EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

by

Brian E. Ellis

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education Field of Educational Leadership and Management at the DREXEL UNIVERSITY

March 2014

Drexel University
Winter Quarter, 2014
Abstract

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Brian E Ellis

Drexel University (March 2014)

John Gould

Despite a decade of reform driven by the NCLB legislation, there continues to be a significant gap in mathematics achievement between race/ethnicity and socioeconomic groupings of students. This study examines the practice of tracking and an effort to improve mathematics achievement by eliminating the general level mathematics track. The suburban high school in this study eliminated such courses to raise the rigor for all students while also encouraging minority students and students of low-socioeconomic status to participate in more challenging mathematics instruction. The school’s program was based upon research that demonstrates promise in programs where detracking, the process of eliminating academic tracks, has been implemented. This research complements research that demonstrates that tracking has adverse effects on minority and poor students, while positively impacting high-achieving students. Through analysis of this school’s program, mathematics education leaders may be able to apply the principles of tracking and general course elimination to their own reform efforts.

The researcher examined Pennsylvania State System of Assessment (PSSA) achievement results and Pennsylvania Value Added Assessment System (PVAAS) growth measures for two cohorts of students. PVAAS is a growth model that predicts
individual student PSSA results based upon previous testing history. The students in the graduating class of 2012 were the last students with access to three tracks: general, college preparatory, and honors that address the Algebra 1, Geometry, and Algebra 2 content of the mathematics program. The students in the graduating class of 2013 were the first group required to choose from only two tracks: college preparatory and honors.

The quantitative analysis began by comparing the two cohorts to determine the differences in student achievement and growth. The analysis reveals that the general class elimination was unsuccessful in positively impacting overall mathematics achievement and growth. The research revealed that the 2012 three-track cohort, who had access to general level classes, had significantly higher average achievement and growth. Furthermore, all but one achievement and growth gap between race/ethnicity and socioeconomic subgroups remained significant. The research also identified that eliminating general level classes did not positively impact honors/AP level enrollment as minority participation did not significantly improve while economically disadvantaged participation actually declined between 2012 and 2013. Furthermore, the research failed to reveal any interaction effect upon growth between the students’ academic program (honors/AP, college preparatory, general) and race/ethnicity or socioeconomic status.

While the research failed to demonstrate overall improvement given the course elimination, further quantitative research identified the impacts of the various academic levels: general, college preparatory, and honors/AP. The research revealed a consistent trend showing that average growth of students was higher at more rigorous course levels. Students in the honors/AP program had significantly higher growth factors, 46.5 points, $p = .005$, and 45.4 points, $p = .029$, for the 2013 two-track and 2012 three-track cohort.
respectively, than the students in the college preparatory program. Additional analysis revealed an interaction effect between the students’ academic program and the students’ predicted PSSA performance across the two cohorts, $p = .012$.

With the exception of Below Basic students, students at each successive predicted performance level (Basic, Proficient, and Advanced) had higher average growth factors than their peers in lower levels. The difference in growth factors, 123.0 points, between advanced predicted students taking honors/AP classes and advanced predicted students taking college preparatory classes was significant, $p = .002$. The study further reveals that for students in the same academic program but having different predicted PSSA performance levels, the students with lower predicted performance levels always had higher average growth factors than the students with higher predicted performance levels. The only exception was for proficient and advanced predicted students at the honors/AP level. The Below Basic students taking general level classes had significantly higher growth results than their Basic and Proficient predicted peers who also took general level classes. The analysis suggests that Below Basic students were in need of a general level program which contrasts with the design of the mathematics program. Analysis of participation rates identified that when comparing students with the same predicted performance level, minorities and economically disadvantaged students were underrepresented in the most rigorous academic programs. Overall, the analysis indicates that eliminating the general level classes did not have the positive impact on growth and achievement that was intended and suggests that the lowest-achieving mathematics students were adversely impacted by the general course elimination. However, the analysis also provides
significant evidence demonstrating the negative impacts of tracking as well as the positive impacts of students participating in more rigorous programming.
The Dissertation Committee for Drexel University
certifies that this is the approved version of the following dissertation:

EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION
AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A
SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

Committee:

Dr. John Gould, Supervisor

Dr. Kenneth Voss

Dr. Jason Silverman
Dedication

I dedicate this dissertation to Melissa who has continued to support me through all the challenges even as she pursued her own college degree, to my mom who “always knew” I would earn my doctorate some day, to my dad who has always supported me, and lastly to Grandma who passed away as I completed my “edits”. She always asked, “can we call you doctor?”
Acknowledgements

I would like to acknowledge all the various people who supported me in my efforts with this dissertation. From Drexel University: Dr. Gould who inspired me with his vision for what our school systems can be, Dr. Mawritz who read and critiqued many drafts of my early chapters during my coursework, and Dr. Voss and Dr. Silverman who assisted my work as part of my committee, both acknowledging but also challenging my work.

Of course I would also like to acknowledge all my cohort members who made my doctoral studies such an enjoyable part of the last few years.
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Chapter 1

Introduction to the Problem

“The soft bigotry of low expectations” was an expression used frequently by President George W. Bush during his 2000 campaign to call attention to one of the fundamental causes of the achievement gap. The expression emphasizes the concern that many students are indirectly discriminated against simply because they are never challenged with a rigorous curriculum. Our schools are often content to hold weaker students to lower standards, making it impossible for those students to ever close the gap (Welner and Oakes, 1996). Bush’s expression is particularly relevant when we consider the state of our high schools, particularly in the learning of mathematics as we continue to observe an achievement gap between groups of students whether those groups are race-based or Socioeconomically based. The 2011-12 Pennsylvania State Report Card provides a summary of the Pennsylvania System of School Assessment (PSSA) results that demonstrates the existing achievement gap. The gap is demonstrated in Figure 1:

Figure 1

![2012 Grade 11 Mathematics PSSA Results % of Proficient & Advanced Students](image)

*Figure 1. A graphical display of student achievement on the 2012 PSSA (2011-12 Pennsylvania State Report Card)*
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On the 2012 PSSA for eleventh grade mathematics, 66 percent of White students scored Proficient or Advanced, measurements that indicate satisfactory or superior performance, compared to 33 and 35 percent of Black and Latino students respectively. Furthermore, 59 percent of all students scored Proficient or Advanced compared to just 40 percent of Economically Disadvantaged students. Pennsylvania schools are expected to ensure that all students meet minimum proficiency expectations and they have been working for over a decade to comply with the requirements of the No Child Left Behind (NCLB) legislation (2002). In efforts to help students meet these standards, most schools have continued to subscribe to the belief that they can best meet students’ needs by separating them based upon ability, commonly referred to as tracking, or homogenous grouping (Oakes, 2005). However, existing research has demonstrated that tracking actually furthers the very gaps schools are trying to close (Schmidt, 1998; Heubert & Hauser, 1999; Oakes, 1992; Linn, 1998; Speilhagen, 2010) and a body of research has attributed that separation to the fact that the rigor and expectations of low-track classes is much lower than the rigor of high-track courses (Welner and Oakes, 1996). If two students, separated by perceived ability, are not given access to a course of similar rigor and expectations, it is not reasonable to believe that those two students can reach the same level of performance. Consequently, to address the gaps in achievement, schools must raise the rigor of the low-track classes or eliminate those classes forcing students to participate in the more rigorous high-track settings. An emerging body of research has shown that the later approach, eliminating tracking altogether, has raised achievement and provided a more equitable education to all students (Burris & Garrity, 2008; Boaler, 2006; Venkatakrishnan & Wiliam, 2003).
Statement of the Problem to Be Researched

Despite a decade of school reforms driven by NCLB, there continues to be a significant achievement gap between race/ethnicity and socioeconomic based demographic groups of students.

Purpose and Significance of the Problem

This quantitative study examined the impacts of tracking as well as efforts to raise overall achievement and close the achievement gap in a suburban high school mathematics program that eliminated their general level mathematics program. In an effort to raise achievement, the high school mathematics program adopted the philosophy that since nearly all of their students pursue further education after high school, it was important that all students participate in, at minimum, a college preparatory mathematics program. They accomplished this by eliminating the “technical preparatory” or “general” strand so that students were only offered two options for each of the traditional mathematics courses: honors or college preparatory.

Despite effort and attention, school leaders such as those in this school continue to face the challenging and significant problem of closing the gap in mathematics achievement that exists between demographic subgroups of students. This study was designed to examine how tracking impacted these gaps while also determining if the effort to reduce this gap in achievement by eliminating general level courses has resulted in higher mathematics achievement and a closing of the achievement gap between demographic groups of students at the suburban high school.

This school’s efforts are not unique. There is an emerging, although limited, body of research regarding the impact of detracking efforts where one or more academic track
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is eliminated. These studies have generally demonstrated positive effects for all students (Burris & Welner, 2005; Boaler, 2006; Venkatakrishnan and Wiliam, 2003). However, while there is limited research into detracking and the elimination of general level classes, there has been a significant amount of research into the effects of tracking. These studies identify tracking a significant cause of the achievement gap while demonstrating that tracking undermines the potential achievement of schools’ least successful students (Heubert & Hauser, 1999; Oakes, 1992; Linn, 1998; Ballon, 2008; Speilhagen, 2010). However, research has also shown that tracking is often beneficial to highest achieving students (Steelman, Mulkey, Crain, & Catsambis, 2005; Loveless, 2009; Kulik and Kulik, 1992).

Through the study of this school’s efforts, mathematics education leaders and school administrators may better understand the impact of tracking while also being able to apply the track elimination solution to their reform efforts. The school’s efforts challenge a widely and commonly held belief about mathematics instruction, that the best way to help students meet standards is to separate students by ability so that instruction can be “customized” to meet common needs (Burris & Garrity, 2006). By analyzing the school’s program, school leaders will have information they can utilize as they attempt to improve mathematics achievement in their schools.

**Research Questions**

The study was developed around the overriding research question: How have the practices of tracking and the elimination of general level courses impacted mathematics achievement and mathematics growth of students overall and have they impacted
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demographic groups differently? To answer this overriding question, the study examines the following more specific sub-questions:

1. How has the elimination of general level classes impacted the mathematics Achievement and Student Growth overall and has it positively impacted the Achievement and Growth gaps that are present between Racial/Ethnicity and Socioeconomically based groups of students?

2. How has the elimination of general level classes impacted the participation rate of Minority and Economically Disadvantaged students in the most rigorous mathematics course offerings?

3. How have the various Academic Programs, before and after the General Level class elimination, impacted Student Growth overall, and do the programs impact Racial/Ethnicity and Socioeconomically based groups of students differently?

4. How have the various Academic Programs impacted Student Growth overall when controlling for Predicted Mathematics Performance?

Through examination of these more specific sub-questions and their connections, we have a more complete picture of the impact of tracking and eliminating general level mathematics courses at this high school.

The Conceptual Framework

The researcher was the mathematics coordinator and assistant principal at the high school during the investigation of, planning for, and implementation of the general course elimination, and consequently was able to frame much of the implementation around his personal views. Having previously taught at the same high school, this researcher had direct experience with the difficulties that weaker students had in the “general” program.
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Furthermore the planning and implementation of the general course elimination was grounded in extensive study of data along with ongoing refinement. The researcher advocated for the implementation of the program out of his desire to advocate for minority and economically disadvantaged students who consistently struggled to meet acceptable levels of achievement in the mathematics program. The researcher approached the study with a methodological approach underpinned with the researcher’s desire to advocate for less fortunate and less successful students (Creswell, 2007).

The overall conceptual framework of the study was to consider the impact of tracking on student growth and achievement and to contrast that with the impact of the general level course elimination on student growth and achievement. The ideas that led the mathematics program to eliminate the general level courses emerged from three general themes of research. The three themes are:

- Tracking has negative effects on low-achieving, economically disadvantaged, and minority students. (Schmidt, 1998; Heubert & Hauser, 1999; Oakes, 1992; Linn, 1998; Speilhagen, 2010); This negative effect arises from the fact that minority students are underrepresented in high academics tracks (Ballon, 2008), overrepresented in remedial math courses (Bradock, 1990), and the academic rigor and expectations of low-track classes is much lower than the rigor of high-track courses (Welner and Oakes, 1996).

- Tracking generally has positive effects on high-achieving students (Steelman, Mulkey, Crain, & Catsambis, 2005; Loveless, 2009; Kulik and Kulik, 1992);
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- Detracking and/or the elimination of general level courses has positive effects upon all students (Burris & Welner, 2005; Burris & Garrity, 2008; Boaler, 2006; Venkatakrishnan & Wiliam, 2003).

