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# Effects of School Choice on Math Performance

Rachel Ricioli Wittenberg
*Dominican University of California*

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# Effects of School Choice on Math Performance

Rachel Ricioli Wittenberg

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| Rachel Ricioli Wittenberg, Candidate | Date |
| Dr. Lisa Ray, Chair | Date |
| Debra Polak, Thesis Advisor | Date |

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**Abstract**

The purpose of this study is to determine if there is a significant skill level difference between freshmen geometry students who attended charter schools and those who attended non-charter schools during middle school. The study addresses the controversy over charter schools providing better educational outcomes. The literature reviewed focuses on achievement in charter schools, and also discusses the indirect effects charter schools may have on surrounding public schools. The sample includes two cohorts of freshmen geometry students from the 2011-2012 and 2012-2013 school years, which resulted in a sample size of 115 students. The results show that the difference between the skill levels of charter and non-charter school students is statistically significant; charter school students at the study's site are less prepared for high school geometry than students coming from the local public middle school. In this study, it appears that charter schools are not creating better educational outcomes, and interventions must be created to fill the skill-level gaps.

## Introduction

In a fast-paced, competitive world, parents are always looking for ways to help their children succeed. In the context of education, this may mean seeking out the best school for their child, and encouraging their child to take advanced math classes. In an affluent, suburban area in Northern California, school choices are abundant and include public, private, and charter schools. Although some parents choose alternative schools for their children during elementary school or middle school, many return to public education during high school when there are fewer school choices. This study will examine whether there is a significant difference between different types of local middle schools and their ability to prepare students for high school mathematics.

### Background and Need

At a suburban high school in Northern California, students come from a variety of middle school experiences. Most ninth-grade students come from the local public middle school, but others come from local charter and private schools. At this study's site, administrators, teachers, counselors, and parents are concerned that some adolescents may be inadequately prepared for the rigors of high school classes. The researcher has also heard complaints from parents who are simply concerned for their child's education, and worry that the charter schools in the district are not preparing students for high school math. In one conversation with a parent, the researcher found that a student had received an A grade in math during 8th grade Algebra I, and both the parent and student felt highly confident in the student's mathematical abilities. It was not until geometry, her freshman year of high school, that this student realized that others were far more advanced in critical algebra skills.

Besides being a local issue, charter schools have been a controversial topic since their emergence in 1992. Although some research has been done on the success of charter schools on a state-by-state or citywide basis, more research must be done to understand charter schools in rural and suburban areas.

**Statement of Problem**

In order for the researcher's site to better articulate with local middle schools, it is important to know if there is a difference in the quality of math education given at the mainstream public middle school and the local charter schools. This study will examine if there is a difference in ability between two groups of students: those who attended local charter schools and those who attended the local public middle school.

**Purpose Statement**

The purpose of the study was to determine if there was a significant skill level difference between freshman geometry students who had attended local charter schools compared to the mainstream public middle school. Specifically, this research assessed freshman geometry students during the 2012-2013 and the 2013-2014 school years. These are students who all completed Algebra I at the middle school level and were recommended by their middle school to take geometry their freshman year of high school. This study will investigate if there is a local issue concerning freshman math students being unprepared for the rigors of high school math, and what specific skills they may be lacking.

**Hypothesis**

Although there are many supporters of charter schools in the United States, there is some controversy over whether or not they provide better educational outcomes. This study provides a unique opportunity to test math readiness of students from charter and public schools to see which group is most prepared. The researcher's prior personal experience suggests that charter school preparation is actually less effective, which contrasts with most observers' expectations. The hypothesis tested here, then, is that students coming from local charter schools are less prepared for freshman geometry classes than students who are from the public middle school in this area.

**Theoretical Rationale**

The research assumes that the Math Diagnostic Testing Project (MDTP) test is an accurate judge of a student's ability to succeed in high school geometry. The "Geometry Readiness Test" is specifically designed to assess if a student has the preparation and proper skills for geometry. The test covers standards that should be covered in all California Algebra I classes including: exponents, rational expressions, linear equations, polynomials, and graphical representations. It also tests their ability to answer questions related to "Informal Geometry and Logic." Achievement in these standards is an indicator of how well they might succeed in a high school geometry class.

## Literature Review

The literature reviewed in this study examines the origins and outcomes of charter schools in the United States. Charter schools have extended more choices to families looking to serve their children's education needs. The literature reviewed will also study current charter schools across the United States and their effects on their respective communities in areas where school choices are abundant. It is important to know not only if charter schools are successful, but also to understand their indirect effects on local public schools.

