale codes (Phan & Glander, 2008). The author defined rural schools as those that NCES identified as schools in towns or rural locations, suburban schools as those that NCES identified as schools in suburbs, and urban schools as those that NCES identified as schools in urban locations, as described previously in the Literature Review.

[1] http://nces.ed.gov/ccd/schoolsearch/

Description of participating schools. The survey process (described in the Procedure section) resulted in complete, usable responses from 188 participants. Of these, 93 responses came from disadvantaged schools and 95 responses came from affluent schools. It was also found that 92 responses came from rural schools, 76 responses came from suburban schools, and 20 responses came from urban schools.

Measure

Survey. The survey was constructed using two previously used surveys: a principal's survey (Becker & Anderson, 1998a) and a teacher's survey (Becker & Anderson, 1998b) used in the Teaching, Learning, and Computing study. The author drew from these two surveys to create survey questions that were relevant to this study (see Appendix A). The items were reworded to fit this study focused on mathematics instruction, as opposed to all subjects as in Becker and Anderson's study.

The survey was created on SurveyMonkey[2] and was administered via the internet. Screen shots of the survey can be seen in Appendix A. SurveyMonkey allowed for easy administration and data collection.

Procedure

Recruitment. The author searched for Pennsylvania public high schools using the NCES School Search database. The author used NCES because it was able to provide demographic information that was not available through the Pennsylvania Department of Education (PDE). The NCES database also provided mailing addresses for the schools. This resulted in a smaller number of public high schools than the total number in Pennsylvania, because full information about demographics was only available on 561 schools. All mathematics department heads in

[2] http://www.surveymonkey.com

these 561 schools were invited to participate in an online survey regarding the use of technology in mathematics education at their schools.

A letter was mailed to each school inviting the mathematics department head to participate in an online survey regarding the use of technology in secondary mathematics education (see Appendix B). Included with these letters was an implied consent form, as approved by Penn State's Institutional Review Board, indicating to participants that by completing the survey they were consenting to take part in the research (see Appendix C). In this implied consent form, the author assured participants of their anonymity. Participants were informed that names were not linked to responses, school-level information would be reported only in aggregates, and no individual schools would be identified or discussed.

After one month there was a response rate of 33.0%, or 185 schools. Of these 185 schools, there were 87 disadvantaged schools and 98 affluent schools. There were 97 rural schools, 76 suburban schools, and 12 urban schools. Response rates are shown in Table 1. From this, it was concluded that urban schools were significantly under-represented in the data.

Table 1

Initial Response Rate

Locale	Number of Schools	Initial Number of Responses	Initial Response Rate
Rural	300	97	32.3%
Suburban	210	76	36.2%
Urban	51	12	23.5%
Total	561	185	33.0%

In an attempt to get better representation from urban schools, the author sent out a second mailing solely to urban schools, stressing a desire to understand better how urban schools are using technology in mathematics education. After the second mailing, an additional 23 responses were received. After two mailings the overall response rate was 37.1% for a total of 208 schools. Of these 208 schools, there were 106 disadvantaged schools and 102 affluent schools. There were 104 rural schools, 83 suburban schools, and 21 urban schools. Response rates are shown in Table 2.

Table 2

Second Mailing Response Rate

Locale	Number of Schools	Second Mailing Number of Responses	Second Mailing Response Rate
Rural	300	104	34.7%
Suburban	210	83	39.5%
Urban	51	21	41.2%
Total	561	208	37.1%

Upon downloading all of the data from SurveyMonkey.com, the author noticed that 20 participants failed to complete the second part of the survey, labeled Part B (see Appendix A). Because the majority of the data for these participants was missing, the author judged that these participants' data could not be used for this study. After removing incomplete participants from the data, the author established a total count of usable responses for each classification of school. At the end of the research, the usable response rate was 33.5% for a total of 188 schools. There were 93 disadvantaged schools and 95 affluent schools in the final data set. There were 92 rural schools, 76 suburban schools, and 20 urban schools. Final response rates are shown in Table 3.