The members of this high school's mathematics department took each of these themes into the review of the mathematics program and the premise for eliminating general level classes emerged. The department recognized the lack of achievement of students in the general level courses but also believed that the highest-achieving students required the challenges yielded through a tracked environment. While they recognized and relied on the work of Burris and Garrity (2008), they did not believe complete detracking or leaving only one academic path for students was appropriate and instead they chose to apply the principles of detracking by eliminating general level courses. The purpose of this study is to identify if such an approach had the impact they desired.

The three themes are demonstrated in the Figure 2:
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Figure 2

The Strategies’ Impacts on Students

Tracking (Homogenous Grouping)
Students are separated into multiple levels (3, 4, or even more) based upon perceived mathematics ability.

Detracking / Track Elimination
Students are separated into fewer ability groups. This approach can indicate a process of reducing the number of existing tracks or “full detracking” where there is only one level which is generally taught at the honors level.

Low Achieving
Research clearly demonstrates tracking negatively impacts achievement. It deters interest in mathematics and results in inferior mathematics instruction for students that need it most.

High Achieving
Research generally indicates tracking’s positive effect on high-achievers. Students achieve at higher levels when grouped with similar ability peers.

All Students
There is conflicting research regarding the impact of detracking. It clearly shows that low-achieving students significantly improve in a detracked environment, but there is conflicting research regarding high achievers, some suggesting that they perform as well in detracked environments and others suggesting that the lack of tracks negatively impacts high-achieving students.

Definition of Terms

Advanced – a PSSA performance rating that indicates superior academic performance.

College Preparatory Course/Track - an individual course or sequence of courses taught at a rigor level consistent with college and university expectations. Students taking
the course are college bound but will generally not study a mathematics related field. Students at this level master the required standards generally through learning algorithms and some conceptual underpinnings of mathematics.

Detracking – the reduction of the number of academic paths students can take courses from. The term generally applies to situations where the number of academic tracks is reduced to one.

General Course/Track/Level - an individual course or sequence of courses taught at a rigor level lower than that of college preparatory. Such courses are often referred to as Work-Preparatory or Technical-Preparatory. The activities in such a program involve students mastering basic mathematical competencies and focus upon addressing the required standards. Instruction generally involves students mastering algorithms.

Heterogeneous or Mixed-Ability Grouping – the practice of including students of varying ability into the same class.

Homogeneous or Same-Ability Grouping – the practice of separating students by perceived ability into different classes, so that there are “high ability classes” and “low ability classes.”

Honors/AP Course/Track/Level - an individual course or sequence of courses taught at a rigor level generally exceeding the minimum college and university expectations and specifically designed for students of significant ability and past success in the content area. Students at this level are assumed to be able to easily master the required standards and are therefore exposed to more in-depth and conceptual study of mathematics with emphasis on proof and justification.
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Predicated PSSA Performance – a value indicating what a student is expected to score on the PSSA based upon the student’s past testing performance and the past results of all other students in Pennsylvania.

Proficient – a PSSA performance rating that indicates satisfactory academic performance.

PSSA (Pennsylvania System of School Assessment) – assessments administered to Pennsylvania students in grades three through eight and grade eleven that measures mastery of state standards in reading, mathematics, science, and writing. In 2012-13 the eleventh grade PSSA was replaced with Keystone Assessments.

PVAAS (Pennsylvania Value Added Assessment System) – methodology that analyzes and reports on the academic growth students experience between PSSA examinations, as well as predicting students’ future PSSA performance.

Student Growth - the amount that a student's PSSA score exceeds (or falls short of) his/her PVAAS predicted PSSA score.

Tracking – the practice of students being separated homogenously into classes based upon ability.

Assumptions, Limitations, and Delimitations

The primary assumption of the research was that changes in student achievement and student growth are the result of the program’s elimination of general level courses. Since the school employs a Professional Learning Community model where teachers regularly meet to discuss student results and plan instruction (Dufour, Dufour, Eaker, and Karhanek 2004), and smaller reforms and modifications to instruction are developed on an ongoing basis, some of the effect on achievement could be derived from these smaller modifications.
Also recognizing that teacher effectiveness and experience is an important factor in student achievement, the district has seen a significant turnover in mathematics teachers. Of the 25 members of the middle school and high school mathematics department who were employed prior to the reform efforts, nine have retired or resigned, each being replaced with a younger and less experienced teacher. This drop in teacher experience has likely had a negative effect on student achievement, at least in the short term. However, the department distributes teaching assignments in a fashion where all teachers teach courses at each of the academic levels which mitigates some of the concern regarding teacher experience and its impact on this study.

**Summary**

Schools are continually faced with the challenge of raising student achievement in mathematics. For years an achievement gap has existed between groups of students based on race/ethnicity and socioeconomic status (Schmidt, 1998). These gaps have been sustained by a practice called tracking where students are placed in classes based upon perceived ability (Oakes, 2005). The students in the highest tracks are able to accelerate their learning while the pacing of lower tracks is slowed in an effort to allow students to master basics (Welner and Oakes, 1996; McKnight et al., 1987). The suburban high school in this study has attempted to address this inequity by eliminating general level courses and teaching all students at the college preparatory or higher level. This study examined the impact of their efforts on mathematics achievement and mathematics growth.
Chapter 2: The Literature Review

Introduction of the Problem

Improving mathematics achievement continues to be one of our schools’ most challenging tasks. While mathematics instruction has been a focus of the No Child Left Behind (NCLB 2002) legislation, our students’ mathematics performance continues to trail the performance of students in other nations. The average score of our eighth graders ranked just ninth among countries participating in the 2007 Trends in International Mathematics and Science Study (TIMSS Results 2007). In an effort to improve the overall achievement of our students, while also complying with the accountability requirements imposed by NCLB, schools have implemented various academic reforms. One such approach has been to implement detracking efforts, where students are heterogeneously grouped so that students of varying ability levels are included in the same classroom (Burris and Garrity, 2008; Boaler 2006). This is done by schools based upon research that consistently demonstrates that the tracking system which has been embedded in our school systems for decades has had significant negative effects on students while also being a large contributor to the achievement gap (Schmidt, 1998). However, such efforts are often undertaken under challenge by members of the educational community because they may also undermine the achievement of the most talented students (Burris and Garrity, 2008; Loveless, 2009; Kulik & Kulik, 1992).

Consequently, further research into detracking efforts and related efforts such as the elimination of general level courses is necessary to determine if its practice should be more widely implemented across the country in an effort to raise student achievement.

This study examined the efforts of a suburban high school mathematics program
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in south-central Pennsylvania, where the school phased in the elimination of the lowest
ability or general level track, leaving students only two options for mathematics courses:
honors and college preparatory. The graduating class of 2013 was the first class to
experience a mathematics program consisting of Algebra 1, Geometry, and Algebra 2 that
did not include a general level option. This study analyzed the mathematics growth of
the class of 2013 in comparison to the previous graduating class that participated in a
tracked program which included a general level course offering in addition to honors and
college preparatory offerings. The foundation of the study was developed around the
following overriding research question: How have the practices of tracking and the
elimination of general level courses impacted mathematics achievement and mathematics
growth of students overall and have they impacted demographic groups differently?

Conceptual Framework

While the concept of detracking is relatively new in the literature, the existing
body of research provides a foundation for the study. The literature includes
contradictory studies that in some cases support and in other cases reject tracking and
homogenous grouping approaches to improving student learning of mathematics. The
literature also includes an emerging base of research that supports detracking and the
elimination of general level courses.

Through these studies emerge three themes that underpin the study. First, the
literature demonstrates that tracking is detrimental to minority and low-achieving
students and consequently tracking is a significant contributor to the achievement gap.
Second, the literature demonstrates that tracking and high-track placement generally
contributes positively to the achievement levels of high-achieving students. Third, the
literature demonstrates that detracking efforts have been effective in raising the achievement of all students. This research demonstrates that detracking can help to close achievement gaps and also helps to improve academic behavior of all students.

These three themes mirror the goals and concerns that were present at the high school when the general level course elimination process began. The department recognized that their current levels of achievement, as demonstrated by PSSA scores, had reached a plateau. Despite various remediation programs and new alternative curricula little had changed in terms of student achievement and for students in the lowest track, achievement had begun to decline. Consequently the high school mathematics department recognized that a completely new approach was necessary if they were to improve achievement. While the department accepted the premise of completely detracking courses so that only one path remained, reservation remained that they would be watering down courses in an effort to set “a bar” that students all could achieve. To partially address this they maintained two tracks, as opposed to three, so that the higher achievers were continually challenged and the remaining students would be expected to participate at a college preparatory level. The three themes included in the review of literature parallel the concerns. The department recognized the potential negative effects of tracking upon the highest achieving students which led to the decision to maintain the highest honors/AP track; however, the idea of eliminating general level courses moved forward in an effort to improve the mathematics education of the lowest achieving students.
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**Literature Review**

The review of the literature is organized around the three themes of the conceptual framework. The three themes include the negative effects of tracking on low-achieving students, economically disadvantaged, and minority students, the positive effects of tracking on highest-achieving students, and the positive effects of detracking efforts upon all students. These three themes mirror the structure of the high school mathematics program that was studied, as they maintained a high track for high-achieving students but also eliminated the general level courses in an effort to improve the achievement of the students who would have typically been lower-track students.

**The Negative Effects of Tracking**

The impact of tracking and homogenous grouping received a great deal of attention in the 1990’s and 2000’s as researchers began to review its impact upon students. The findings of these research studies demonstrate negative impacts upon low-achieving, minority, and economically disadvantaged students including low achievement and limited participation in higher level classes.

The studies clearly demonstrate concern over the practice of tracking. They identify its impact towards minority students and the poor, including how those groups are underrepresented in higher tracks and how consequently those students are subjected to inferior teachers and instruction in lower tracks. The studies also suggest negative long-term implications for students who participate in lower track classes.

In 1999, the National Research Council completed a study of high stakes testing, *High Stakes: Testing for Tracking, Promotion, and Graduation* (Heubert & Hauser, 1999), which cited many research efforts from the nineteen-eighties and nineties.
Congress commissioned the study to ensure that high stakes tests were appropriate and that the results of the testing were being used appropriately. The committee reviewed research involving testing’s impact on tracking, promotion, and graduation and consequently made recommendations based upon their review of the research. Their research raised significant concerns regarding tracking and referenced numerous researchers and research projects in their findings. They referenced a significant concern about the ethnic and socioeconomic make-up of high-track classes (Oakes, 1992). Additionally they referenced Darling-Hammond (1985) stating that minority students were consistently underrepresented in programs for the gifted and talented.

The National Research Council researchers also found that the achievement gap between students in different tracked classes in United States schools is far greater than in other countries (Linn, 1998). They found that instruction in low-track classes is less rigorous than in high-track classes (Welner and Oakes, 1996; McKnight et al., 1987), and that students in low-track classes had less access to the most motivated and highest quality teachers (McPartland and Crain, 1987). They also determined that low-track classes limit students’ ability to learn the knowledge and skills necessary for future success and the students could acquire that knowledge and skills if placed in more challenging educational environments (Slavin et al., 1996; Levin, 1988). The researchers reached a general conclusion regarding tracking and recommended its elimination:

It is inappropriate to use tests to place students in settings that are demonstrably ineffective educationally. As tracking is currently practiced, students assigned to typical low-track classes are worse off than they would be in other placements. The most common reasons for this disadvantage are the failure to provide students
in low-track classes with high-quality curriculum and instruction and the failure to convey high expectations for such students’ academic performance. Unless these conditions are changed, and there is evidence that students will benefit more from such placements than from others, we recommend that low-track placements be eliminated, whether based on test scores or other information. (p.102)

The NRC study presents a foundation for why efforts other than tracking are necessary to raise student achievement. It demonstrated the shortcomings of tracking, recommended its elimination, and further cited studies regarding tracking’s negative impact upon minority and low-socioeconomic students in terms of achievement and rigorous course participation. The research of the study aligns with the rationale of this school’s course elimination initiative and this study was designed to identify the results of such efforts.

Schmidt (1998) conducted a review of data from the Third International Mathematics and Science Study (TIMMS) to place the United States' largely tracked system in the context of education across the world. He concluded that tracking does not positively impact average or advanced students. Schmidt’s analysis also indicates that a students’ math placement into mathematical tracks resulting in students taking algebra versus regular math is the greatest single factor in accounting for the disparity in mathematics achievement. The study further suggests that an alternative approach is necessary for American students to meet the achievement of their peers across the world.