Next, literature will be reviewed to understand the impacts of placing 8th grade students in Algebra I. Some studies show that there is a pressure for middle schools to enroll a large amount of students in advanced classes regardless of their ability level. This could offer information as to why some students are coming to the study's school site unprepared for geometry. In addition, studies that compare the Algebra I experience of charter school and traditional public schools will be highlighted.

### Review of Previous Literature

**Historical Overview.** In 1955, Nobel-prize winning economist Milton Friedman argued that Americans should be offered choices, and that greater school choice could force public schools to compete and improve. It was this idea of market supply that spurred the movement of "choice" for education, and from 1992 to 2009, the number of charter schools grew dramatically from a single charter in Minnesota to over 4,000 schools (Zimmer & Buddin, 2009).

A charter school is a non-traditional and relatively new and unique organizational structure for a school. Renzulli's 2005 study stated:

> They are the only choice option that can be created by groups of laypeople. Unlike traditional schools which are run by local and state governmental boards, charter schools are developed and managed by groups of parents, community members, teachers, or educational management organizations (EMOs). (p. 2)

Communities seeking "freedom from bureaucratic conventions and regulations" embrace the idea of charter schools and create them, and the "administrators of charter schools agree to be accountable for students' success, as specified in their school's charter" (Renzulli, 2005, p. 2). Charter schools may also set their own salary schedules and hire, or fire, at will, creating a staff that is employed based on merit (Ravitch, 2010).

Charter schools are formed for a variety of specific reasons based upon the needs of a particular community. Generally speaking, founders of charters are looking for choice and autonomy, and seeking to fulfill a "vision that could not be realized in a traditional public school" (Renzulli, 2005, p. 3). Some charters may be formed to implement an alternative education program such as art or music throughout the curriculum. They may also be seeking an alternative institutional approach with structural differences from a public school (Renzulli, 2005). In her book *Death and Life of the Great American School System* (2010), Ravitch stated that the charter school movement was empowering for teachers who wanted to make their own decisions regarding curriculum and pedagogy. Many teachers were interested in exploring new techniques to motivate dropouts and other disaffected youth (Ravitch, 2010). The first charter school in Minnesota, St. Paul City Academy High School, catered to dropouts and was designed to "help students that were not succeeding at a traditional school" (Ravitch, 2010, p. 125).

Ravitch cites Albert Shanker, president of the American Federations of Teachers, as one of the "founding fathers" of the charter school movement. However, in 1993, Shanker withdrew his endorsement, and said that the charters "had been taken over by corporations, entrepreneurs, and practitioners of 'do your own thing' " (Ravitch, 2010, p. 124). Shanker grew to believe that charter schools could threaten the public school system (Ravitch, 2010). Despite this, charter schools had plenty of supporters including every sitting president since the commencement of the first charter: George H.W. Bush, Bill Clinton, George W. Bush, and Barrack Obama. Charters were supported by both Republicans and Democrats across the United States and appealed to those looking to deregulate public education and promote choice, certain that all students would gain from the forces of competition. Federal dollars were given to spur the development of charter schools, and by 2010, 1.4 million students attended charters (Ravitch, 2010).

In 2001, charter schools were most commonly found in urban areas, where "demand for alternatives was high" (Ravitch, 2010, p. 125). Washington D.C., Dayton, Ohio, and Southfield, Michigan each enrolled approximately one-third of their students in charters, and in New Orleans, 55% of students attended a charter school. Certain states were also more impacted by the charter school movement. 60% of charter school students lived in California, Arizona, Texas, Florida, Michigan, and Ohio (Ravitch, 2010).

**Achievement in Charter Schools**. The results of charter schools are mixed, and it is difficult to identify statistically significant findings in most studies. In her book, Ravitch illustrates that charter schools vary in performance from dreadful to excellent (Ravitch, 2010). For example, Ravitch cited a 2008 RAND Corporation study in which the authors considered the charters schools in Philadelphia. RAND compared charter and non-charter schools and found

that the differences between the two groups were statistically insignificant. They noted that many interventions were made in both groups so it was difficult to attribute improvements or failures to the charters themselves. In addition, there was no evidence that traditional public schools changed because of the presence of charters. Some charters in the study (6) did better, and some did worse (10) (Zimmer, Blanc, Gill, Christman, & RAND Education, 2008).

In 2004, Harvard University economist Caroline M. Hoxby studied charter school students at elementary schools across the country. She found that charter school students were more likely to be proficient in math and reading than students at traditional public schools. The advantage was also shown to increase with the number of years a student had attended a charter school (Hoxby, 2004). In contrast, a 2007 NAEP (National Assessments of Educational Progress) study showed that students in public schools had higher scores than students in charter schools in fourth grade reading, fourth grade mathematics, and eighth grade mathematics. However, when the students were compared by race and ethnicity, there were no statistical differences between the two groups (Lubienski & Lubienski, 2006). The data continues to indicate there is no clarity at all.