Table 3

Final Response Rate

Locale	Number of Schools	Final Number of Responses	Final Response Rate
Rural	300	92	30.7%
Suburban	210	76	36.2%
Urban	51	20	39.2%
Total	561	188	33.5%

Results

When analyzing data, the author had to group survey questions according to relevant subscales. The questions were grouped into five subscales: frequency of software use, objectives for calculator use, objectives for computer use, the importance of calculators in test preparation, and the importance of computers in test preparation. The author looked at these subscales in terms of two categorical groupings for schools: poverty level and locale. As described before, poverty level was divided into disadvantaged and affluent schools, and locale was divided into urban, suburban, or rural schools. These variables and subscales were most useful in approaching the author's research questions:

1. Do high school mathematics teachers differ in this reported use of technology and software as related to the overall poverty level of students in their schools?
2. Do high school mathematics teachers from different kinds of schools (urban versus suburban versus rural and affluent versus disadvantaged) differ in the degree to which they use technology for low-level instruction related to accountability test preparation?

Technology and Software Use Subscales

The author grouped items measuring computer and/or calculator use (question 5 in the survey), and software use (question 6 in the survey) together. Using SPSS, the author ran a factor analysis to confirm the existence of three factors and their component items (see Table 4). Items were grouped under the factor where they had the highest loading. Only loadings of .3 and above were included. These three factors were treated as subscales of a) objectives for computer use (component 1 in Table 4), b) objectives for calculator use (component 3 in Table 4), and c) frequency of software use (component 2 in Table 4).

Table 4

Factor Analysis

ITEM	COMPONENT		
	1	**2**	**3**
Which of the following are among the objectives you have for computer use?			
Mastering skills just taught	**.59**	-.28	.11
Remediation of skills previously mastered	**.49**	-.25	-.01
Practicing computation skills	.24	**-.35**	-.02
Engaging in individual problem solving activity	**.65**	-.12	.06
Engaging in group (2 or more students) problem solving activity	**.58**	.18	.07
Graphing or interpreting graphs	**.39**	.05	.05
Expressing themselves in writing	**.59**	.35	.05
Communicating electronically with others	**.55**	.37	-.04
Information search	**.55**	.31	-.01
Analyzing information (e.g., quantitative analysis of data)	**.57**	.12	-.12
Presenting information to an audience	**.61**	.24	-.12
Learning to work collaboratively	**.71**	.17	.03
Learning to work independently	**.71**	-.04	.20
Which of the following are among the objectives you have for calculator use?			
Mastering skills just taught	.04	-.08	**.41**
Remediation of skills previously mastered	-.02	.08	**.34**
Practicing computation skills	.03	-.04	**.40**
Engaging in individual problem solving activity	.05	.12	**.42**
Engaging in group (2 or more students) problem solving activity	.13	.21	**.33**
Graphing or interpreting graphs	-.05	.16	-.01
Expressing themselves in writing	-.31	.00	**.46**
Communicating electronically with others	-.21	.09	**.48**
Information search	-.21	-.07	**.32**
Analyzing information (e.g., quantitative analysis of data)	.12	.10	**.50**
Presenting information to an audience	.05	.17	**.44**
Learning to work collaboratively	.15	.01	**.59**
Learning to work independently	.21	-.13	**.58**
For each of the following types of software, please indicate for how many lessons mathematics teachers have used that type of software on average per year (please estimate if you don't know):			
Games for practicing skills	.28	.21	.01
Simulations or exploratory environments	.35	**.40**	.17
Encyclopedias or other references on CD-ROM	.13	**.39**	.05
Word processing	.11	**.67**	.06
Software for making presentations	-.04	**.66**	.18
Statistical analysis software (e.g., Fathom, Minitab)	.14	**.48**	-.10
Spreadsheets or database programs (creating files or adding data)	.16	**.69**	.04
Dynamic software programs (e.g., Geometer's Sketchpad)	.12	**.50**	.03
Internet browser	.22	**.62**	.23

Use of Computer Test Preparation

The two items for the importance of computers in test preparation subscale and the two items for the importance of calculators in test preparation subscale were selected a priori. These items are the second and third statements in question 8 for the importance of computers in test preparation and the second and third items in question 9 for the importance of calculators in test preparation (see Appendix A).

Reported Use of Technology and Software

Affluent versus disadvantaged schools. The results indicated significant differences in frequency of software use $F(1,185) = 6.788$, $p=.010$. The mean is higher for affluent schools, indicating that affluent schools report using software more frequently for mathematics instruction (see Table 5). The results indicated that there was no significant difference in objectives for computer use $F(1,185) = .002$, $p = .962$ or objectives for calculator use $F(1,185) = .225$, $p = .635$. The means are presented in Table 5.