Kulik and Kulik (1992) conducted a meta-analysis of research regarding ability grouping in secondary schools that indicated tracking had little advantage over heterogeneous or detracked classrooms. Their study examined three types of ability grouping, one of which mirrors the tracking that is being examined in this study:
multilevel grouping. In this grouping, students in the same grade are divided into groups divided by ability and taught in a separate classroom. The meta-analysis examined 56 studies of multi-level grouping, 51 of which measured the affect on achievement. The average effect size found in the studies was 0.03 which when interpreted suggests that the multi-level grouping had no effect on achievement. These findings matched the findings of Robert Slavin (1990) and Mosteller, Light and Sachs (1996) both of which conducted similar meta-analysis of ability grouping and found no significant difference between ability and heterogeneous groupings.

The cited studies all indicate that tracking, or ability grouping, has no statistically significant impact upon student achievement when compared to heterogeneous groupings. The studies align with the research conducted in this study to determine if there is a statistically significant difference between tracked and detracked classes in regards to student achievement.

Boaler et al. (2000) completed a four-year longitudinal qualitative study monitoring the impact of tracking on student perceptions of mathematical learning in six British schools. The authors referred to the British practice of "setting" which correlates to the American term "tracking." Their research identified that students were "severely disaffected" (p. 633) from the limits of their placement and that students gave up on mathematics when they realized the only had access to lower courses. The research also identified that the student's social class influenced placement and disproportionate numbers of working-class students were placed into the lowest classes, and that this pattern continued even when the researchers controlled for ability. Furthermore, the researchers reported significant numbers of students were dissatisfied by the pace of
instruction as being too slow, while others became anxious because the pace was too fast. The researchers concluded that their study “linked setting (tracking) to underachievement, ... despite the widely-held public, media and government perception that setting increases achievement” (p. 634).

Oakes (1990) completed a comprehensive study of students in mathematics and science classes out of concern for the low achievement and lack of participation of woman, minorities, and the poor in those two disciplines. The study was not concerned with the resulting academic achievement of such students, but rather the students’ access to the highest quality classrooms and instruction in mathematics and science. To gather data, the researchers administered the National Survey of Science and Mathematics Education (NSSME) to a national sample of 1200 public and private school principals. In those principals’ schools, approximately 6000 teachers were randomly selected to gather further classroom data. The teacher questionnaires focused on the specifics of curriculum and instruction occurring in the classroom, and the teachers’ perception of student ability level. The researchers also gathered data on the training, experience, and attitude of the teachers and administrators towards students and towards the math/science programs. The researchers also collected data on the race and socioeconomic backgrounds of the students in the school. Their analysis was able to contrast different schools as well as programs within schools. The researcher’s analysis found that the teachers’ and the principals’ assessment of academic ability and track placement parallels race and social differences. The researcher found that placement into low-ability classes has a profound effect on students’ ability to learn, and consequently minority students are disproportionately affected due to their disproportionate representation in low-ability
classes. She further stated that while ability groupings may “appear logical”, the consequential differences in learning opportunities actually serve to limit instruction rather than improve it. Students in low-track classes are far less likely to take courses emphasizing traditional academic science and mathematics content, meaning that economically disadvantaged and minority students have considerably less access to the knowledge and skills necessary to pursue careers in science and mathematics or to become part of the “increasingly technological workforce.” The researcher found that the teachers in low-ability classes are considerably less qualified than the teachers at other levels, and also found that tracking “fails to increase learning generally and has the unfortunate consequence of widening the achievement gaps between students judged to be more and less able.” (p. xi)

Oakes’ study (1990) presented a significant statement regarding the impact of tracking on students. While the study did not examine efforts to end tracking, it clearly demonstrated the shortcomings of tracking including the quality of instruction in low track classes and the disproportionate impact upon minorities and the poor.

Rees, Argys, and Brewer (1996) examined data from the National Educational Longitudinal study to examine the impact of tracking. They examined the premise that factors other than achievement impact placement into an academic track. They found that both socioeconomic status and ethnicity strongly correlated with track placement. Their research found 18.7 percent of students from the highest socioeconomic quartile were placed in the highest math classes, while only 3.7 percent of the students from the lowest socioeconomic quartile were in the highest math classes. When considering race and tracked classes, they found 10.5 percent of white students took honors classes,
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compared to 6.9 percent of blacks and 7.4 percent of Hispanics. Meanwhile they found that 27.8 percent of whites, 45.8 percent of blacks, and 38.3 percent of Hispanics were enrolled in general classes. This led the authors to conclude that “If one does not control for ability, a strong correlation between socioeconomic status and track placement exists.” They also stated that “it is clear that blacks and Hispanics are less likely to be enrolled in an upper-track class, and more likely to be enrolled in non-academic classes than whites.”

Ballon (2008) researched racial differences in high school mathematics track assignment in the Southwestern United States. Using data from the 1988 National Educational Longitudinal Study, Ballon linked the high school student track assignment to student ethnicity. Without controlling for any variables, the researcher found that African-American and Mexican-American students were underrepresented and Asian-Americans were overrepresented when compared to whites in high-ability courses. After controlling for prior math achievement, pre-high school composition and student coursework, Ballon found that African-American students were significantly underrepresented in the college preparatory math track and Asian-Americans were significantly overrepresented in the honors math track. This study mirrored Braddock’s (1990) findings that minorities were over represented in remedial math courses and significantly under-represented in honors math courses when compared to white students.

The NELS data studies conducted by these researchers further indicate the negative impact that tracking has on minority and poor students. It clearly demonstrates the disproportionate participation that such students have in low-tracked classes and their lack of participation in higher tracked classes. The study suggests the importance of
examining the participation of minority and poor students in the various classes of the tracked and detracked programs at this suburban high school.

Forgasz (2010) examined the impact of streaming, another term for tracking, from an international perspective as a social justice issue, emphasizing its negative impact upon low achievers. Forgasz states (p.32): "Findings from the research literature with respect to mathematics learning lend support to the contention that streaming is inappropriate, particularly for low achievers." Forgasz cited a number of research studies regarding the negative impact of tracking. Ireson et al. (2002) from the UK reasoned that there was likelihood for long term effects on children that were placed in low ability groups and did not move out of the low ability groupings later in their school career. Zevenbergen (2003) found that high achievers in Years 9 and 10 benefitted most from streaming and those most at risk were often in low streams. Forgasz also cites Clarke and Clarke (2008) who strongly advocated the elimination of streaming citing numerous reasons, including the facts that high achievers benefit from streaming, that there is a negative impact on low achievers, that the lowest ability classes are often assigned to the least qualified teachers, that teachers have low expectations for what low-achieving students can do mathematically, and that it is difficult for students to leave the low ability stream.

Speilhagen (2010) conducted a quantitative and qualitative study of students in a large suburban district in the Southeastern United States. The district grouped students in eighth grade where a higher “ability” group took Algebra and the other students took traditional eighth grade mathematics. The quantitative study found that group membership did not guarantee higher achievement and only reinforced existing patterns.
They found minority students had a lesser chance of getting into the Algebra group and that students with similar credentials were directed into both groups. The study identified long-term benefits for students who study Algebra in eighth grade. The researchers also found that when interviewed as seniors, the eighth grade Algebra students reported positive feelings about academics, confidence in mathematics, and clear career goals. They found the non-Algebra students, while still college bound, did not have specific career plans, and lacked positive high school mathematics experiences. Both groups of students identified their belief that placement in eighth grade was based upon work habits rather than cognitive ability, and they also felt that all students should have the opportunity to study Algebra in eighth grade.

This study further questions the practice of tracking in mathematics as it identifies the impact that eighth grade mathematics placement has upon students as they continue their education. The study reflects that students themselves identify the advantages of more significant math study at younger ages. While this study addresses eighth grade placement and the suburban high school's effort does not begin until ninth grade, there are parallel beliefs regarding the importance of more rigorous mathematics exposure as a component of detracking or general level course elimination.

There is a significant body of research that demonstrates concerns over the practice of tracking. The studies consistently identify concern over tracking's impact on minority and economically disadvantaged students. The concerns include the fact that such students are under-represented in high tracks and over-represented in low tracks, and that these low tracks are more likely to be taught by inferior teachers and taught in a fashion that is less rigorous than in higher tracks.
The Effects of Tracking on High-Achieving Students

While many educators advocate for tracking because they believe it assists teachers in better meeting the needs of all students, the research does not support that premise for low achieving students. However there is a body of research that indicates that tracking can have a positive academic impact upon high-achieving students albeit with some negative psychological effects.

Studies of the impact on high-achieving students place some question regarding detracking initiatives, but overall they suggest that the initiatives of the suburban high school program is consistent with the body of research. The studies suggest that high achievers benefit from tracking; however each study cites concerns that align with the concerns of the suburban high school initiative and the research question of this study.

Steelman, Mulkey, Crain, and Catsambis (2005) studied the impact of tracking on middle school students as they move into the high school. Utilizing data from the 1988 National Educational Longitudinal Study, the researchers studied the achievement in tracked and untracked schools as well as in high-ability and low-ability groupings. The researchers linked eighth grade course placement with variables including the school’s use of tracking and used it to connect to 10th grade social-psychological outcomes and 12th grade educational outcomes. While the researchers found that tracking had “persistent benefits” for all students, they also identified that for high-achieving students, tracking may lead to “considerable losses” in self-concept that can depress further mathematics achievement and course selection.

This study contrasts the purpose and beliefs of the suburban high school implementation being studied. It suggests that tracking is beneficial for all students
which contradicts the earlier presented research and the philosophy of eliminating the
general level courses. However, the study also provides reservations and concerns for
high-achieving students.

Faitar and Faitar (2011) conducted an anonymous survey of students in the
mathematics department of a New York university and analyzed the results
quantitatively. The study had a pool of 15 candidates consisting of three minorities and
twelve Caucasians. The authors found that of the twelve Caucasian students, eight had
been placed in high-track classes as students and four had been in average-track classes.
Two of the minority students indicated being part of tracking systems, one being part of a
high-track system and the second being part of an average-track system. The third
student was not in a tracked environment. The authors used the results of their qualitative
study to indicate that it was important for students interested in future careers in STEM
oriented careers to be part of tracking because it would help them have “confidence in
their abilities.”

Faitar and Faitar (2011)’s research contrasts much of the research into detracking
that is shared in the third theme. Thier study indicates that high-track placement is an
important factor in decisions regarding pursuit of STEM based careers. However, it also
presents an argument consistent with the suburban high school’s efforts to preserve a
higher track for students interested in pursuing science and mathematics study.

In 2009, Tom Loveless (2009b), a Senior Fellow of the Brookings Institute,
examined the impact that tracking had on student performance on the Massachusetts
Comprehensive Assessment System (MCAS). Loveless has been an advocate for high-
achieving students, having written *High Achieving Students in the Era of No Child Left
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*Behind* (2008) and *Smart Child Left Behind* (2009a) which suggested that NCLB has caused schools to neglect high achievers. The study was designed to answer a number of questions and one question was specifically related to tracking: Are there differences in the number of high-achieving students associated with tracked and untracked schools? Specifically, do tracked and untracked schools produce similar percentages of students reaching the “advanced” level on the Massachusetts Comprehensive Assessment System (MCAS)? The study collected data on the number of different course offerings, or tracks, for eighth graders at each Massachusetts middle school. These schools were broken down into schools with one, two, and three or more tracks and the study calculated the percentage of students scoring at each of the scoring levels on the MCAS: Advanced, Proficient, Needs Improvement, and Failing. In the short-term, when controlled for the percentage of poverty, the researchers found that each additional track, up to three tracks, was responsible for a three point gain in the percentage of advanced students, and the reverse was also true: each fewer track was responsible for a three point drop in the percentage of advanced students. However, when the researchers looked at achievement over longer periods of time and controlled for socioeconomic status and initial achievement, they found no difference in achievement based upon the number of tracks a school had in eighth grade. The researchers concluded that “detracking carries risks for high-achieving students” due to the percentage drop that came from having fewer tracks but they could not conclusively say that tracking or the lack of tracking was the cause of the drop.

Loveless's study (2009b) conflicts with the underpinnings of this study's examination of general level course elimination. The study claims that three tracks of
students result in the highest percentage of students performing at the advanced level, where as this study’s high school has reduced the program to two tracks. Additionally Loveless’s study conflicts with the findings of the Kulik and Kulik study (1992) discussed next.