In a 2011 study, Crane, Huang, Barrat, and REL West studied charter schools in Arizona. The study examined math proficiency at the elementary, middle, and high school levels, and compared the results to students attending charter schools. Overall, "71% of Arizona public school students scored proficient on the AIMS" compared to 71% of charter school students (Crane, Huang, Barrat, & REL West, 2011, p. 5). At the elementary school level, 72% of public school students scored proficient, compared to 75% of charter school students. At the middle school level, 68% of public school students scored proficient, but only 63% of charter students scored proficient. Finally, results at the high school level were dramatically different: 72% of

public school students scored proficient and charter school students fell short at 53% (Crane, et al., 2011). In Arizona, it seems that charters at the elementary school level are fairly similar, but results begin to diverge at the middle school level, and only widen at high schools.

In a 2007 study by Crane, Edwards, and Edsource, California charter and non-charter schools were compared using multiple performance measures. The study analyzed four different performance measures: the Academic Performance Index (API), which measures school performance based on California Standards Tests (CST); AYP (adequate yearly progress), which measures the percent of students proficient and above on the CST; mean CST scores for math and English; the mean score for sophomores on the CAHSEE (California High School Exit Exam) in English and math. The study also took into account "differences in enrollment and student characteristics," and used multiple years of data making it one of the most thorough reports on California charters in recent years (Crane, et al, 2007).

The study had some interesting findings among elementary, middle, and high schools. At the elementary school level, "charter schools did not perform as well as elementary non-charters." (Crane, et al., 2007, p. 8). In math, the AYP was 5.2% points lower in charter schools after adjusting for enrollment and school characteristics. In addition, the CST Math test scores in third grade were 10.0 scale score points lower in charter schools. However, at the middle school level, "both with and without controlling for differences in enrollment and SCI [school characteristics], charter middle schools scored significantly higher than non-charters on the API. The results are consistent over time and across multiple measures" (Crane, et al., 2007, p. 10). Charter schools were ahead by 7.1% on the AYP in mathematics and had CST Math 14.8 scale score points higher than traditional public schools. According to the report, charter middle schools are a rarity with only 54 existing in California, enrolling about 21,000 students. There

were 1,211 traditional middle schools at the same time enrolling approximately 1.15 million students. At the high school level results were less consistent. In English, non-charters scored higher when adjusting for enrollment and school characteristics. In math, charters had a lower percentage on the AYP and 2.6 scale score points lower on the math section of the CAHSEE (Crane, et al., 2007)

In addition to these findings, the study also noted that "charters have higher percentages of teachers who are not fully credentialed and have two years or less of experience" (Crane, et al., 2007, p. 3). The report, which included 574 charter schools and 9,001 non-charters, revealed that 15% of teachers at charter schools were not fully credentialed compared to 5% of teachers at non-charters. Teachers at charters also lack experience with 24% of teachers at charters having two years of experience or less compared to 12% at non-charters (Crane, et al., 2007).

**Influences of Charter Schools on Traditional Public Schools.** Most research on charter schools focuses on the direct effects of charter schools on their students, but it is also important to consider the indirect effects of charters on other local public schools in the community. Zimmer & Buddin studied the effects of charter schools on six communities. They suggest that charter schools may not only have a benefit for those attending the schools, but also for those attending public schools because of the forces of competition. The study examined charter schools in California within six districts: Napa Valley Unified, San Diego Unified, Los Angeles Unified, Fresno Unified, West Covina Unified, and Chula Vista Elementary. The presence of charter schools varied within each district, with an average of 4.6% of the total student population attending charter schools in these six districts (Zimmer & Buddin, 2009).

Zimmer and Buddin's study showed that the presence of charter schools may have some indirect benefits and detriments to local public schools. Based on surveys sent to principals in the six districts, it was concluded that about a quarter of traditional public schools changed "instructional practices" in response to the presence of charter schools in their district (Zimmer & Buddin, 2009, p. 834). In addition, 20% restructured compensation for teachers, approximately 12% changed their curriculum, and 25% changed their professional development. It is unclear from this data whether principals considered these positive or negative changes, but it is clear that charters had a significant effect on school and district practices. Zimmer and Buddin also noticed that districts with a larger proportion of the students' attending charters were affected the most (Zimmer & Buddin, 2009).