Table 5

Reported Use of Technology and Software by School Poverty Level

	Disadvantaged		Affluent	
Item	M	(SD)	M	(SD)
Objectives for Computer Use	6.67	(3.45)	6.69	(3.62)
Objectives for Calculator Use	6.30	(2.06)	6.16	(2.02)
Frequency of Software Use	19.55	(5.79)	21.78	(5.90)

Urban versus suburban versus rural schools. The results indicated significant differences in objectives for calculator use $F(2,184) = 4.544$, $p = .012$. Post hoc analyses were conducted using the Sheffe method. These analyses indicated that urban versus suburban groups were significantly different on Calculator Objectives ($p = .016$). Urban schools reported significantly higher use of calculators as compared to suburban schools. The other contrasts were not significant. The means are presented in Table 6.

Table 6

Reported Use of Technology and Software by School Locale

	Rural		Suburban		Urban	
Item	M	(SD)	M	(SD)	M	(SD)
Objectives for Computer Use	6.30	(3.58)	6.81	(3.54)	7.90	(3.09)
Objectives for Calculator Use	6.36	(2.04)	5.80	(2.01)	7.25	(1.71)
Frequency of Software Use	21.13	(5.74)	20.77	(6.10)	18.15	(5.88)

Reported Importance of Computers and Calculators in Test Preparation

Affluent versus disadvantaged schools. The results indicated that there were no significant differences in the importance of calculators in test preparation $F(1,185) = .802$, $p = .372$ or the importance of computers in test preparation $F(1,185) = .058$. While the latter finding is not significant, the means indicate that disadvantaged schools report greater use of computers for test preparation (mean = 5.6) as compared to affluent schools (mean = 5.4). The means are presented in Table 7.

Table 7

Reported Importance of Computers and Calculators in Test Preparation by School Poverty Level

	Disadvantaged		Affluent	
Item	M	(SD)	M	(SD)
Importance of Computers in Test Preparation	5.41	(.89)	5.14	(1.04)
Importance of Calculators in Test Preparation	5.74	(.66)	5.65	(.76)

Locale of the schools. The results also indicated that there were no significant differences in the importance of calculators in test preparation $F(2,184) = 1.878$, $p = .156$ or the importance of computers in test preparation $F(2,184) = 2.482$, $p = .086$. Inspection of the means for importance of computers in test preparation indicated that rural schools (mean = 5.6) and urban schools (mean = 5.8) report that computers are of more importance in test preparation than that reported by suburban schools (mean = 5.3). The means are presented in Table 8. To investigate this relationship further, the author contrasted suburban schools (those originally classified as suburban) versus non-suburban schools (those originally classified as urban or rural). The author then conducted a follow-up analysis on the importance of computers in test preparation by redefined locale. The results indicated a significant difference in computer test preparation by redefined locale F(1, 186) = 4.661, p = .032. This finding suggests that urban and rural (non-suburban) schools report the use of computers in test preparation more than suburban schools do. The means are presented in Table 9.

Table 8

Reported Importance of Computers and Calculators in Test Preparation by School Locale

	Rural		Suburban		Urban	
Item	M	(SD)	M	(SD)	M	(SD)
Importance of Computers in Test Preparation	5.40	(.89)	5.08	(1.06)	5.70	(.94)
Importance of Calculators in Test Preparation	5.77	(.61)	5.57	(.82)	5.80	(.62)

Table 9

Reported Importance of Computers in Test Preparation by Redefined Locale

	Suburban		Non-Suburban	
Item	M	(SD)	M	(SD)
Importance of Computers in Test Preparation	5.09	(1.06)	5.40	(.90)

Secondary Analysis: Access to Computers in Home

In looking at correlations between questions related to technology access, the author observed a positive correlation (r = .89) between the following two items:

- Approximately what percent of your students this year have a computer at home to use?

- Approximately what percent of your students this year have a computer at home with internet access?

This suggests that almost all students that had a computer at home also had internet access at home. The author also found that these two items were correlated with school poverty level ($r = .45$ and $.46$ respectively). This suggests that students from more affluent communities (schools) are somewhat more likely to have computers at home and somewhat more likely to have internet access than are students from disadvantaged communities (schools). This finding reaffirms previous research and is consistent with information reported in (Becker, 2000b), as cited previously.