The Kulik and Kulik (1992) study also examined studies where student ability was incorporated into analysis. 36 of the 51 studies included analysis with groups separated by ability. The effect size of tracking for high-achieving students was 0.10 and the effect for low-achieving students was -0.02, showing that high-achieving students had small benefits from tracking, while low achieving students had no statistically significant effects. The researchers concluded that eliminating tracking would have minimal effects on students whether high-achieving or low-achieving. The achievement of high-achieving students would fall slightly but the overall impact would be negligible. The researchers were clear that this impact would be different than the impact of eliminating acceleration programs, which some schools termed detracking. In acceleration programs, students study mathematics earlier and with different grade level students based upon readiness. The positive effects of these programs were far greater. Students in accelerated classes outperformed those in non-accelerated classes by 0.87 standard deviations while those in enriched classes (honors) outperformed those students in mixed-ability classes by 0.41 standard deviations.

Kulik and Kulik’s (1992) work provides a correlation to the philosophy of the suburban high school's initiative. It suggests that the elimination of general level classes will have minimal impact upon achievement, including for high-achievers. However, the study also suggests the importance of maintaining acceleration programs where
students begin advanced mathematics study at earlier ages. The suburban high school's mathematics program continues to include acceleration and that component was not modified during the general course elimination initiative.

**Positive Effects of Detracking**

While research into the effects of detracking is limited due to the minimal amount of detracking implementation in schools and the many variations of what is termed detracking, research is emerging. The final theme examines specific detracking efforts, where schools reduced or eliminated tracks available to students. These studies specifically address efforts to address the concerns raised in the first theme: the negative impacts of tracking.

These studies align with the goals of the suburban high school whose results were examined. The studies demonstrate success as a result of detracking efforts in a variety of environments: suburban, urban, and international. These studies suggest that detracking is a prudent step towards raising achievement and therefore they tightly align with the rationale of this study.

Carol Burris and her colleagues, Welner and Garrity (2005, 2008), have researched and reported on the detracking efforts at their district, the Rockville Center Union Free School District, which has fully implemented heterogeneously grouped, or detracked classes, over the previous fifteen years. They comment about detracking following its implementation: “By dismantling tracking and providing the high-track curriculum to all, we can succeed in closing the achievement gap on important measures of learning.” (2005, p. 595) The researchers tracked achievement and demographic information on cohorts of students identified by their freshman year. They compared the
cohort groups of 1997 through 2003 on various measurements of academic achievement to demonstrate the effects of detracking. 1997 was the last cohort that was not part of detracking efforts. Through the detracking efforts, the school has seen minorities as well as white and Asian students experience significant gains in achievement. The number of African American and Hispanic students passing the Algebra regents exam increased from 23 percent to 75 percent, while white and Asian students saw an increase from 54 percent to 98 percent. Meanwhile, the district saw the number of African American and Hispanic students earning regent diplomas increase from 32 percent to 82 percent between the 1997 and 2000 cohorts, while white and Asian students saw their percentage of regent diplomas increase from 88 percent to 97 percent. The researchers concluded: “When all students were taught the high-track curriculum, achievement rose for all groups of students—majority, minority, special education, low-SES, and high-SES.” (p. 598)

While the Burris studies reference a full detracking effort where only one track remains, they also clearly demonstrate how raising expectations for students by requiring participation in more rigorous coursework can result in positive student achievement for all. The initiative at this suburban high school began as a result of reviewing the success at Rockville Center, and consequently aligns well with the study.

Other studies have found similar promising results for detracking efforts. Over a four year study, Boaler (2006) compared Railside School, a pseudonym for an urban district in California which employed a mixed-ability approach to student grouping and instruction, to two other California high schools. They found that in spite of the fact that Railside’s students were more ethnically diverse and had lower pre-assessment results
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than the students in the comparison schools, Railside’s students performed significantly higher on achievement tests and saw more students enrolled in Calculus as seniors, 41 to 27 percent. The study also examined why achievement improved in the detracked environment. They identified multidimensional teaching (valuing multiple approaches to solving tasks), identification of specific roles when in groups, assigning competence (praising low status students in front of their peers), student responsibility (giving all students in a group responsibility for the learning of all students), high expectations, effort over ability, and relational equity (teaching the need for high levels of respect between students).

This study further reinforces the effectiveness of detracking efforts and complements the earlier reported research regarding the ineffective educational environments of the tracked classrooms. This study suggests positive academic achievement and more effective instruction results from detracking efforts, just as was hypothesized regarding the suburban high school’s implementation.

Internationally, a report commissioned by the European Union (Varlas 2010) concluded that heterogeneous grouping in Nordic countries helps all students and does not hurt high achievers. Venkatakrishnan and Wiliam (2003) reviewed the effects of tracking upon a British school set up in a similar fashion to the program at the suburban high school. The school was detracked in a fashion where there was a high-level cohort consisting of 25-30 percent of the students and the balance of students in a “mixed track”. The researchers related student ability, track placement, and student test scores using ANCOVA and found a significant interaction between track placement and test scores. They found that tracking was only beneficial for twelve percent of the highest achieving
students and for the rest it made no difference or was “deleterious”. The researchers also indicated significant differences in the achievement of students in the high track versus the low track. The researchers used these findings to conclude that schools should be utilizing mixed ability grouping, since tracking systems only benefit the highest achieving students while providing disadvantages to lower achieving students.

These studies further suggest that detracking is beneficial to students and the Venkatakrishnan and Wiliam study almost directly aligns with the framework of the suburban high school's implementation. It suggests that tracking is only helpful for the highest achievers and schools should otherwise utilize mixed ability grouping. These basic premises are all being examined by the overriding research question of this study.

**Conclusion**

Raising student achievement is the fundamental purpose of our schools. Regardless of the ability or background students bring with them into our schools, it is the schools’ responsibility to help each student reach their maximum level of performance. Tracking, particularly in mathematics, presents a sound philosophical rationale, namely that by separating students by ability, instruction can more readily address the students needs. However, after a half-century of tracking being the predominant methodology for mathematics instruction, the research indicates that tracking has failed to meet its purpose. Tracking has served to widen the achievement gap amongst students, has failed to raise the student achievement of our lowest-achieving students, and has resulted in minority and economically disadvantaged students being under-represented in high-track and over-represented in low-track classes. Detracking efforts have shown promise in raising the achievement of all students. However, there is
also a base of research critical of detracking efforts’ impact on the highest achieving students. Research indicates high achieving students benefit from tracked environments and their achievement may be dampened by detracking efforts.

There is no dispute in the literature, tracking negatively impacts low-achieving students and consequently negatively impacts minority and poor students who are over-represented in low-track classes. These students are well served by detracking and the elimination of general level classes. There is little debate in the literature that students who would typically make up low-track classes are much better served in detracked or heterogeneously grouped classrooms because these classrooms provide a richer academic environment for students. The potential negative of detracking is how it impacts the highest-ability students.

The study of the impacts of tracking and eliminating general level classes at this suburban high school parallel the available literature. The study attempted to confirm that low-achieving, minority, and economically disadvantaged students were negatively impacted by tracking and that their respective achievement has improved through the elimination of general level classes. Furthermore the study also identifies the impact that the initiative has had on the highest-achieving students.
Chapter 3

Introduction

School leaders are faced with a difficult problem. Despite much effort and attention, there continues to be a significant gap in mathematics achievement between groups of students identified by race/ethnicity and socioeconomic status (NCES, 2009). The purpose of this study was to determine the impacts of tracking and to determine if the elimination of general track courses can be correlated to higher levels of student growth and a closing of the achievement gap at this suburban high school. The underlying hypothesis of this quantitative study was that by eliminating general track mathematics courses, students will have experienced higher levels of mathematics achievement, and also experienced higher levels of mathematics growth. The study examined the track placement, achievement, and growth for two cohorts of students from a suburban high school in south-central Pennsylvania who graduated in 2012 and 2013. The 2013 students were the first group of students that did not have access to the general level courses that were available to previous students, including the cohort of 2012.

The research was a quantitative investigation relating students’ academic level and demographic qualities with their mathematics achievement as measured by the Pennsylvania State System of Assessment (PSSA) and their mathematics growth as measured by the Pennsylvania Value Added Assessment System (PVAAS). The PVAAS system analyzes an individual student’s test history in the context of the past students across the state and uses that information to predict a score on an upcoming PSSA examination. Therefore it is possible to identify the growth a student experiences
by calculating the difference between the student’s predicted scores and actual scores. In the study this difference is referred to as Student Growth.

The null hypothesis of the study was that there were no significant differences between the achievement and growth of students prior to or after the elimination of general level classes, nor was there a difference in the impacts when considering the various academic programs in the context of predicted student mathematics achievement and student demographics: race/ethnicity and socioeconomic status. The alternative hypothesis was that there will be a significant difference in student achievement and mathematical growth when considering the academic programs and their interactions with the students’ predicted performance and their interactions with the different demographic groups of students.

Site and Population

The study examined two cohorts of high school students over their mathematics careers. The sample included all students of the high school in the graduating classes of 2012 and 2013 who took both the eighth grade and eleventh grade PSSA mathematics assessment while they were students in the district. There were 389 and 362 students in the two cohorts respectively. All students were identified with their race/ethnicity, their socioeconomic status, their track placement within the two track program (Class of 2013) or three-track program (Class of 2012), their actual eleventh grade PSSA score and their PVAAS predicted eleventh grade PSSA score and proficiency level.

The school in this study is a suburban high school located in south-central Pennsylvania. The high school serves ninth through twelfth grade students and is the sole
high school of its district. The students are fed to the high school via one middle school, one intermediate school, and six elementary schools.

The school district and high school have been successful academically having earned the U.S. News and World Report Silver Rating in recent years. The high school’s overall PSSA scores are consistently among the top in the area and are frequently among the top five to ten percent statewide. However, like many suburban schools, the high school is having difficulty maintaining its high levels of achievement as more students from different backgrounds move into the school district. The percentage of minority students increased from 12.4% to 21.7% between 2005 and 2010 while the percentage of economically disadvantaged students increased from 4.6% to 12.8% during the same time frame. These changes have forced the high school to consider alternative instructional approaches to meet the needs of the diversifying population. The school board and district administration has been supportive and encouraging of alternative approaches such as the high school mathematics program initiative to eliminate general level classes which was examined in this study. The district and high school are located in a largely conservative republican community. Conservative candidates and interest groups have challenged building projects and other financially expensive initiatives. Consequently it remains important politically that the school district maintain its strong academic achievement as reported through PSSA, PVAAS, and School Performance Profile (SPP) results. If the district fails to maintain high levels of achievement, the conservative political base will likely become even more vocal in challenging the efforts of the school district.
The school board and district administration recognize the importance of educational research and are supportive of informal and formal studies of student achievement. In the past, the district employed an Assessment and Testing Consultant and/or an Accountability Director whose primary responsibilities were to report assessment results and to study academic programs. However, the position was eliminated prior to the 2011-12 school year due to budgetary constraints.

The researcher had no access issues to the site. As a former employee, the researcher has a positive relationship with administration and was granted permission by administration to access the needed student data: student courses, demographic information, and assessment results. The researcher previously served the district as a High School Assistant Principal and the district’s Assessment and Testing Consultant prior to leaving the district. Additionally, the Assistant to the Superintendent for Secondary Education, formerly the Director of Curriculum and Instruction under whom the program was implemented, and Superintendent were both supportive of the initiative and were interested in information regarding the effectiveness of the program.

Research Design and Rationale

This quantitative study was designed to determine the impact that tracking and the general course elimination had on student achievement and growth in mathematics. The study was an ex-post facto study focusing on quantitatively identifying significant differences in the dependent variables: student mathematical achievement and growth given various independent variables: student cohort, race/ethnicity, socioeconomic status, academic program, and predicted performance level. The study compared overall and subgroup results for the graduating classes of 2012, whose students had access to three
tracks which included general level classes, and 2013, whose students were the first class after general level classes were eliminated leaving access to two tracks. The study also compares the impact of the various academic programs: general, college preparatory, and honors/AP upon achievement and growth, as well as examining the participation rates of demographic groups in the various programs.