Principals surveyed in the study also stated some specific negative affects of charters in their districts. Of those surveyed, 12% said that financial security was affected negatively, 12% stated teacher recruitment and retention was affected negatively, and 12% said that their ability to attract and retain students was affected negatively. However, the study concludes that the vast majority of school principals stated that there was no effect. What is clear is that the charter schools within these six districts are rapidly expanding and increasing in number. In 1998 there were 27 charters and 16,081 students attending these schools. In 2002, just four years later, the number of students attending charters more than doubled to 38,831 students attending 73 charter schools (Zimmer & Buddin, 2009). This is just one example of the growth and affects of charter schools in the United States. As time goes on and charter schools continue to increase in number, additional research may be conducted, providing additional information about the forces of competition on local public schools.

The study concluded that at that time, no definitive conclusions could be made about the specific effects of charters on student achievement in traditional public schools. The authors admit that the study:

> Which used both survey and student achievement data with an array of different measures, shows little evidence of positive competitive effects of from charter schools in California, which adds to the literature that has shown only modest competitive effects (at best) arising from the introduction of charter schools. (Zimmer & Buddin, 2009, p. 841)

In summary, Zimmer and Buddin suggest that the biggest of effect of charter schools is on those attending these schools.

**Algebra I in the Middle Grades.** In 2009 study, Williams stated that 54% of 8th graders and 6% of 7th graders in the state took the Algebra I CST test at the end of the school year, indicating that they took the course (Williams, 2011, p. 7). In his dissertation at UC Davis, Taylor studied the impacts of 8th graders taking Algebra I. There is an apparent push in California to expose students to algebra material early on, in middle school, as past research has shown that exposure benefits all students. Taylor reviewed this claim and found that students who took algebra before high school not only "improved beyond simple math knowledge and were encouraged to take more mathematics courses, thereby improving access to advanced math courses and increased math achievement in high school" (Taylor, 2011, p. 14). Students who took algebra as an 8th grader were also shown to attend college at higher rates than those who didn't. However, other research in California has found that approximately 65% of 8th grade Algebra I students are placed in the same course the next year, in their Freshman year of high

school (Taylor, 2011). Many students may be placed into Algebra I as an 8th grader even though they may not be ready for the material.

In a 2011 study, Williams, Haertel, Kirst, & EdSource surveyed hundreds of principals from both traditional public schools and charter middle grade schools across California. Of the study's sample, 96% of the schools offered an Algebra I course, and charter schools in the study placed a greater proportion of 8th graders into Algebra I than non-charter schools. The authors also found that districts vary in their student placement policies used to determine if a student can be placed into any given class, such as Algebra I. Survey responses stated that placement could be based on "prior academic achievement, student CST scores, and/or teacher recommendations," but "no single criterion was consistently reported" in the majority of responses (Williams, 2011, p.8). This indicates that there is little consistency between schools, and their ability to assess students' readiness for Algebra I.

The research also found alarming statistics involving teachers' credentials in middle grade schools. The most common credential for a middle grade math teacher was a multiple subject credential. Of 6th grade math teachers in the study, 87% had a multiple subject credential, 58% of 7th grade math teachers had a multiple subject credential, and 54% of 8th math teachers had a multiple subject credential. Remarkably, even 8th grade teachers, who taught Algebra I were lacking a single-subject math credential. Only 50% of 8th grade math teacher who taught Algebra I had a single subject math credential (Williams, 2011).

Literature that investigates why some middle schools may be performing higher than others is critical to understanding the variety of school choices in this study's geographical area. In a 2010 study by Edsource, the research team concluded that there are several characteristics

that successful middle schools have in common. By surveying hundreds of California principals on their practices, the study investigated why some middle schools perform higher on standardized tests despite serving the same or similar populations. It is evident from the study that there are specific practices for schools and districts that have a "significant impact on student outcomes regardless of student background" (Edsource, 2010, p. 2). These practices include:

1. Implementation of standards-based curricula and instructional practice is tight and coherent.

2. Cohesive policies and strategies are implemented to further strengthen student learning of ELA and math in 7th and 8th grades.

3. Adults are held accountable and take responsibility for improved student outcomes. The school expects students and parents to share the responsibility for student learning.

4. Setting measurable goals for improved student outcomes on standards-based tests.

5. The district plays a strong leadership role regarding the provision and use of student assessment data.

6. The records of entering students are reviewed thoroughly for possible warning signs of academic vulnerability and need for support. (Edsource, 2010, p. 2-10)

It is clear from this report that even though middle schools may be catering to similar populations, there are practices that some schools implement, and thereby increase student performance. These practices are very data oriented, and focus on setting goals that can be

measured. It is possible that smaller schools may not have the capability to collect data and analyze the results for improvements.

**Summary of Major Themes**

There is little consensus about the successes or failures of charter schools in general. What may have worked in one area in the country, has not worked in another. There are many studies that consider schools in highly urban areas, such as Philadelphia, Washington DC, or New York City, but little research exists that focuses on charter school achievement in suburban or rural areas of the United States. In addition, there is no consensus about whether the forces of competition have affected traditional public schools in areas where charter schools exist. Schools and districts must be examined on a case-by-case basis as some results may only be relevant to those particular areas.