Discussions and Conclusions

The author expected to observe differences in technology and software use as related to school poverty level in all categories of technology and software use: calculator use, computer use, and software use. In particular, the author expected differences in the use of technology with urban schools reporting more low-level instruction, accountability test preparation, and remediation.

Reported Use of Technology and Software

Affluent versus disadvantaged schools. The results indicated significant differences in frequency of software use. Affluent schools reported using software more frequently than disadvantaged schools for mathematics instruction. The items associated with this subscale describe the number of lessons devoted to using software related to simulations and explorations, statistical analysis, spreadsheet and database creation, and dynamic mathematical models and systems. Thus these results may indicate that affluent schools are using software to engage in more higher-order tasks such as investigations or problem-solving in mathematics.

As the author expected, schools differed in reported use of software as related to the poverty level of students in these schools. However, schools did not differ in their reported use of other technology, such as general calculator or computer use, as related to poverty level.

Urban versus suburban versus rural schools. The results indicated significant differences in reported objectives for calculator use. Urban schools reported significantly higher use of calculators as compared to suburban schools. The items associated with this subscale describe objectives for calculator use related to skill mastery, remediation, computation practice, problem solving, and information analysis. The majority of these items suggest that calculators are being used predominantly for calculation and computation, which led the author to conclude that objectives for calculator use for problem solving and information analysis may also be related to the computational part of these activities. Thus urban schools may be using calculators more often for low-order objectives than their suburban counterparts. It is possible that mathematics teachers in urban schools are having their students use calculators to compensate for poor computational skills, as the lack of computation skills does not inhibit students' problem solving.

As the author expected, there is evidence that high school mathematics teachers from different kinds of schools differ in the extent to which they use technology and the ways in which they employ it. Specifically, urban schools appear to use calculators more for than suburban schools do. They may be using calculators as an accommodation for students' lack of computation skills. There is no evidence that urban schools use calculators more for accountability test preparation. There were no significant differences in objectives for computer use or frequency of software use, as related to school locale.

Reported Importance of Computers and Calculators in Test Preparation

Affluent versus disadvantaged schools. There were no significant differences in reported importance of calculators in test preparation or reported importance of computers in test preparation.

Locale of the schools. The results also indicated that there were no significant differences in reported importance of calculators in test preparation or reported importance of computers in test preparation. Thus while calculators may be used more for low-level instruction in urban schools than in suburban schools, this is probably not related to accountability test preparation. When the author contrasted suburban schools (those originally classified as suburban) versus non-suburban schools (those originally classified as urban or rural), the results indicated a significant difference in reported computer test preparation by redefined locale. Urban and rural schools reported the use of computers in test preparation more than suburban schools do. The items associated with this subscale included the importance of improving student achievement scores and preparing or remediating for state tests in determining how computers are used in their school. Thus this difference in the reported use of computers in test preparation may indicate that urban and rural schools are using computers for more remediation and drill-and-practice for accountability tests than suburban schools.

As the author expected, there is some evidence that high school mathematics teachers from different kinds of schools differ in the extent to which they report using technology for remediation in relation to accountability test preparation – specifically, urban schools appear to use computers more for this purpose than suburban or rural schools do. However, there were no significant differences in reported use of other forms of technology for accountability test preparation, as related to either school poverty level or locale.

Secondary Analysis: Access to Computers in Home

The author used the information from this survey to investigate possible home access to computers as related to the demographic characteristics of the school that the students attended. The mathematics department heads were asked to estimate the percentage of students who had access to computers and the internet. Based upon these estimates, it suggests that almost all students that have a computer at home also have internet access at home. Furthermore, students from affluent communities (schools) are more likely to have computers at home and are more likely to have internet access than are students from disadvantaged communities (schools). While these estimates by the department heads are not scientific, they do reaffirm that there may be a digital divide in home access to computers based on poverty level (Becker, 2000b).

Limitations

The author recognizes three main limitations with this study. First, the study is based on self report of mathematics department heads. Second, the results are only applicable to Pennsylvania. Finally, the survey could be improved.