The variables of the study and their possible values, shown in parenthesis, are described in more detail below:

- **Student Achievement - dependent:** The student achievement value is the student’s scaled score on the Mathematics PSSA assessment.
- **Student Growth - dependent:** Student Growth is calculated as the difference between a student’s actual PSSA scaled score and the PVAAS predicted PSSA score.
- **Graduation Cohort - independent:** Each student is identified with his/her year of graduation and type of program he/she had access to. (2012 Three-track Cohort, 2013 Two-track Cohort)
- **Race/Ethnicity - independent:** Each student is identified with one of two race/ethnicity groupings. To make sample sizes viable and to address the underlying focus of the research questions, Minority students are grouped together. The Minority students are considered to be students who identify themselves as African-American, Latino-American, or multi-racial. The comparison group is comprised of White and Asian students as they have traditionally been the highest achieving groups. (Minority, White/Asian)
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- Socioeconomic Status - independent: Each student’s status was identified by his/her participation in the federal Free and Reduced Lunch Program. (Economically Disadvantaged, Non-Economically Disadvantaged)

- Academic Program (independent): Each student was identified by the academic program, or "strand/track", corresponding to his/her graduating cohort and academic level. (2012 Three-track General, 2012 Three-track College Preparatory, 2012 Three-track Honors/AP, 2013 Two-track College Preparatory, and 2013 Two-track Honors/AP)

- Predicted Performance Level: Each student is identified with a Predicted Performance Level. The PVAAS system predicts a PSSA score and Proficiency Level for each student. (Below Basic, Basic, Proficient, and Advanced)

The review of the literature demonstrated many negative effects associated with tracking and general level classes, including limited achievement and growth for traditionally low-achieving students, negative self-perception and teacher-perception of students’ ability, as well as minorities and economically disadvantaged students being disproportionately represented in the lower-achieving tracks. The elimination of the general track classes is one potential solution to the issue of poor student achievement among students who are minorities, poor, or have traditionally struggled academically. The study was designed to identify the impact of tracking on student achievement and growth, along with determining if eliminating of general level classes was successful in raising the achievement and growth of students while also closing gaps in achievement.
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Research Methods

Student information data was collected for students in the graduating classes of 2012 and 2013 who took the PSSA during the springs of 2011 and 2012 respectively. To be included in the study, students needed to be members of the graduating classes of 2012 or 2013 and also needed to have completed their freshman, sophomore, and junior years in the high school’s regular education mathematics program. The student information was gathered by school employees from two sources: the PVAAS website and the district’s student information system. The collected data is available to any researcher who receives permission of the Superintendent and since only aggregate and no personally identifiable data is presented as part of the study, no further permission was needed from the students involved. The following information was collected for each student:

- Basic Demographic Information (Race/Ethnicity and Socioeconomic status)
- Eleventh grade PSSA mathematics scaled score and the eleventh grade predicted PSSA score and proficiency level as generated by PVAAS
- Student mathematics course history (Year, Grade Level, Course, and Teacher)

The quantitative investigation focused on identifying significant differences in Mathematics Achievement as measured by a student’s PSSA score and Mathematics Growth as measured by PSSA and PVAAS. The investigation examined results overall as well as within the context of the different academic programs, demographic groupings, and predicted levels of student performance. This investigation enabled the researchers to compare the students of the 2012 graduating class whose academic program included a general level track with the students of the 2013 graduating class whose academic
program did not include a general level track, as well as analyzing differences in the impact of tracking on achievement and growth at different academic levels within the cohorts of students.

To analyze the differences in mathematics growth, the researcher first established the amount of Student Growth for each student. The Student Growth measure served as the dependent variable for much of the study and was calculated as the difference between the student’s actual eleventh grade PSSA score and their PVAAS predicted eleventh grade PSSA mathematics score.

\[
\text{Student Growth} = \text{Actual PSSA Score} - \text{Predicted PSSA Score}
\]

As the PVAAS Predicted score is a new and emerging measurement of student learning it is important to share additional context regarding the PVAAS system and how it can be utilized by educators and researchers. The PVAAS system was developed by the SAS Institute, Inc. located in Cary, North Carolina. SAS is a leader in analytics, data mining, and data analysis across numerous industries including K-12 education. Their EVAAS System, upon which PVAAS is based, is utilized by the Tennessee, Ohio, North Carolina, and Pennsylvania departments’ of education to provide value added, also referred to as growth, information on every student in the state. Additionally, the EVAAS system has also been adopted by numerous independent school districts to provide similar analysis to that shown in PVAAS (SAS Institute Inc. 2012).

To determine predicted PSSA scores, the PVAAS system uses all of student’s prior testing data, including PSSA scores in all disciplines to predict the student’s performance on the subsequent PSSA exam. The process is explained by the PVAAS Statewide Team for PDE (2014):
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The predicted score for a student is calculated by observing how all students with a similar prior testing history performed on the test of interest, so we have an expectation of how that student should score. Growth is then a function of the difference between the average predicted score of the student group and the average actual score for the student group (p. 17).

A more detailed description of the underlying statistics used in the PVAAS methodology can be found at http://www.sas.com/resources/asset/SAS-EVAAS-Statistical-Models.pdf. Over the history of the PVAAS system, the predictions on the High School Mathematics PSSA have been very accurate. The PVAAS Statewide team (2014) cites that the average multiple correlation coefficient for predication of PSSA math ranges from 0.82 to 0.87.

Once the independent and dependent variables were identified or calculated for each student, the researcher conducted a series of examinations to identify the impact the general level program elimination along with the impacts of tracking. The researcher analyzed the student data as follows:

1. The researcher constructed a series of descriptive statistics tables to analyze achievement, growth, and participation rates in the various programs overall as well as given the students’ race/ethnicity, socioeconomic status, and predicted performance level. The researcher examined the following:
   a. Changes in Academic Program Participation by Race/Ethnicity and Socioeconomic Status Following the Elimination of General Level Classes
   b. Differences in Academic Program Participation by Socioeconomic Status and Race/Ethnicity given Predicted Performance Levels.
2. The researcher conducted a series of \( t \)-tests as well as one-way and two-way Analysis of Variance (ANOVA) tests to identify significant differences in student achievement and growth given the various individual independent variables and also the interaction of the independent variables. The researcher examined the following:

   a. Comparison of the Achievement and Growth Differences between the 2012 Three Track and 2013 Two Track Cohorts of Students Overall and by Race/Ethnicity and Socioeconomic Status
   b. The Effect of Academic Programs on Student Growth
   c. The Interactions of Academic Programs and Race/Ethnicity
   d. The Interactions of Academic Programs and Socioeconomic Status
   e. The Interactions of Academic Programs and Predicted Performance

For letters b through e, modifications were made to the data set to address the ANOVA assumptions. To address the assumption of independence students were removed if they had participated in multiple academic levels during their career. For example a student that took one honors course and two college preparatory courses were removed. To address the assumptions of normality and homogeneity of variances, students were removed if their performance was more than 2.5 standard deviations from the mean of all students in their Academic Program. The assumption of normality was tested using the Shapiro-Wilk test, while the assumption of homogeneity of variance was tested with Levene's test. Violations of the assumptions that remained after the data removal are indicated within the study along with how the violations were handled.
3. To identify which program differences were significant, the researcher conducted Games-Howell post-hoc tests when the ANOVA results indicated that there were significant differences amongst the various independent variables or interactions between the independent variables. The researcher utilized the Games-Howell test in each case where a post-hoc test was warranted because the data lacked homogeneity of variance.

During the initial review of data, the researcher also considered the potential confounding variable of teacher experience as the mathematics department at the school had experienced significant changes in the teaching staff. Of the eighteen staff positions in the department over the years the cohorts were taking math classes, eight of the positions involved a resignation/retirement and subsequent new hire, and three of the eight positions have turned over multiple times during the time period. However the researcher found that when looking at the various academic programs, teaching experience was not a notable factor in that most teaching staff taught at all levels and individual students nearly always had a mixture of both new and experienced teachers. No specific academic program had any “advantage” in teaching experience over another academic program.

Another confounding variable that the researcher could not control for was variance in curricular materials. The college preparatory and honors level programs utilized similar curricular materials with both cohorts of students. These students followed a traditional Algebra 1, Geometry, Algebra 2 sequence. However, the general level program from the Three-Track Cohort of 2012 utilized an integrated approach that mixed the content of Algebra 1, Geometry, and Algebra 2 into three courses. While the
material was taught in a different order than the traditional sequence, both the traditional and integrated program taught the same material over the three year period as both programs were aligned to the Pennsylvania Academic Standards. 47 students out of the 389 in the Three-Track Cohort of 2012 utilized these unique materials and consequently the materials may be a factor in the results experienced by the 2012 general level students.

From the collection of analyses, the researcher had a base of information and knowledge from which to answer the proposed research question: How have the practices of tracking and the elimination of general level courses impacted mathematics achievement and mathematics growth of students overall and have they impacted demographic groups differently?

**Ethical Considerations**

The ethical considerations of the study were primarily limited to securing student achievement information that is commonly protected by the Federal Educational Rights and Privacy Act (FERPA). The researcher collected student achievement data in the form of PSSA results and PVAAS statistics. In addition to the achievement data, the researcher collected data on the students’ academic history in mathematics from the student information system. The researcher took the following efforts to maintain student privacy as required by FERPA and the district’s data use policies:

- No student names were attached to data. The district created a unique identification key for each student prior to transferring the data to the researcher.
- Only aggregate information is presented in the final study, so no personally identifiable test results or academic history is accessible to the reader.
The researcher sought and received IRB approval as an exempt study. The research fell under the exempt category two: “Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement)”. 

Chapter 4

This study investigated how eliminating a high school general level mathematics program impacted student mathematics achievement and growth. The research also examines the related question of how the school's multiple academic tracks, or levels of courses, impacted students, as such examination provides context for the results of the study and recommendations that emerge from the study. The mathematics department of the high school made the decision to eliminate general level mathematics courses in an effort to raise the overall achievement of their students and also in an effort to close an achievement gap that was present between Racial/Ethnicity groups and also between Socioeconomic groups of students. The research presents answers to the overall research question: How have the practices of tracking and the elimination of general level courses impacted mathematics achievement and mathematics growth of students overall and have they impacted demographic groups differently?

The analysis is organized and presented around the more specific research sub-questions which focus on specific aspects of the overall question:

1. How has the elimination of general level classes impacted the mathematics Achievement and Student Growth overall and has it positively impacted the Achievement and Growth gaps that are present between Racial/Ethnicity and Socioeconomically based groups of students?

2. How has the elimination of general level classes impacted the participation rate of Minority and Economically Disadvantaged students in the most rigorous mathematics course offerings?
3. How have the various Academic Programs, before and after the General Level class elimination, impacted Student Growth overall, and do the programs impact Racial/Ethnicity and Socioeconomically based groups of students differently?

4. How have the various Academic Programs impacted Student Growth overall when controlling for Predicted Mathematics Performance?

By examining the answers to the sub-questions, we can identify if the General Level program elimination was successful in raising student Achievement and Growth, but also understand how such efforts impacted Minority and Economically Disadvantaged students. Furthermore the questions allow us to consider the relative value of the various Academic Programs for different groups of students. Through these series of examinations we can examine if eliminating General Level courses was a successful overall strategy, while also identifying positive and negative aspects of the tracked or detracked program that can be used to further improve the overall mathematics instruction of students.

**Findings**

**Comparison of the Achievement and Growth Differences between the 2012 Three-Track and 2013 Two-Track Cohorts of Students Overall and by Race/Ethnicity and Socioeconomic Status**

Research Sub-Question #1: How has the elimination of general level classes impacted the mathematics Achievement and Student Growth overall and has it positively impacted the Achievement and Growth gaps that are present between Racial/Ethnicity and Socioeconomically based groups of students?
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The primary goal of eliminating general level courses was to raise the overall achievement of students, while also positively impacting the achievement and growth of Minority and Economically Disadvantaged students. These analyses identify the impact of the elimination upon overall and subgroup achievement and growth.

To measure the overall and demographic differences between the 2012 Three-Track and 2013 Two-Track Cohorts in regards to PSSA Achievement and Student Growth, which is calculated as the difference between a student's actual PSSA scores and his/her PVAAS predicted PSSA score, the student performance was analyzed using independent sample t-tests. Prior to the tests, the data set was analyzed to identify its compliance with the t-test assumptions. The Shapiro-Wilk Test of Normality was significant for both cohorts ($p < .001$ and $p < .001$ respectively) and Levene’s Test of Equality of Variances was significant for both cohorts ($p = .025$ and $p = .047$ respectively), consequently the t-test results are reported assuming heterogeneity of variance. The overall results are presented in Table 1:

<table>
<thead>
<tr>
<th>Program</th>
<th>2012 Cohort</th>
<th>2013 Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M (SD)</td>
</tr>
<tr>
<td>PSSA Score</td>
<td>389, 1498.1 (272.6)</td>
<td>362, 1441.4 (242.0)</td>
</tr>
<tr>
<td>Student Growth</td>
<td>389, 35.7 (147.2)</td>
<td>362, 2.8 (131.2)</td>
</tr>
</tbody>
</table>

The 2012 Three-Track Overall Cohort ($M = 1498.1, SD = 272.6$) had significantly higher PSSA scores than the 2013 Two-Track Overall Cohort ($M = 1441.2, SD = 242.0$), $t (747.3) = 3.019, p = .003$. The 2012 Three-Track Overall Cohort ($M = 35.7, SD = 147.2$) also had significantly higher Student Growth factors than the 2013 Two-Track
Overall Cohort ($M = 2.8, SD = 131.2$), $t (747.6) = 3.249, p = .001$. The significant results indicate that general course elimination was not a successful strategy for improving student achievement and growth.