**How Present Study Will Extend the Literature**

The study will extend the literature by focusing on a local suburban area in California. The research site will be able to use the information gathered to help all students be successful and tailor interventions to better fit the needs of struggling students. In addition, similar schools may be able to better understand their own student populations and educational environments within their community. This study will also add to the literature using MDTP data to better understand charter students and non-charter students, as most studies use other types of standardized test scores.

## Methodology

The methodology used in this study was part of the researcher's normal teaching routines. The researcher had a dual-relationship with her participants as not only the researcher in this study, but also the teacher of record for many of the geometry classes involved. Data was collected from two years of school data in order to create a robust sample size. The MDTP test was used to assess freshman geometry students during the first week of high school, which allowed the researcher to collect entry-level data and look for correlations between a student's 8th grade middle school choice, and his or her score on the test.

### Sample and Site

The site in this study is a suburban high school in Northern California. According to the 2011-12 School Accountability Report Card, the school has a population of approximately 1600 students with 10.9% of students being socioeconomically disadvantaged, 7.7% English Language Learners, and 9.6% with disabilities. The ethnicities of the student population are 66.1% Caucasian, 15.8% Hispanic or Latino, 7.7% Asian, 3.3% African American, 0.8% American Indian or Alaska Native, 0.9% Filipino, 0.7% Native Hawaiian or Pacific Islander, and 4.4% two or more races. In the 2011-2012 school year, there were 444 freshman (grade 9) students.

This study uses two cohorts of freshman students in order to create a robust sample size. The first cohort consists of students who were freshmen during the 2012-2013 school year, and the second cohort consists of students who were freshmen during the 2013-2014 school year. In the 2012-2013 school year, there were three sections of freshman geometry taught by two different teachers. These sections were specifically designed to be exclusively freshman classes,

but because of scheduling reasons, a sophomore or a junior may have been placed in these classes. These "misplaced" students were not included in the sample. In the 2013-2014 school year, there were two sections of freshman geometry taught by two different teachers. This allowed for a total of five sections, and a total of approximately 138 freshman students from both cohorts.

Students in this study passed Algebra I with a C- or better, and were recommended by their former teachers to take geometry as ninth graders. These students are considered above grade-level, with the majority of freshman students taking Algebra I. However, there are also freshman students who are considered more advanced than the sample. These advanced students are enrolled in either Honors Geometry or Algebra II, and were not included in this study.

CST scores are not used in this study, but provide an additional description of the study's sample. Not all of the participants in this study took the CST tests in 8th grade because some were exempt due to their attending a charter school or private school, or use of a waiver. However, 100% of this study's participants who did take the CST Math test in 8th grade scored either Proficient or Advanced. In contrast, according to the site's School Accountability Report Card, only 48% of the total student population at this site scored Proficient or Advanced on the Mathematics CST (School of Study, 2011).

**Access and Permissions**

Subjects in this study and data gathered were available to the researcher through normal teaching practices. The site's mathematics department supported the analysis of this data, and freshman geometry teachers allowed for their MDTP test results to be used in this study. Additionally, the site principal and the district's school board approved the research project.

Approval was also granted by the MDTP in order to use the data. The MDTP stated that test results belong to the teacher and site giving the test, and clarified that no materials from the test may be presented in this thesis.

**Data Gathering Strategies**

The MDTP test data was gathered through normal practices of the researcher in her classroom. The researcher also received data from other teachers at the school site who teach geometry to freshman students. The MDTP test is given to students during the first week of each school year in their math classes. The MDTP test was chosen for this study because of its ability to provide fast feedback at the beginning of the school year, and its itemized results of critical skills needed for success in geometry.

Traditionally, the math teachers at the study's site give the MDTP test in order to assess their students' entry-level abilities and adjust their lessons according to the groups' strengths and weaknesses. Teachers may also discuss the results of the MDTP test with individual students and recommend appropriate interventions for struggling students. The MDTP test is never used to place students in a specific class. In a letter from the MDTP site director at UC Berkeley, Emilio Gomez states that:

> The major purpose of the MDTP test is to help teacher prepare their students for further study in mathematics through the use of diagnostic materials. Our tests identify areas of strength and weakness both for a whole class and for each individual student, allowing you to make informed decisions about instruction and curriculum, and to address the particular needs of your students. (E. Gomez, personal communication, September 2012).