The author chose to have mathematics department heads to provide a self report of how mathematics teachers in their school use technology rather than using observation to gather this information. The author chose this method because given time and schedule constraints, it was infeasible for the author to get an accurate view of technology use in mathematics education by observation. However, self report presents room for error in how mathematics department heads may perceive technology as being used in their schools versus how technology is actually being implemented. Secondly, self report of mathematics department heads may provide an incomplete view of how all teachers are using technology. The study may have been more accurate if the author could have surveyed individual teachers, but funding and access limitations made it most practical for the author to survey one representative from each school instead.

The findings of this study only apply to Pennsylvania public high schools. Since only mathematics department heads in Pennsylvania public high schools participated in this study, the author cannot conclude that any of the reported trends would apply to other states. Other states may use technology differently in general instruction or in accountability state test preparation. There may be inherent characteristics of the Pennsylvania state test that influence how teachers prepare students, and the author does not know how this relates to other state tests and related instruction.

The questionnaire used for this study could be refined to produce more useful and accurate results. In creating the questionnaire, the author adapted many items from the 1998

Teaching, Learning, and Computing surveys (Becker & Anderson, 1998a; Becker & Anderson, 1998b). However, this survey involved an exploration of technology use in all subjects rather than just mathematics. In designing the questionnaire, the author included some items that were not as relevant to mathematics education and could have been omitted. For instance, items related to "information search" could have been excluded. Excluding less relevant items might have strengthened the author's ability to observe trends in reported mathematics technology use. The author also noticed that some items were worded in such a way that it was harder to draw conclusions about the level of instructional tasks. For instance, items referring to the use of "statistical analysis software" could include exploration of statistics concepts, which might be considered a high-order task, or straight computation of statistical values, which might be considered a low-order task. The author could have designed items to more clearly represent specific tasks in order to more easily identify the levels of these tasks.

Educational Implications

One clear educational implication of this study is that there is some prevalence of the use of technology for test preparation. It appears that urban and rural schools may be using computers for remediation and practice for state accountability tests. This use of computers may be an effective way for students to practice skills, but it may also result in increased instructional time spent using computers on low-order tasks. This possible impact of state tests in driving instruction presents another important educational implication of the use of technology for test preparation. Specifically, the importance of tests seems to be changing the way that urban and rural schools use technology for instruction more than it is changing the ways suburban schools use technology. In this way, the importance of state accountability tests may result in increased involvement in low-order tasks such as remediation in urban and rural schools.

Another implication is that technology can assist students to engage in higher level tasks as a tool – as in the use of calculators. The author found that urban schools reported using calculators more than their suburban and rural counterparts. It appears that urban schools may be using calculators as an accommodation for students' lack of computation skills. In this way, children can still do more difficult problems without being debilitated by low computation skills. While this may be seen as a crutch, it is not unlike how we, the nonschool population, use calculators every day. They handle cumbersome calculations and enable us to engage in relevant tasks.

Suggestions for Further Research

The findings of this study suggest that there may be fundamental differences in how schools are using technology based on school poverty level and locale. These differences may affect what kinds of tasks students in different schools are engaging in with technology. Further research that explores what kinds of tasks associated with software use could clarify important instructional differences based on school poverty level. Investigations into how calculator use differs based on locale could help explain what this means in terms of levels of tasks explored and learning that occurs. Finally, studies of the use of computers for accountability test preparation could shed light on how teachers are using technology to prepare students for tests, what kinds of instructional tasks they are exploring with this technology, and how this affects student learning.

Further research on the use of technology in secondary mathematics education could use observational data rather than rely on self report. This could produce more accurate and explicit insight into the levels of tasks explored with different forms of technology. Observational research could also measure frequency of use and amount of use more accurately than self report.

Appendix A: Survey

Technology Use in Secondary Mathematics Education

1. PART A: School Characteristics

1. Please provide the following information about your school:

What is the name of your school?

Do you have technology support staff?

How many technology support staff (eg. media specialists) provide some instruction to students, but teach students less than half time?

2. For how many years have you held the following positions?

# of years as Mathematics Department Head at this school

# of years in a teacher position at any school

3. Approximately what precent of your students this year (please estimate if you don't know):

	<25%	25-50%	51-75%	>75%
Have a computer at home to use				
Have a calculator for personal use				
Have a computer at home with internet access				
Are in a college preparatory or academic program				

Next

Technology Use in Secondary Mathematics Education

2. PART B: Technology Use

4. How often do you think teachers typically use the following technology in their mathematics classes:

	Never	Rarely (a few times per year)	One or two times per month	Weekly	A couple times per week	Daily
Calculators						
Computers						

Please specify how many students typically operate any one computer at one time during their mathematics classes (1 student; in pairs (2); in groups of 3-4; or if other, please describe arrangement)

5. Which of the following are among the objectives you have for student computer and/or calculator use?
Please reply for calculators in the first column and computers in the second.
Check ALL that apply.