The PSSA Score and Student Growth results disaggregated by Racial/Ethnicity groups are shown in Table 2:

<table>
<thead>
<tr>
<th>Program</th>
<th>Minority</th>
<th>White/Asian</th>
<th>Minority</th>
<th>White/Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M (SD)$</td>
<td>$n$</td>
<td>$M (SD)$</td>
</tr>
<tr>
<td>2012 PSSA Score</td>
<td>49</td>
<td>1329.69 (238.5)</td>
<td>340</td>
<td>1522.39 (268.9)</td>
</tr>
<tr>
<td>2012 Student Growth</td>
<td>49</td>
<td>-15.5 (123.0)</td>
<td>340</td>
<td>43.2 (149.0)</td>
</tr>
<tr>
<td>2013 PSSA Score</td>
<td>51</td>
<td>1314.35 (200.2)</td>
<td>311</td>
<td>1462.25 (242.1)</td>
</tr>
<tr>
<td>2013 Student Growth</td>
<td>51</td>
<td>-13.5 (115.4)</td>
<td>311</td>
<td>5.5 (133.6)</td>
</tr>
</tbody>
</table>

The 2012 Three-Track White/Asian PSSA Scores ($M = 1522.39, SD = 268.9$) were significantly higher than the 2012 Three-Track Minority PSSA Scores students ($M = 1329.69, SD = 238.5$), $t (387) = 4.753, p < .001$. While the difference in PSSA scores between White/Asian and Minority students was reduced from 192.7 to 147.9 points in 2013, the 2013 Two-Track White/Asian PSSA Scores ($M = 1462.25, SD = 242.1$) remained significantly higher than the 2013 Two-Track Minority PSSA Scores ($M = 1314.35, SD = 200.2$), $t (360) = 4.3145, p < .001$. Sustaining the significant differences over the two cohorts indicates that the general-course elimination strategy was unsuccessful in closing the gap in achievement between White/Asian and Minority students.

The 2012 Three-Track White/Asian average Student Growth factor ($M = 43.2, SD = 149.0$) was significantly higher than the 2012 Three-Track Minority Student Growth
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factor \((M = -15.5, SD = 123.0)\), \(t(387) = 2.632, p = .009\). The difference in average Student Growth factors in 2013 was 19.0 points after having been 58.7 points in 2012.

The 2013 Two-Track White/Asian average Student Growth factor \((M = 5.5, SD = 133.6)\) was not significantly higher than the 2013 Two-Track Minority Student Growth factors \((M = -13.5, SD = 115.4)\), \(t(360) = .959, p = .338\). By reducing the significant difference between the two cohorts, the results indicate that the general-course elimination strategy was successful in closing the gap in growth that exists between White/Asian and Minority students.

The PSSA Score and Student Growth results disaggregated by Socioeconomic groups are shown in Table 3:

<table>
<thead>
<tr>
<th>Program</th>
<th>2012 PSSA Score</th>
<th>2012 Student Growth</th>
<th>2013 PSSA Score</th>
<th>2013 Student Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Economically Disadvantaged</td>
<td>Economically Disadvantaged</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSSA Score</td>
<td>(n)</td>
<td>M (SD)</td>
<td>(n)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSSA Score</td>
<td>330</td>
<td>1523.37 (268.8)</td>
<td>59</td>
<td>1356.88 (245.9)</td>
</tr>
<tr>
<td>Student Growth</td>
<td>330</td>
<td>38.8 (147.9)</td>
<td>59</td>
<td>19.1 (143.2)</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSSA Score</td>
<td>301</td>
<td>1475.12 (239.2)</td>
<td>61</td>
<td>1275.08 (179.8)</td>
</tr>
<tr>
<td>Student Growth</td>
<td>301</td>
<td>9.8 (132.0)</td>
<td>61</td>
<td>-31.7 (122.1)</td>
</tr>
</tbody>
</table>

The 2012 Three-Track Non-Economically Disadvantaged PSSA Scores \((M = 1523.37, SD = 268.8)\) were significantly higher than the 2012 Three-Track Economically Disadvantaged PSSA Scores \((M = 1356.88, SD = 245.9)\), \(t(387) = 4.423, p < .001\). The difference in average PSSA scores increased from 166.5 points to 200.0 points between the Cohorts of 2012 and 2013. The 2013 Two-Track Non-Economically Disadvantaged PSSA Scores \((M = 1475.12, SD = 239.2)\) remained significantly higher than the 2013
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Two-Track Economically Disadvantaged PSSA Scores ($M = 1275.08, SD = 179.8$), $t (360) = 6.184, p < .001$. Sustaining the significant differences over the two cohorts indicates that the general-course elimination strategy was unsuccessful in closing the gap in achievement between Non-Economically Disadvantaged and Economically Disadvantaged students.

The 2012 Three-Track Non-Economically Disadvantaged Student Growth factors ($M = 38.8, SD = 147.9$) were not significantly higher than the 2012 Three-Track Economically Disadvantaged Student Growth factors ($M = 19.1, SD = 143.2$), $t (387) = .945, p = .345$. The difference in average Growth Factors between Non-Economically Disadvantaged and Economically Disadvantaged students increased and became significant for the 2013 Cohort. The 2013 Two-Track Non-Economically Disadvantaged Student Growth factors ($M = 9.8, SD = 132.0$) were significantly higher than the 2013 Two-Track Economically Disadvantaged Student Growth factors ($M = -31.7, SD = 122.1$), $t (360) = 2.263, p = .024$. The fact that the growth differences increased to a significant level for the 2013 Cohort indicates that the general-course elimination strategy failed to close and actually increased the gap in growth that was present between Non-Economically Disadvantaged and Economically Disadvantaged students.

The primary goal of eliminating general level classes was to improve the overall PSSA scores, while also closing the achievement and growth gap present between Minority and White/Asian students as well as closing the gaps between Economically Disadvantaged and Non-Economically Disadvantaged students. This analysis indicates that the goal was not reached. The overall 2012 Three-Track Cohort had higher achievement and greater growth than the overall 2013 Two-Track Cohort. Furthermore,
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the results do not indicate consistent closing of the achievement and growth gaps. Only the growth gap between White/Asian and Minority students closed to a non-significant level. The achievement gaps between White/Asian and Minority students as well as between Non-Economically Disadvantaged Students and Economically Disadvantaged students remained significant, while the growth gap between Non-Economically Disadvantaged Students and Economically Disadvantaged increased from a non-significant to a significant level.

Changes in Academic Program Participation by Race/Ethnicity and Socioeconomic Status Following the Elimination of General Level Classes

Research Sub-question #2: How has the elimination of general level classes impacted the participation rate of Minority and Economically Disadvantaged students in the most rigorous mathematics course offerings?

The high school mathematics department recognized that there was a disproportionately high participation of Minority and Economically Disadvantaged students in General courses while also noting the disproportionately low participation rates in Honors/AP courses. A related goal of eliminating the general level classes was to increase the participation rates of Minority and Economically Disadvantaged students in the most advanced course work. While the goal was one primarily of equity, the goal also was intended as a means to improve the overall performance of the school on the PSSA, given the belief that students in more rigorous coursework would likely perform better on the assessment given the preparation they received. A review of participation rates was conducted to examine if the elimination of General classes impacted the
disproportionate participation occurring at the Honors/AP level. The Racial/Ethnicity breakdown of students in each Academic Program is displayed in Table 4:

Table 4

<table>
<thead>
<tr>
<th>Program</th>
<th>Minority Percentage</th>
<th>Minority Number</th>
<th>White/Asian Percentage</th>
<th>White/Asian Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 Total</td>
<td>12.6%</td>
<td>49</td>
<td>87.4%</td>
<td>340</td>
</tr>
<tr>
<td>2012 H/AP</td>
<td>5.3%</td>
<td>9</td>
<td>94.7%</td>
<td>179</td>
</tr>
<tr>
<td>2012 CP</td>
<td>14.6%</td>
<td>21</td>
<td>85.5%</td>
<td>123</td>
</tr>
<tr>
<td>2012 Gen</td>
<td>32.2%</td>
<td>19</td>
<td>67.8%</td>
<td>38</td>
</tr>
<tr>
<td>2013 Total*</td>
<td>13.5%</td>
<td>48</td>
<td>86.5%</td>
<td>307</td>
</tr>
<tr>
<td>2013 H/AP</td>
<td>8.0%</td>
<td>16</td>
<td>92.1%</td>
<td>185</td>
</tr>
<tr>
<td>2013 CP</td>
<td>20.7%</td>
<td>32</td>
<td>79.2%</td>
<td>122</td>
</tr>
</tbody>
</table>

*7 members of the class of 2013 participated in the general program despite its elimination. These students failed classes placing them off sequence with their peers

The data of Table 4 demonstrates the disproportionate participation of Minority students in the academic programs. White and Asian students make up a larger percentage of the participation in Honors/AP classes than their overall proportion of the student body. Consequently, Minority students participate at lower rates than their overall proportion of the student body. While Minorities represent 12.6 percent of the Three-Track Cohort of 2012, they represented just 5.3 percent of the Honors/AP students. In the Two-Track Cohort of 2013, Minorities represented 13.5 percent of the Class of 2013 and 8.0 percent of the H/AP students. The increase in the participation rate of Minorities in the Honors/AP classes experienced between the Three-Track Cohort of 2012 ($M = 18.4\%, n = 49$) and Two-Track Cohort of 2013 ($M = 33.3\%, n = 48$) was not statistically significant at the $p < .05$ level, $p = .09296$.

The percentage of students by Socioeconomic Status and Academic Program for each cohort is displayed in Table 5:
EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

Table 5

<table>
<thead>
<tr>
<th>Program</th>
<th>Economically Disadvantaged</th>
<th>Non-Economically Disadvantaged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage</td>
<td>Number</td>
</tr>
<tr>
<td>2012 Total</td>
<td>15.2%</td>
<td>59</td>
</tr>
<tr>
<td>2012 H/AP</td>
<td>6.9%</td>
<td>12</td>
</tr>
<tr>
<td>2012 CP</td>
<td>14.6%</td>
<td>21</td>
</tr>
<tr>
<td>2012 Gen</td>
<td>44.6%</td>
<td>26</td>
</tr>
<tr>
<td>2013 Total#</td>
<td>16.1%</td>
<td>57</td>
</tr>
<tr>
<td>2013 H/AP</td>
<td>5.0%</td>
<td>10</td>
</tr>
<tr>
<td>2013 CP</td>
<td>30.5%</td>
<td>47</td>
</tr>
</tbody>
</table>

\#7 members of the class of 2013 participated in the general program despite its elimination. These students failed classes placing them off sequence with their peers.

The data of Table 5 demonstrates the disproportionate participation of Economically Disadvantaged students in the academic programs. Non-Economically Disadvantaged students make up a larger percentage of the participation in Honors/AP classes than their overall population of the student body. Consequently, Economically Disadvantaged students participate at lower rates than their overall population of the student body. While 15.2 percent of the Three-Track Cohort of 2012 was considered Economically Disadvantaged, only 6.9 percent of those students participated in Honors/AP classes. In the Two-Track Cohort of 2013, which followed the general program elimination, Economically Disadvantaged students represented 16.1 percent of the student body and 5.0 percent of the students in Honors/AP classes. While the goal was to increase participation, participation actually decreased between the Three-Track Cohort of 2012 ($M = 20.3\%$, $n = 59$) and Two-Track Cohort of 2013 ($M = 17.5\%$, $n=57$); however, the decrease was not statistically significant at the $p < .05$ level, $p = .70394$.