In her analysis of diagnostic testing, Betts, Hahn, Zau, and Public Policy Institute used the MDTP readiness tests, and stated that, "the intent of the MDTP tests is quite different from statewide testing systems mandated under the federal No Child Left Behind law. The latter are designed to measure overall school progress, and results can trigger various interventions at the school, district, and state levels. The MDTP tests are designed to help students and teachers work together in specific math areas that the student has yet to master" (Betts, et al, 2011a, p. 10).

The test documents are sent to, and scored by, the office of the Mathematics Diagnostic Testing Project (MDTP) at UC Berkeley. The results are sent back to the local school site within a few weeks. The results show an overall score for each student, and are also already separated into subtopics chosen by the MDTP. Tests used in this study were given during the first two weeks of school during the 2012-2013 and 2013-2014 school years.

**Data Analysis Approach**

Test scores of participants were organized into two groups based upon the participants' school in 8th grade. Data from students who attended charter schools in 8th grade was labeled "charter," and data from students who attended the local public middle school was considered "non-charter." Data from students who attended other institutions, such as private schools, were removed from this study. In addition, students who attended a public school outside of the local area were also left out of this study. The independent variable in this study was a student's middle school (charter or non-charter). The dependent variable was a student's score on the MDTP test (overall and on the six subtopics).

Statistical analysis was performed using the students' test results on each subtopic listed below. *T-tests* were conducted in order to determine whether there were any significant differences in these more targeted areas between charter and non-charter students.

Exponents and Square Roots; Scientific Notations (EXPS)

Rational Expressions (RATL)

Linear Equations and Inequalities (LINR)

Polynomials, including Quadratic Equations (POLQ)

Graphical Representation (GRPH)

Informal Geometry and Logic (INGL)

Statistical analysis was performed using the students' composite total scores. *T-tests* were conducted with this data as well to understand if there is an overall difference between charter and non-charter students.

**Ethical Standards**

This study adheres to Ethical Standards in Human Subjects Research of the American Psychological Association (Publication Manual of the American Psychological Association, 2009). Additionally, the project was reviewed and approved by the Dominican University of California Institutional Review Board (#10143).

## Findings

The study compared charter and non-charter students' MDTP scores, both overall scores and on six different subtopics. The study found a statistically significant difference between the scores of charter students and non-charter students in every category.

### Description of Site and Individuals

There were 115 participants in this study by collecting data over two school years. Diversity among the freshmen students, in terms of the middle school they attended, was surprising. Of 115 students, 21 were those who attended a charter school in 8th grade, and 94 attended the local public middle school. Although most charter students came from one specific charter school (12 students), students from other charters were included in the study and attended 5 other local charters. Students who attended private schools or public schools outside the district were not included in this study. This group consisted of 23 students who attended 12 different schools.

There was a dramatic decrease in freshmen enrolled in geometry during the 2013-2014 school year, causing the sample group to be smaller than expected.

### Description of Data

The MDTP Geometry Readiness test had a total of 45 questions and included 6 different subtopics: exponents and square roots; scientific notation (4 questions); rational expressions (6 questions); linear equations and inequalities (8 questions); polynomials, including quadratic equations (8 questions); graphical representation (5 questions); and informal geometry and logic (14 questions). For each subtopic, the MDTP provides a "critical level." This is considered to

be the minimum number of questions correct in order to be prepared for the rigors of geometry class.

**Inferential Analysis**

Table 1

*MDTP Test Scores: Overall Score*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 29.90 | 6.71 |
| Charter (a) | 21 | 22.76 | 6.68 |
| Non-Charter (b) | 94 | 31.5 | 5.42 |

*Table 1 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -8.7381 | -6.22 | 113 | <.0001 |

The MDTP test had 45 questions, and the critical level was 32. Non-charter students averaged 31.5 on the test, nearly reaching the critical level, while charter students averaged a

score of 22.76. The difference between these two means was statistically significant and resulted in a *P* value of <.0001, showing a confidence level greater than 99%.

Table 2

*MDTP Test Scores: Exponents and Square Roots; Scientific Notations (EXPS)*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 2.49 | 1.03 |
| Charter (a) | 21 | 1.86 | 1.02 |
| Non-Charter (b) | 94 | 2.62 | .85 |

*Table 2 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -.77 | -3.23 | 113 | .001621 |

The subtopic "Exponents and Square Roots; Scientific Notation" had only four questions, and the critical level was 3. Similar to the overall score data, the non-charter students nearly reached the critical level with a mean score of 2.62, and the charter students fell short with a

mean score of 1.86. The difference between these two means was found statistically significant, and resulted in a *P* value of .001621, showing a confidence level greater than 99%.

