# DIFFERENCES IN TEACHERS' CHOICE OF TECHNOLOGY AND ITS IMPLEMENTATION AMONGST ABILITY-GROUPED HIGH SCHOOL MATH CLASSES

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# ABSTRACT

This paper investigated the differences in types of technology, methods of technology implementation, and frequency for the types and methods of technology used in Pre-AP, regular, and trailer classes of Algebra and Geometry. Fifty-one high school math teachers from two districts and eight schools completed technology surveys. Additionally, two teachers were interviewed and observed teaching. Data indicated that no one ability group was favored in all three aspects of the investigation. Regular classes implemented the most types and methods, but Pre-AP and trailer classes had higher overall and individual frequencies for types and methods used. The data also suggested the frequent technology use in trailer courses may be due to teachers' desires to provide new experiences to previously unsuccessful students. Overall, teachers of all groups favored calculator use for procedural knowledge, and showed less focus on other technologies or uses, such as applications, critical thinking skills, or assessment.

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# CHAPTER 1

# INTRODUCTION

Today's students must do more than just know how to use technology; they must be able to perform in a society saturated with opportunities for problem solving, communicating, and analyzing using technology (Barron, Kemker, & Harmes, 2003; Solomon, 2002). Therefore, "it is in the best interest of both today's young people and the nation as a whole that *all* students have an opportunity to master the elements of technology they will need to have a productive future" (Milone & Salpeter, 1996, p. 39). This wasn't always what occurred in practice, especially with the introduction of technology into the classroom in the late 1970's (Sutton, 1991). The introduction of technology sparked a new field of research in the 1980's that focused on computer access. Researchers found that computer use in education maintained some of the inequities already existing in society between students of different genders, races, and socioeconomic statuses (Sutton, 1991). Researchers also investigated the differences in access and technology use by student ability groups.



Data indicated that higher ability students (e.g. honors students, gifted and talented, etc.) not only spent more time on computers than did lower ability groups, but the higher ability groups also practiced programming and word processing – more higher level uses of technology - instead of drill-and-practice activities like the lower ability groups (Becker & Sterling, 1987; Chambers & Clarke, 1987). More recent studies on general ability group treatment, though not specifically addressing technology, have also shown that higher ability students receive better quality of instruction than do students in lower ability groups (Westchester Institute for Human Services [WIHS], 2002). Pugalee (2001) found that, unlike their higher ability counterparts, the low ability groups were often denied opportunities to experience rigorous coursework, hands-on

activities, and critical thinking and problem solving situations. These students were also often underestimated (Slavin, 1988; William & Bartholomew, 2004), and often developed low self esteems (Oakes, 1985; Venkatakrishnan & William, 2003) which further affected their choice in friends, extracurricular activities, and electives (Sedlak, Wheeler, Pullin, & Cusick, 1986). Hallam and Ireson (2003) concluded that the alienation of students in low ability groups resulted primarily from teacher attitudes toward these students and toward teaching low ability classes.

Despite the separate studies on ability grouping and technology and older studies on computer use among ability grouped students, there is relatively little new information specifically focusing on technology in a mathematics classroom and the differences between ability-grouped classes. The current availability of technology for mathematics classrooms now allows teachers to provide students with opportunities to problem solve, reason, explore, make decisions, analyze, visualize, and reflect on their answers ("Handheld graphing", 2001; Kramarski & Zeichner, 2001; Pugalee, 2001); and while educators understand that students with different learning abilities can require different needs, technology is one way to help all students reach their individual potential (Brown, Higgins, & Hartley, 2001) so that no student is denied the opportunity to succeed in mathematics.

**Statement of Problem**

As the emphasis on technology use in the classroom increases, so do questions regarding access, implementation, and student and teacher benefits, to name a few. This study focused on three specific aspects of incorporating technology into the classroom: type of technology, method of technology implementation, and the frequency of occurrence for those two aspects. More specifically, this study examined the often overlooked stratification of students through ability grouping in high school mathematics classes and how they compared to each other in

regards to teachers' choice of technology, methods of technology implementation, and frequency for the types and methods used in these classes. This study considered data for three specific ability groups - Pre-Advanced Placement, regular, and trailer courses (see definitions p. 5-6) - and three high school math subjects - Algebra 1, Geometry, and Algebra 2 – through surveys, observations, and interviews with high school math teachers.

## Rationale

Implementation and differences between groups (in this case, ability groups) are two important issues when studying the use of technology in the math classroom. There is no sense in learning how technology is being used if it is being denied to a certain population. Similarly, there is no use in examining the differences between the ability groups if the use of technology is serving no educational purpose. Until now, the researcher has not been successful in finding studies that have considered all available technology, its implementation into the math curriculum, and the differences waged upon the ability groups in one study.

With the increased emphasis for math students to gain a better conceptual understanding of concepts and to move away from rote manipulations (Lapp, 1999) it is no surprise that educators have turned, in part, to technology for assistance. Technology provides benefits that directly help students gain a better conceptual understanding, as well as explore solutions, visualize problems and solutions, and become overall independent mathematical thinkers (Adams & Hamm, 1998; "Handheld graphing", 2001; Pugalee, 2001). Students may have different abilities, especially when it comes to mathematics, but all students still have the right to reach their educational potential (National Research Council [NRC], 1989). This includes "providing all students with comparable educational opportunities" (Milone & Salpeter, 1996, p.