Over this two year period, the elimination of General Level classes did not have a statistically significant impact upon the participation of Minority and Economically
Disadvantaged students in the Honors/AP program. This result indicates that the goal of increasing the Minority and Economically Disadvantaged participation in the Honors/AP program by eliminating the General Level program was not met. Furthermore, the result indicates that Achievement and Growth differences, or lack of differences, between Racial/Ethnicity groups and Socioeconomic groups are related to the performance of students who would have been General Level students but were now expected to take College Preparatory courses, rather than the result of students moving into the more rigorous Honors/AP coursework.

The Effect of Academic Programs on Student Growth

Research Sub-question #3 (Overall Analysis): How have the various Academic Programs, before and after the General Level class elimination, impacted Student Growth overall, and do the programs impact Racial/Ethnicity and Socioeconomically based groups of students differently?

This analysis provides insight into the goal of encouraging students to pursue more rigorous coursework by eliminating General Level courses, as it provides information on how the various programs, or levels, impacted Student Growth. Identifying the differences in the Student Growth experienced in the various Academic Programs provides further information regarding the effectiveness of the various programs and whether or not forcing students into more rigorous coursework through the program elimination was a prudent idea for improving Achievement and Student Growth.

To identify the differences in Student Growth experienced by students in the academic strands, a one-factor analysis of variance (ANOVA) was conducted to identify
EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

differences in Student Growth amongst the different Academic Programs. The Student Growth by Academic Program is presented in Table 6.

Table 6

<table>
<thead>
<tr>
<th>Student Growth of Students by Academic Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>2012 Gen</td>
</tr>
<tr>
<td>2012 CP</td>
</tr>
<tr>
<td>2012 H/AP</td>
</tr>
<tr>
<td>2013 CP</td>
</tr>
<tr>
<td>2013 H/AP</td>
</tr>
</tbody>
</table>

When separated by academic strands, the data set violates the ANOVA assumption of normality. The Shapiro-Wilk Test of Normality was significant ($p < .01$) for the 2013 Two-Track Honors/AP Program and was not significant for the other four Academic Programs ($p > .05$). The assumption of homogeneity of variances was also violated, as assessed by Levene’s Test of Homogeneity of Variance ($p < .01$).

Consequently Welch’s Robust Test of Equality of Means was utilized. This test indicated a significant difference between the Academic Strands, Welch’s $F(4, 213.051) = 8.490, p < .001$. Given the significant Levene's test, the Games-Howell post-hoc tests, where homogeneity of variance is not assumed, were used to identify differences in Student Growth amongst the Academic Programs. The results of the post-hoc tests are displayed in Table 7:

Table 7

<table>
<thead>
<tr>
<th>Average Differences in Student Growth by Academic Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Program #1</td>
</tr>
<tr>
<td>2013 H/AP</td>
</tr>
<tr>
<td>2012 H/AP</td>
</tr>
<tr>
<td>2012 H/AP</td>
</tr>
<tr>
<td>2012 CP</td>
</tr>
</tbody>
</table>

* indicates significance at the $p < .05$ significance level
The analysis identifies statistically significant differences between the Academic Programs within the cohorts of students. In each case, the more rigorous academic program had higher average Student Growth factors, of which three were statistically significant. The difference ($M = 46.5, SD = 13.3$) between the 2013 Two-Track Honors/AP and 2013 Two-Track College Preparatory programs was significant ($p = .005$). The difference ($M = 46.5, SD = 15.4$) between the 2012 Three-Track Honors/AP and the 2012 Three-Track College Preparatory programs was significant ($p = .029$). The difference ($M = 72.8, SD = 23.1$) between the 2012 Three-Track Honors/AP and 2012 General programs was significant ($p = .019$). The sole difference ($M = 27.3, SD = 22.0$) that was not significant ($p = .727$) was between the 2012 Three-Track College Preparatory and 2012 Three-Track General programs. The significant results indicate the benefit students experience by participating in more-rigorous levels. Students in the higher levels experience significantly more growth than those in lower levels which is noteworthy especially considering those students generally start at high levels of achievement.

The analysis presents contradictory evidence regarding the General Level Program elimination. The analysis demonstrates that the more rigorous the Academic Program, the greater the Student Growth. For both cohorts, the Honors/AP students outgrew their College Preparatory and General Level counterparts at statistically significant levels. While the College Preparatory students had higher average Student Growth than General students, the difference was not statistically significant.
The Interactions of Academic Programs with Race/Ethnicity and Socioeconomic Status

Research Sub-question #3 (Demographic Sub-group Analysis): How have the various Academic Programs, before and after the General Level class elimination, impacted Student Growth overall, and do the programs impact Racial/Ethnicity and Socioeconomically based groups of students differently?

This analysis extends the prior analysis to address the second part of the sub-question. As one of the primary goals of the program elimination was to raise the Achievement and Growth of Minority and Economically Disadvantaged students, this examination considers if the various academic programs provide positive or negative impacts upon the different Racial/Ethnicity and Socioeconomic groups.

To determine if the Academic Programs impacted Racial/Ethnicity groupings differently, a two-factor ANOVA was conducted. The first factor, Academic Program, included five classifications: 2012 Three-Track General, 2012 Three-Track College Preparatory, 2012 Three-Track Honors/AP, 2013 Two-Track College Preparatory, and 2013 Two-Track Honors/AP. The second factor, Race/Ethnicity, included two classifications: Minority and White/Asian. The dependent variable studied was Student Growth. The data set did not meet the assumption of homogeneity of variance as measured by Levene's test ($p < .001$), consequently a more stringent alpha level ($\alpha = .025$) was utilized to measure significance. The average Student Growth for the Academic Programs by Race/Ethnicity is shown in Table 8:
The two-factor analysis of variance showed no significant interaction effect between the Academic Programs and Race/Ethnicity, $F(4, 578) = 1.61, p = .958$. The main Academic Program effect was not significant given the more stringent alpha level, $F(4, 578) = 2.723, p < .029$. The main Racial/Ethnicity effect was also not significant, $F(1, 578) = 1.816, p = .178$.

To determine if the Academic Programs impacted Socioeconomic groupings differently, a second two-factor ANOVA was conducted. The first factor, Academic Program, included five classifications: 2012 Three-Track General, 2012 Three-Track College Preparatory, 2012 Three-Track Honors/AP, 2013 Two-Track College Preparatory, and 2013 Two-Track Honors/AP. The second factor, Socioeconomic Status, included two classifications: Economically Disadvantaged and Non-Economically Disadvantaged. The dependent variable was Student Growth. The data set did not meet the assumption of homogeneity of variance as measured by Levene's test ($p < .001$), consequently a more stringent alpha level ($\alpha = .025$) was utilized to measure significance. The average growth for the Academic Programs by Socioeconomic status is shown in Table 9:
The two-factor analysis of variance showed no significant interaction effect between the Academic Programs and Socioeconomic Status, $F(4, 577) = 1.20, p = .310$. The main Academic Program effect was significant, $F(4, 577) = 5.484, p < .001$. The main Socioeconomic Status effect was not significant, $F(1, 577) = 0.051, p = .822$.

These analyses indicate that the Academic Programs did not impact the Race/Ethnicity and Socioeconomic groups differently; consequently the General Level course elimination cannot be seen as a way of directly lowering or eliminating the Achievement Gap between Race/Ethnicity and Socioeconomic groups. While the General Level elimination could have that impact, it is not because the Academic Programs positively impact one Race/Ethnicity or Socioeconomic group more than another.

The Interactions of Academic Programs and Predicted Performance

Research Sub-question #4: How have the various Academic Programs impacted Student Growth overall when controlled for Predicted Mathematics Performance?

The primary goal of eliminating the General Level program was to raise the overall achievement of students, in part by expecting the lowest-achieving students to
participate in more rigorous mathematics coursework. This analysis provides insight into the question of how students of different abilities, as indicated by Predicted Performance, benefit from the various Academic Programs. This analysis provides context for the value of having various levels of instruction that are theoretically catered to the different levels of student mathematical ability.

A two-factor analysis of variance was utilized to examine the interaction. The first factor, Predicted Performance Level, includes four classifications: Below Basic (BB), Basic (B), Proficient (P), and Advanced (A) representing the four possible performance levels on the PSSA. The second factor, Academic Program, includes three classifications: General, College Preparatory, and Honors/AP representing the three programs students could participate in during the years being studied. As this analysis was focused upon the impact of the academic levels themselves rather than comparing the differences between the Two-Track and Three-Track system, the two cohorts of students were aggregated together. The dependent variable of the analysis was Student Growth.

The assumption of homogeneity of variances was violated for the data set, as assessed by Levene’s Test of Homogeneity of Variance ($p < .01$). Consequently a more stringent alpha level ($\alpha = .025$) was utilized to determine significance of the interaction and main effects. The Student Growth for each Predicted Performance Level and Academic Program is shown in Table 10:
EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

Table 10

<table>
<thead>
<tr>
<th>Predicted Level</th>
<th>General</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M (SD)</td>
<td>n</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Bel. Basic</td>
<td>20</td>
<td>74.8 (106.2)</td>
<td>10</td>
<td>33.3 (101.4)</td>
</tr>
<tr>
<td>Basic</td>
<td>16</td>
<td>-62.1 (110.1)</td>
<td>46</td>
<td>29.5 (94.7)</td>
</tr>
<tr>
<td>Proficient</td>
<td>11</td>
<td>-106.4 (125.4)</td>
<td>131</td>
<td>-12.8 (97.8)</td>
</tr>
<tr>
<td>Advanced</td>
<td>78</td>
<td></td>
<td>24</td>
<td>-75.0 (121.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>253</td>
</tr>
</tbody>
</table>

The two-factor analysis of variance showed a significant interaction between the Predicted Performance Level and the Academic Program, \( F(4, 583) = 3.224, p = .012 \). Additionally, both main effects were significant: Predicted Performance Level, \( F(3, 583) = 6.171, p < .001 \) and Academic Program, \( F(2, 583) = 10.014, p < .001 \). The interaction and main effects were all significant at the \( p < .025 \) level.

Given that the data does not meet the assumption of homogeneity of variance, the data set was converted so a one-way analysis could be conducted using Welch’s ANOVA. After converting the data groupings to a single factor, Welch’s Robust Test of Equality of Means indicated a significant difference existed between Predicted Performance Level/Academic Program groupings, Welch’s \( F(9, 46.197) = 6.645, p < .001 \). The Games-Howell post-hoc tests, where homogeneity of variance is not assumed, were used to identify differences in student growth amongst the Predicted Performance Level and Academic Program groupings. The results of the post-hoc tests are displayed in Table 11. The first half of the table reflects groupings by Predicted Performance Level, while the second half of the table reflects groupings by Academic Program.
Table 11