	Calculators	Computers
Mastering skills just taught		
Remediation of skills previously mastered		
Practicing computation skills		
Engaging in individual problem solving activity		
Engaging in group (2 or more students) problem solving activity		
Graphing or interpreting graphs		
Expressing themselves in writing		
Communicating electronically with others		
Information search		
Analyzing information (e.g., quantitative analysis of data)		
Presenting information to an audience		
Learning to work collaboratively		
Learning to work independently		

Other (please describe, and specify if it pertains to calculators and/or computers)

6. For each of the following types of software, please indicate for how many lessons mathematics teachers have used that type of software on average per year (please estimate if you don't know):

	Never	Rarely (a few times per year)	One or two times per month	Weekly	A couple times per week	Daily
Games for practicing skills						
Simulations or exploratory environments						
Encyclopedias and other references on CD-ROM						
Word processing						
Software for making presentations (e.g. PowerPoint)						
Statistical analysis software (e.g. Fathom, Minitab)						
Spreadsheets or database programs (creating files or adding data)						
Dynamic software programs (e.g. Geometer's Sketchpad)						
Internet browser						

7. How adequate is your school's supply of useful software in each of the following categories:

	Poor	Fair	Good	Very Good	Excellent	Don't Need or Don't Know
Instructional drills, games, and tutorials						
Computer-based information sources (e.g., CD-ROM encyclopedias and databases)						
Computer-based tools (e.g., word processors, database, presentation software, spreadsheets, etc.)						
The number of licensed copies of specific software titles						
Funds for participating in on-line collaborative projects						

8. How important are each of the following goals in determining how COMPUTERS are now used at your school?

	Not Important	Slightly Important	Very Important
To prepare students for future jobs			
To improve student achievement scores			
To prepare students for state tests (or remediate to pass state tests)			
To increase collaboration among students			
To promote active learning strategies			
To deepen student understanding			

Other (please describe, and indicate level of importance)

9. How important are each of the following goals in determining how CALCULATORS are now used at your school?

	Not Important	Slightly Important	Very Important
To prepare students for future jobs			
To improve student achievement scores			
To prepare students for state tests (or remediate to pass state tests)			
To increase collaboration among students			
To promote active learning strategies			
To deepen student understanding			

Other (please describe, and indicate level of importance)

10. As department head, do you think your district's leadership is attempting to get mathematics teachers to implement any of the following instructional practices?

	No	Yes
Skills and strategies for taking standardized tests		
Project-based teaching (week or longer projects involving a variety of tasks and skills)		
Full coverage of district curriculum or textbook contents		
Developing student independence and responsibility for own learning		
Writing practice across the curriculum		
Process-writing (peer feedback, re-writing)		
Cooperative learning		
Performance assessments, exhibitions and/or portfolios		
Higher-order thinking in each subject; explaining, synthesizing, hypothesizing		
Use of computers for practicing skills and learning facts		
Use of computers for writing, analysis and problem-solving		
Use of the Internet for searching for information		
Use of the Internet for communicating with other classes or adults		

Prev Done

Appendix B: Letter to Participants

Sarah A. Coletta
1500 Fairview Avenue
Havertown, PA 19083

Dear Colleague:

I am an undergraduate honors student in mathematics education at Penn State University. As part of my program, I am doing a thesis on how high schools use technology in mathematics instruction. I would like to ask you to voluntarily participate in a very brief survey. This is a research project affiliated with Penn State University as part of my undergraduate work in the Schreyer Honors College. This survey is very brief and should take only about **5 minutes**.

This survey contains questions regarding access to technology at your school, the types of technology your mathematics teachers employ, and the types of tasks that mathematics teachers ask students to engage in. When you have completed the survey, just submit your results and I will receive them electronically. This survey is on the internet at:

http://sites.google.com/site/technologyinmathed/

I would be extremely grateful if you could spare a little time to help me with my thesis research.