39) regarding technology and the necessary technological skills to perform and succeed in today's society (Becker, 1992; Milone & Salpeter, 1996).

Teachers, however, play a key role in technology implementation. Brown, Higgins, and Hartley (2001) reported that teacher attitudes can affect how technology is implemented into a lesson and who they allow to use technology. Also a teacher's knowledge of technology and how to effectively implement it into a lesson in a manner that maximizes student learning also affects how teachers might - if they even do at all - use technology in the classroom (Solomon, 2002). Moreover, teachers attitudes – intentional or not – about their students may lead to alienation (Hallam & Ireson, 2003) and/or an underestimation of their abilities (William & Bartholomew, 2004) which could in turn affect the teachers use of technology, especially with groups they find less deserving (Sutton, 1991). Improved math education technology and teacher influence are all significant in their own right, but when combined, validate the importance of determining what is occurring in the classroom, how students are being taught using technology, and how different students are being affected.

## Implications

Determining the difference of technology use in ability grouped math classes has implications for many involved in the study. Teachers will become aware of any habits and biases regarding student treatment, and hopefully make changes, as needed, to improve student understanding and opportunity. Administrators will have a better understanding of teaching practices in their school and be able to determine the course of action required to resolve potential problems present in the data. For those teachers and administrators not involved in the study, they may be prompted to examine their own biases and approaches to using technology in ability grouped classes. Most important are the implications for students – regardless of whether

or not their teacher participated in the study. Parents of students who are voluntarily or involuntarily placed into these ability groups and the students themselves may see instructional improvement as teachers are encouraged to reflect on and improve their own practices. Improvements may include higher quality instruction using technology, better student understanding of abstract mathematical concepts, and development of students into more productive and capable workers both technologically and mathematically.

## Definitions

### Technology

Technology is defined as “cameras, videos, calculators, projection systems, and electronic probes and sensors, as well as computers and their applications” (Shelly, 2002, para. 8).

### Pre-Advanced Placement (Pre-AP) Classes

For the purposes of this study, Pre-Advanced Placement classes are defined as the classes that move at a faster pace and study subject matter in more complex and in-depth ways. While students in this class may range from being identified as gifted to being identified as receiving special education services for learning disabilities, the majority of the students are in this class to prepare for Advanced Placement classes, which allow credit by exam for college courses.

### Trailer Classes

For the purposes of this study, trailer classes are defined as the classes that repeat the material from the previous semester (e.g. the first part of Algebra 1 is normally offered in the fall, but a trailer Algebra 1 class offers the first part in the spring). The range of students in this class also varies; however, it is less likely that the students in this class would be identified as

gifted - although it cannot be ruled out. The majority of students in this class have typically failed one or more previous semesters in the math sequence.

**Regular Classes**

For the purposes of this study, regular classes are defined as those classes that are not Pre-AP or trailer classes. Students in this class may range from being identified as gifted to being identified as needing special education services. Students in this class may have also previously failed one or more classes in the math sequence, but managed to return to the standard sequence.

**Tracking**

Tracking is defined as the "broad, programmatic divisions that separate students for all academic subjects. For example, high school tracks divide students into academic, general, and vocational programs" (Gamoran, 1992, p. 11)

**Ability Grouping**

Ability grouping is defined as the "divisions among students for particular subjects, such as special class assignments for math or within-class groups for reading" (Gamoran, 1992, p. 11), or "the practice of dividing students for instruction on the basis of their perceived capacities for learning" (WIHS, 2002, p. 1).

**Equity**

Equity is defined as "[Secada (1989)]…a qualitative property and refers to judgments concerning justice" (Sutton, 1991, p. 477).

**Equality**

Equality is defined as "[Secada (1989)]…a quantitative property that describes parity among groups along some index" (Sutton, 1991, p. 477)

## Research Question

Are there differences in how teachers incorporate technology in Pre-AP, regular, and trailer Algebra 1, Geometry, and Algebra 2 classes?

### Sub-Question One

Are there differences in the types of technology that teachers use for Pre-AP, regular, and trailer Algebra 1, Geometry, and Algebra 2 classes?

### Sub-Question Two

Are there differences in the methods of technology implementation that teachers use for Pre-AP, regular, and trailer Algebra 1, Geometry, and Algebra 2 classes?

### Sub-Question Three

Are there differences in the frequency of total technology use, the frequency of each type of technology used, and the frequency of each method of implementation for the Pre-AP, regular, and trailer Algebra 1, Geometry, and Algebra 2 classes?