Table 3

*MDTP Test Scores: Rational Expressions (RATL)*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 3.83 | 1.29 |
| Charter (a) | 21 | 3 | 1.29 |
| Non-Charter (b) | 94 | 4.02 | .95 |

*Table 3 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -1.02 | -4.15 | 113 | .000844 |

The subtopic "Rational Expressions" had six questions, and a critical level of 4. The non-charter students reached the critical level with a mean score of 4.02, and the charter students again fell behind with a mean score of 3. The difference between these two means was found

statistically significant, and resulted in a *P* value of .000844, showing a confidence level greater than 99%.

Table 4

*MDTP Test Scores: Linear Equations and Inequalities (LINR)*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 5.53 | 1.68 |
| Charter (a) | 21 | 4.24 | 1.58 |
| Non-Charter (b) | 94 | 5.82 | 1.55 |

*Table 4 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -1.58 | -4.16 | 113 | <.0001 |

The subtopic "Linear Equations and Inequalities" had eight questions, and a critical level of 6. The non-charter students nearly reached the critical level with a mean score of 5.82, and the charter students again had a lower mean score of 4.24. The difference between these two

means was found statistically significant, and resulted in a *P* value of <.0001, showing a confidence level greater than 99%.

Table 5

*MDTP Test Scores: Polynomials, including Quadratic Equations (POLQ)*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 5.4 | 1.60 |
| Charter (a) | 21 | 3.95 | 1.42 |
| Non-Charter (b) | 94 | 5.72 | 1.63 |

*Table 5 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -1.77 | -5.04 | 113 | <.0001 |

The subtopic "Polynomials, including Quadradic Equations" had eight questions, and a critical level of 6. The non-charter students nearly reached the critical level with a mean score of 5.72, and the charter students had a mean score of 3.95. The difference between these two

means was found statistically significant, and resulted in a *P* value of <.0001, showing a confidence level greater than 99%.

Table 6

*MDTP Test Scores: Graphical Representation (GRPH)*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 2.91 | 1.12 |
| Charter (a) | 21 | 1.95 | 1.06 |
| Non-Charter (b) | 94 | 3.13 | .86 |

*Table 6 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -1.18 | -4.74 | 113 | <.0001 |

The subtopic "Graphical Representation" had five questions, and a critical level of 3. The non-charter students reached the critical level with a mean score of 3.13, and the charter students again had a lower mean score of 1.95. The difference between these two means was

found statistically significant, and resulted in a *P* value of <.0001, showing a confidence level greater than 99%.

Table 7

*MDTP Test Scores: Informal Geometry and Logic (INGL)*

Group

| | *n* | *M* | *SD* |
|---|---|---|---|
| All | 115 | 9.52 | 2.30 |
| Charter (a) | 21 | 7.76 | 2.12 |
| Non-Charter (b) | 94 | 9.91 | 2.30 |

*Table 7 Results:*

| *Mean a - Mean b* | *t* | *df* | *Two-tailed P* |
|---|---|---|---|
| -2.153 | -4.15 | 113 | <.0001 |

The subtopic "Informal Geometry and Logic" had fourteen questions, and the critical level INGL of 10. The non-charter students nearly reached the critical level with a mean score of 9.91, and the charter students again fell behind with a mean score of 7.76. The difference

between these two means was found statistically significant, and resulted in a *P* value of <.0001, showing a confidence level greater than 99%.

## Discussion

The purpose of this study was to determine if there was a significant skill level difference between freshmen geometry students who attended a charter school during 8th grade, and those who attended the local public middle school. The results of this study showed that charter school students, on average, score lower on the Geometry Readiness MDTP test. Although there are limitations to this study, it provides an important contribution to the existing research on charter schools in rural and suburban areas of Northern California, and adds to literature suggesting charter schools may not always provide the best educational outcomes in all subject areas.

### Comparison of Findings with Existing Studies

This study found that students scored significantly lower on the MDTP Geometry Readiness test if they had taken Algebra I at a charter school during 8th grade. This is a unique study because it assesses freshmen geometry students as they enter a public high school. Many other studies examine achievement of charter school students and non-charter school students separately, but do not analyze what may occur when all students come together at the high school level and are enrolled in the same geometry class. This study revealed what proportion of students may be lacking critical skills when entering a high school math class.

In addition, few studies exist that use MDTP test results. Most studies use CST or other state tests, the CAHSEE, or both. Additionally, most studies simply use the overall scores, but did not disaggregate by subtopic to analyze specific weak areas. More research should be done to see if there are differences in specific skill levels on subtopics on a state wide level.

Findings in this study contradict those of the 2007 study by Crane, et al which showed that charter schools outperformed non-charters in math at the middle school level in California

(Crane, et al., 2007). Crane et. al. were thorough in their sample size and used multiple measures. This suggests that our study could in fact be a localized issue, and may not represent California as a whole.