Any information that you share will remain confidential. I will at no point in my thesis or other reports make reference to specific schools or participants. Participation in my survey is voluntary, and you may choose to stop at any point. However, the information that you have to share is integral to better understanding current instructional practices regarding technology use in mathematics education, and I believe educators could benefit greatly from an open discussion and sharing of ideas on this topic.

If you have any questions, comments, or concerns about this research, please feel free to contact me by email at sac5100@psu.edu, phone at (610) 291-0012, or mail at: 1500 Fairview Avenue, Havertown, PA 19083.

Thank you very much for your time and consideration.

Sincerely,

Sarah A. Coletta

Appendix C: Implied Consent Form

PENNSTATE

Implied Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project: **Technology Use in Secondary Mathematics Education: Is There a Socio-Economic Status Divide?**

Principal Investigator: Sarah A. Coletta
203 Atherton Hall
University Park, PA 16802
Sac5100@psu.edu
610-291-0012 (cell)

Advisor: Dr. Robert James Stevens
202 Cedar Building
University Park, PA 16802
Rjs15@psu.edu
814-863-2417

1. **Purpose of the Study:** The purpose of this research is to gather information about the kinds of technology available in public high schools, the kinds of technology high school mathematics teachers are using in their classes, and the kinds of activities high school mathematics teachers are asking their students to do using technology.

2. **Procedures to be followed:** You will be asked to answer 10 questions on an online survey.

3. **Duration/Time:** It will take about 5 minutes to complete this survey.

4. **Statement of Confidentiality:** Your participation in this research is confidential. Your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet by any third parties. This survey does not ask for any information that would identify you, the participant. The only identification is the name of the school. In the event of any publication or presentation resulting from the research, no personally identifiable information or school information will be shared because your name is in no way linked to your responses. All school-level information will only be reported in aggregates. No individual schools will be identified or discussed.

5. **Right to Ask Questions:** Please contact Sarah Coletta at (610) 291-0012 with questions or concerns about this study.

6. **Voluntary Participation:** Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer.

You must be 18 years of age or older to take part in this research study.

Completion and return of the survey implies that you have read the information in this form and consent to take part in the research. Please keep this form for you records or future reference.

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EDUCATION:

Bachelor of Science Degree in Secondary Education, Mathematics Teaching Option, Penn State University, Spring 2010
Honors in Educational Psychology and Highest Distinction
Thesis Title: Technology Use in Secondary Mathematics Education: Is There a Socio-Economic Status Divide?
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TEACHING EXPERIENCE:

Student Teacher at State College Area High School
Supervisor: Hazel Stryker
Spring 2010

Mathematics Tutor for Penn State Learning Centers
Supervisor: Lisa A. Broniszewski
Spring 2008 to Spring 2010

Pre-Service Student Teacher at Indian Valley High School
Supervisor: Mary Young
Spring 2009

Mathematics Tutor for Volunteers In Public Schools (VIPS)
Supervisor: Catherine Thatcher-Lehman
Spring 2007, 2008, 2009, and 2010

Teaching Assistant at Pennsylvania State University for The Role of the Resident Assistant
Supervisor: Nicholas Pazdziorko
Fall 2008

RELATED EXPERIENCE:

Horseback Riding Instructor at the Delaware County 4-H
Supervisor: Joyce E. Morrison
Summer 2002 to present

Senior Camp Counselor at ESF Summer Camps
Supervisor: Deborah Russo
Summer 2009

Resident Assistant for Penn State Residence Life
Supervisors: Dina Liberatore and Christopher Sclafani
Fall 2007 to Spring 2009

Camp Counselor and Teaching Assistant at the Summer Institute for the Gifted (SIG)
Supervisor: Michael Orlando
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Schreyer Cooperative Extension Summer Intern at the Delaware County 4-H
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HONORS/AWARDS:

Penn State Evan Pugh Scholar Award, Senior year
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Penn State President's Freshman Award
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National Merit Finalist Scholarship
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Donald B. and Mary Louise Elder Tait Scholarship in Mathematics Education 2009-2010
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Mid-Atlantic Association of College and University Housing Officers Academic Excellence Award

ACTIVITIES:

Executive Director (2009-2010) and Treasurer (2007-2009) for Penn State Habitat for Humanity
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CONFERENCES AND PRESENTATIONS:

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PROFESSIONAL AFFILIATIONS:

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