## Delimitations

Although ability groups can be found in elementary and junior high schools, the results of this study cannot be generalized to those settings - or to math populations in these settings - because of the differences in course content which could affect the applicable uses of technology and the different types of technology that may or may not be used in those classes. Similarly, despite the existence of ability groups in high school, this data is specific to the uses of technology in a mathematical context and therefore, cannot be generalized to any other high school subject. As far as making generalizations to other high school math populations, it may be possible to generalize these results to other schools and districts in the city where the research took place. However, it may not be generalizable to any high school with ability grouped

students because the schools where this research was conducted had a high composition of minority and low socioeconomic status students in the population (District 1, 2004; District 2, 2004); and results may not be similar for schools or districts whose student population is different.

## Limitations

### Surveys

Surveys were handed out to teachers in May 2004, which marked the end of the spring semester. This was done with the intent of allowing teachers to complete their semester and then report on their use of technology while information was still fresh in their minds. However, handing out surveys during the end of the year causes limitations in the number of surveys that may be returned because this time of year is very busy for teachers. Many may not have the time to fill out the survey. For those teachers who did complete the survey, limitations include teacher honesty, ability to recollect activities from the semester, and time to complete the survey thoroughly and thoughtfully.



### Observations

Classroom observations were limited by the time constrictions of the researcher and the teachers being observed. Limitations for class observations also included in-class interruptions, lab closures, and technology malfunctions. As far as the technology a teacher was able to use during their lessons, this was limited by the school's available technology, the teacher's daily access to this technology, and the teacher's knowledge on the technology's operation.

## Assumptions

The assumption for this study is that technology has benefits which aid student comprehension and success in learning mathematics concepts. It is understood that teacher

implementation plays a large role in determining the success of technology implementation in the classroom (Cuoco & Goldenberg, 1996). However, without assuming that technology can be beneficial, there would be no need to determine if students have access to technology or how teachers are implementing technology into their lessons, much less the differences between technology use among ability groups. This is not to say that researchers have not written on the ineffective use of technology, its limitations and limited intelligence, the concern over eroding knowledge and skills, and the focus on technology at the expense of strategies for learning (Lipson & Fisher, 1983; Ruggieri, 2005; Young, 2004); however, these concerns will not be addressed in this research project.

# CHAPTER 2

# LITERATURE REVIEW

Few studies exist that specifically examine high school mathematics teachers' use of a variety of technology within the different ability groups for each subject (Becker & Sterling, 1987; Sutton, 1991). On the other hand, much information exists on mathematics, technology, and ability groups in general (Congress of the United States of America, 1995; Kline, 1973; National Council of Teachers of Mathematics [NCTM], 2000; Oakes, 1985; Oakes, Ormseth, Bell, & Camp, 1990; Slavin, 1988; The National Commission on Excellence in Education [NCEE], 1983). By examining these three areas, a foundation will emerge that brings to light the importance of this study. This chapter addresses some of the significant changes in mathematics and education reform from the 1950's to current day, the use of technology during the 1980's and beyond, and the pros and cons behind the long standing debate on ability grouping.

## Fifty Years of Education Reform

Mathematics education has long been studied by educators to see if students were not just memorizing information, but actually understanding what they were being taught (NCTM, 2000). In fact, educators were studying these problems as far back as the 1930's (NCTM, 2000). However, it was the launching of the Russian spacecraft, Sputnik, in 1957 that prompted Americans to reexamine their standing as a leader in math and science and begin demanding reforms (Kline, 1973). This section will discuss the needs in education - particularly math and science - in the 1950's and the changes that followed, the effects of *A Nation at Risk* – a report on the state of education in the United States – and the three major reform movements that followed its release, and the current needs and reforms developed in the 20 years since that report.

**Sputnik Ignites Change**

After the launching of Sputnik in 1957 (Kline, 1973), groups like the American Mathematical Society, the National Council of Teachers of Mathematics, and the College Entrance Examination Board, among others, began creating new curriculums to fix the problems present in the traditional curriculum (Kline, 1973; Remillard & Bryans, 2004). These groups argued that the traditional curriculum involved too many mechanical processes and forced students to memorize facts rather than understand concepts (Kline, 1973). The traditional curriculum was also said to be filled with topics that were outdated, disconnected from each other, and provided little opportunity for application or student motivation (Kline, 1973). These groups planned reforms designed to create a new mathematics curriculum that removed outdated topics and added a logical and unified understanding of modern math (Kline, 1973).

Yet, these reforms did little more than change the order in which the traditional topics were taught and add new content that students still only learned through mechanics and memorization (Kline, 1973). Although educators still stressed the need for applications, critical thinking, interdisciplinary studies of mathematics, and a broad understanding of the most important principles, little else was done (Kline, 1973). By the 1970's the nation found itself behind, not only in mathematics, but other subject areas as well. Twenty-three million adults were illiterate (NCEE, 1983); college entrance exam scores were falling (Burrill, 1998); seventeen-year-olds lacked higher order thinking skills, and one-third of them could not solve a multiple step math problem (NCEE, 1983). These problems became more evident at a time when technology was transforming occupations and the skills needed by workers to obtain these jobs (NCEE, 1983), and in April of 1983, the nation addressed these concerns in a letter to the public entitled, *A Nation at Risk: The Imperative for Educational Reform* (NCEE, 1983).