In the 2011 Arizona study by Crane, et al., however, students at charter middle schools scored as high as students at public schools. Additionally, many other studies showed that results were mixed and statistically significant findings were a rare. This confirms that results vary from school to school and region to region, and are difficult to generalize on a larger scale. What may have worked in one area of the country, or in a certain educational environment, may not have worked in another.

**Limitations of the Study**

There are some limitations that may have affected the validity of this study. A larger sample size or a long-term study, over multiple years, would help to strengthen the conclusions of this study. In addition, there may have been several confounding variables that affected the results. First, students are affected by elementary schools as well, not just the middle school they attended in eighth grade. It's possible that certain students were more prepared for Algebra I in eighth grade because of their solid foundation at an exceptional elementary school or with an exceptional teacher. Secondly, it's possible that charter schools may attract lower-level students, or students with learning difficulties. Some charter schools offer extra support and alternative teaching methods, which appeal to this demographic. It is not clear whether the charter schools in this study cater to this population. However, the charter school in which the majority of the charter school students in this study attended, did boast several facts on a 2013 Fact Flier. The school reports that:

> At [the charter school] approximately 50% of 8th grade students are enrolled in Algebra I. Other middle schools enroll only 30% or less of the student body in Algebra 1. Of those taking Algebra 1 at [the charter school], 54% scored proficient or advanced in their Algebra 1 CST scores. Per capita, more than two times as many students take Algebra1 at [the charter school] than at neighboring middle schools (Charter School of Study, 2013).

These statistics show that a large percentage of 8th graders are taking Algebra I. Based on our study, this may mean some students are not ready for this level of difficulty. However, it seems that many students are scoring proficient or above, so this information somewhat contradicts the scores on the MDTP Geometry Readiness Test.

**Implications for Future Research**

Further research could be performed at this study's site to better understand its student population. Analysis at different course levels could help to identify whether or not this issue only affects freshman geometry classes. It may prove useful to also compile data from freshman Algebra I classes to see if there are weak areas in charter schools' pre-algebra courses. In addition, the site could consider running *t-tests* using CST Algebra I tests, or analyzing students' grades in the freshman geometry classes. Also, a charter that does not provide a solid mathematical foundation for high school may have different results in English, Science, or Social Sciences. Further research could be done to compare student scores in other subject areas.

Many of the students who attended the local public school enrolled in the CPM (College Preparatory Math) geometry class at the 9th grade level. CPM is an exploratory, project-based curriculum, which is not offered at the charter schools. Since students coming from charter middle schools were not exposed to this curriculum, most enrolled in the "traditional" college-prep geometry class in 9th grade. This caused a disproportionate amount of charter students in

the "traditional" geometry classes, and nearly homogeneous CPM classes, with almost all students from the local middle school. Further research could be done to determine if the students who had taken a CPM course in 8th grade were more successful on the MDTP test.

Lastly, research could be performed to determine if this is a school-specific issue, or a broader issue at the district-level. The site's school district could test freshmen geometry students at other high schools within the district. It's possible that this study's public middle school is exceptional, and other public middle schools are similar to the data on charters in this study.

**Overall Significance of the Study**

Previous research comparing charter and non-charter students had not been performed at the school site. In addition, analysis using MDTP test results had not previously been performed to look at an entire group of students, or data over multiple school years. In the past, teachers had used MDTP test results to plan their lessons and interventions for a given class, but more often used the results to understand a student as an individual and advise parents or counselors of any weak skill areas.

In conclusion, this study suggests that charter schools may not always be the best choice for success in mathematics. It is important to consider school choices, but make informed decisions about what these charters may provide in different subject areas. Although there is evidence to say that this study's charters do not prepare students for high school math as well as the local middle school, there may be other benefits of attending these charter schools. This study adds to the research suggesting negative characteristics of charter schools, but the concept of a charter school and the research on these institutions is still relatively new. As time goes on,

research on charters may be able to draw more definitive conclusions on charter schools as a whole.

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June 3, 2013

Rachel Ricioli
502 Santa Rosa Creek Drive
Santa Rosa, CA 95409

Dear Rachel:

I have reviewed your proposal (entitled, *Effects of Middle School Choice on Math Performance*) submitted to the Dominican University Institutional Review Board for the Protection of Human Subjects (IRBPHS Application, #10143). I am approving it as having met the requirements for expedited review.

In your final report or paper please indicate that your project was approved by the IRBPHS and indicate the identification number.

I wish you well in your very interesting research effort.

Sincerely,

Martha A Nelson

Martha Nelson, Ph.D.

Chair, IRBPHS

cc: Lisa Ray

**Institutional Review Board for the Protection of Human Subjects**
Office of the Associate Vice President for Academic Affairs • 50 Acacia Avenue, San Rafael, California 95901-2298 • 415-257-1310
www.dominican.edu