<table>
<thead>
<tr>
<th>Level/Program</th>
<th>Level/Program</th>
<th>Difference (#1 - #2)</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BB – Gen</strong></td>
<td><strong>BB – CP</strong></td>
<td>41.5 (39.9)</td>
<td>.985</td>
<td>[-114.3, 197.4]</td>
</tr>
<tr>
<td><strong>B – Gen</strong></td>
<td><strong>B – CP</strong></td>
<td>-91.6 (30.9)</td>
<td>.142</td>
<td>[-209.0, 25.8]</td>
</tr>
<tr>
<td><strong>B – Gen</strong></td>
<td><strong>B – H/AP</strong></td>
<td>-203.3 (59.2)</td>
<td>.187</td>
<td>[-557.7, 151.1]</td>
</tr>
<tr>
<td><strong>B – CP</strong></td>
<td><strong>B – H/AP</strong></td>
<td>-111.7 (54.2)</td>
<td>.618</td>
<td>[-522.7, 299.3]</td>
</tr>
<tr>
<td><strong>P – Gen</strong></td>
<td><strong>P – CP</strong></td>
<td>-93.6 (38.8)</td>
<td>.398</td>
<td>[-261.5, 74.3]</td>
</tr>
<tr>
<td><strong>P – Gen</strong></td>
<td><strong>P – H/AP</strong></td>
<td>-128.7 (39.4)</td>
<td>.120</td>
<td>[-296.7, 39.4]</td>
</tr>
<tr>
<td><strong>P – CP</strong></td>
<td><strong>P – H/AP</strong></td>
<td>-35.1 (13.9)</td>
<td>.618</td>
<td>[-83.1, 12.9]</td>
</tr>
<tr>
<td><strong>A – CP</strong></td>
<td><strong>A – H/AP</strong></td>
<td>-123.0* (26.8)</td>
<td>.002</td>
<td>[-221.9, -24.1]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level/Program</th>
<th>Level/Program</th>
<th>M (SD)</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BB – Gen</strong></td>
<td><strong>BB – Gen</strong></td>
<td>137.0* (36.4)</td>
<td>.020</td>
<td>[3.0, 270.9]</td>
</tr>
<tr>
<td><strong>BB – Gen</strong></td>
<td><strong>P – Gen</strong></td>
<td>181.2* (44.7)</td>
<td>.020</td>
<td>[5.4, 357.0]</td>
</tr>
<tr>
<td><strong>B – Gen</strong></td>
<td><strong>P – Gen</strong></td>
<td>44.2 (46.8)</td>
<td>.992</td>
<td>[-137.4, 225.9]</td>
</tr>
<tr>
<td><strong>BB – CP</strong></td>
<td><strong>B – CP</strong></td>
<td>3.8 (35.0)</td>
<td>1.000</td>
<td>[-142.9, 150.5]</td>
</tr>
<tr>
<td><strong>BB – CP</strong></td>
<td><strong>P – CP</strong></td>
<td>46.1 (33.2)</td>
<td>.907</td>
<td>[-100.1, 192.3]</td>
</tr>
<tr>
<td><strong>BB – CP</strong></td>
<td><strong>A – CP</strong></td>
<td>108.3 (40.6)</td>
<td>.249</td>
<td>[-48.7, 263.3]</td>
</tr>
<tr>
<td><strong>B – CP</strong></td>
<td><strong>P – CP</strong></td>
<td>42.3 (16.4)</td>
<td>.242</td>
<td>[-15.0, 99.5]</td>
</tr>
<tr>
<td><strong>B – CP</strong></td>
<td><strong>A – CP</strong></td>
<td>104.6* (28.5)</td>
<td>.023</td>
<td>[0.9, 208.2]</td>
</tr>
<tr>
<td><strong>P – CP</strong></td>
<td><strong>A – CP</strong></td>
<td>62.3 (26.3)</td>
<td>.379</td>
<td>[-35.5, 160.0]</td>
</tr>
<tr>
<td><strong>P – H/AP</strong></td>
<td><strong>P – H/AP</strong></td>
<td>118.9 (53.5)</td>
<td>.560</td>
<td>[-304.9, 542.6]</td>
</tr>
<tr>
<td><strong>B – H/AP</strong></td>
<td><strong>A – H/AP</strong></td>
<td>93.2 (53.3)</td>
<td>.744</td>
<td>[-334.9, 521.3]</td>
</tr>
<tr>
<td><strong>P – H/AP</strong></td>
<td><strong>A – H/AP</strong></td>
<td>-25.7 (14.8)</td>
<td>.777</td>
<td>[-76.5, 25.2]</td>
</tr>
</tbody>
</table>

* and boldface indicates significance at the p < .025 significance level

The analysis indicates that when considering students in one Predicted Performance Level, the students who participated in the higher-level academic program nearly always had a greater average Student Growth factor than those students who participated in the lower-level program; however, the differences were only significant in one instance. There was a significant difference (p = .002) in average student growth (M = 123.0, SD = 26.8) between the students predicted to be Advanced who participate in the Honors/AP level and those who were predicted to be Advanced and participated at the College Preparatory level. This significant result indicates the importance of Advanced predicted students taking the most challenging course possible as their mathematical achievement will not be as high in the College Preparatory program as it would in the
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Honors/AP coursework. The only circumstance where a more rigorous Academic Program had a lower Student Growth factor than a less rigorous program, was for Below Basic students who had higher Student Growth factors in General classes than they did in College Preparatory classes; however, this result was not significant ($p = .985$).

The analysis further indicates that when considering students with different Predicted Performance Levels within the same Academic Program, the students with a lower Predicted Performance Level nearly always had higher average Student Growth factors than their fellow students who had higher Predicted Performance levels. Three of the pairings were significant. At the General Level, students predicted to perform at a Below Basic level had significantly higher average student growth factors ($M = 137, SD = 36.4), p = .020$, than students predicted to perform at a Basic level, and significantly higher average student growth factors ($M = 181.1, SD = 44.7), p = .020$, than students predicted to perform at a Proficient level. These significant results suggest that Below Basic students benefit from a General Level program while higher predicted students will not grow as much as the Below Basic students when taking General Level classes. At the College Preparatory level, students predicted to perform at the Basic level had significantly higher average student growth factors ($M = 104.6, SD = 104.6), p = .023$, than students predicted to perform at the Advanced level. This significant result indicates further rationale for why Advanced predicted students should not participate at the College Preparatory level, as the less able students who are predicted to score Basic will experience greater growth from the program.

The analysis provides a number of findings relevant to the question of the General Level Program elimination. The results suggest that eliminating General Level programs
may adversely affect the students who are predicted to perform at the Below Basic level. These students had higher growth factors in a General Level program than they did in a College Preparatory program, albeit not at a statistically significant level; however, amongst the students in the General Level program, those predicted to score Below Basic had significantly higher growth factors than their classmates who were predicted to score Basic or Proficient. For Basic and Proficient students there were no significant differences in the amount of growth experienced based upon the program they participated in. However, for students predicted to score Advanced, those participating in Honors/AP courses significantly outgrew those participating in College Preparatory courses.

**Differences in Academic Program Participation by Socioeconomic Status and Race/Ethnicity given Predicted Performance Levels.**

The final analysis connects the previous analyses and research sub-questions to explain the Achievement and Growth gaps present between Racial/Ethnicity and Socioeconomic groups and to also provide further information regarding the value of the various Academic Programs for the various demographic groups. The study’s second analysis identified a disproportionately low representation of Minority and Economically Disadvantaged students in the Honors/AP program both before and after the General Level Program elimination, while the third analysis demonstrated that students in the Honors/AP program significantly outgrew their peers in College Preparatory and General Level classes. Therefore it can be inferred that a contributor to both the Race/Ethnicity and Socioeconomic Achievement and Growth gaps is the disproportionate participation of Minority and Economically Disadvantaged students in Honors/AP coursework.
EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

However, the previous analysis also demonstrated an interaction effect between Predicted Performance and the Academic Programs. Consequently it becomes important to identify if there are differences in Predicted Performance that lead to disproportionate participation.

Table 12 shows the program participation for White/Asian or Minority students based upon their predicted PSSA performance.

<table>
<thead>
<tr>
<th>Academic Program Participation by Predicted Performance Level and Race/Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Bel. Basic</td>
</tr>
<tr>
<td>Basic</td>
</tr>
<tr>
<td>Proficient</td>
</tr>
<tr>
<td>Advanced</td>
</tr>
</tbody>
</table>

The table demonstrates factors that are present in Academic Program placement that contributes to the achievement gap. The participation rates demonstrate that even when grouping students by Predicted Performance Levels, Minority students were still more likely to participate in lower-level Academic Programs. Minority students \(M = 35.3\%, n = 17\) who were predicted to be Basic were more likely than White/Asian students \(M = 15.8\%, n = 76\) to take General Level classes, although the difference was not statistically significant at the \(p < .05\) level, \(p = .06576\). The difference in participation of Proficient predicted Minorities \(M = 23.8\%, n = 42\) and Proficient predicted White/Asian students \(M = 40.9\%, n = 242\) at the Honors/AP level was statistically significant at the \(p < .05\) level, \(p = .03572\). Minority students \(M = 77.8\%, n = 18\) who were predicted to be Advanced were less likely than White/Asian students \(M = 90.8\%, n = 283\) to take Honors/AP classes, although the difference was not statistically
significant at the \( p < .05 \) level, \( p = .07508 \). While the difference in participation rates was only significant at the \( p < .05 \) level for students Predicted to be Proficient, the differences at the Basic and Advanced predicted levels had \( p \)-values that would be significant at the \( p < .10 \) level. The results consistently demonstrate a pattern of Minority students not participating in Academic Programs at levels consistent with the participation patterns of White/Asian students. This is noteworthy given that previous analyses demonstrated that with the exception of Below Basic predicted students, students experience greater Student Growth in the more rigorous Academic Programs. It can be inferred that if Minority students participated at levels consistent with their predicted performance, their achievement and the school’s overall achievement would improve.

A similar review of Academic Program participation rates given Socioeconomic Status and Predicted Performance Level is displayed in Table 13.

<table>
<thead>
<tr>
<th>Predicted Performance Level</th>
<th>Non-Economically Disadvantaged</th>
<th>Economically Disadvantaged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>Gen</td>
</tr>
<tr>
<td>Bel.Basic</td>
<td>45</td>
<td>40.0%</td>
</tr>
<tr>
<td>Basic</td>
<td>72</td>
<td>13.9%</td>
</tr>
<tr>
<td>Proficient</td>
<td>230</td>
<td>2.6%</td>
</tr>
<tr>
<td>Advanced</td>
<td>284</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

The table demonstrates additional factors that are present in Academic Program placement that contributes to the gaps in achievement and growth. The participation rates demonstrate that even when grouping students by Predicted Performance Levels, Economically Disadvantaged students were more likely to participate in less rigorous
EXAMINING THE EFFECTS OF GENERAL LEVEL COURSE ELIMINATION AND TRACKING ON STUDENT GROWTH AND ACHIEVEMENT IN A SUBURBAN HIGH SCHOOL MATHEMATICS PROGRAM.

Academic Programs. The difference in participation of Basic predicted Economically Disadvantaged students ($M = 38.1\%$, $n = 21$) and Basic predicted Non-Economically Disadvantaged students ($M = 13.9\%$, $n = 72$) in General Level classes was significant at the $p < .05$ level, $p = .01352$. The difference in participation of Proficient predicted Economically Disadvantaged students ($M = 22.2\%$, $n = 54$) and Proficient predicted Non-Economically Disadvantaged students ($M = 42.2\%$, $n = 230$) was statistically significant at the $p < .05$ level, $p = .00652$. The difference in participation of Advanced predicted Economically Disadvantaged students ($M = 58.8\%$, $n = 17$) and Advanced predicted Non-Economically Disadvantaged students ($M = 91.9\%$, $n = 284$) in Honors/AP classes, was statistically significant at the $p < .05$ level, $p < .001$. The results clearly demonstrate statistically significant evidence of a pattern of Economically Disadvantaged students not participating at Academic levels consistent with the participation rates of Non-Economically Disadvantaged students.

This examination identifies a root cause of the Achievement and Growth gap that exists between Minorities and White/Asian students and also between Economically Disadvantaged and Non-Economically Disadvantaged students. There are smaller percentages of Minority and Economically Disadvantaged students who are predicted to score Proficient and Advanced which can justify the lower participation rates in the Honors/AP program, and conversely the higher participation at the opposite end of the spectrum. However, this analysis demonstrates that Minority and Economically Disadvantaged students are not participating in more rigorous academic programs as frequently as their White/Asian and Non-Economically Disadvantaged peers even when their Predicted Performance levels suggest they are capable of doing so. The difference
in participation rates demonstrated in the second analysis, but more importantly the differences in participation rates in the context of predicted performance levels, provide evidence to explain some of the reasons that Achievement and Growth gaps exist in this school.

Results

The findings, particularly the first analysis, demonstrate that eliminating the General Level program was unsuccessful in its primary efforts: raising the growth and achievement of all students and closing the Achievement and Growth gaps between Race/Ethnicity and Socioeconomic subgroups. However, the analyses do provide insights into how the general practice of tracking and the individual Academic Programs impact the various demographic groups differently when students are separated by Race/Ethnicity, Socioeconomic status, and Predicted Performance Levels.

The findings reveal that the Achievement and Student Growth experienced by the Cohort of 2012, which had access to a General Level program, was significantly higher than the Achievement and Student Growth experienced by the Cohort of 2013. Furthermore, there was only minimal evidence of closing the gaps in Achievement and Student Growth that were present between Racial/Ethnicity and Socioeconomic groups. Only the Student Growth gap between Minority and White/Asian students closed to a non-significant level. The other Achievement and Student Growth gaps remained significant and in the case of Economically Disadvantaged students, the gaps actually increased. These results contrast the research of Burris, Welner, and Garity (2005, 2008) and Boaler (2006) which found that all students benefit from detracking, although their
research involved eliminating all tracks to leave just one level, where as this school eliminated just one level, leaving two options for students.

While the findings suggest that eliminating the General Level program did not have the intended effects, examining the participation rates of Minority and Economically Disadvantaged students in the various Academic Programs, before and after the General Level program elimination, demonstrate the negative effect that tracking has upon such students. The finding was consistent with the research of Boaler et al. (2000), Oakes (1992), Linn (1998), Rees, Argys, and Brewer (1996), and Braddock (1990) who all found that a disproportionately high number of Minority and Economically Disadvantaged students are placed in the lowest classes and a disproportionately low number were placed in the highest classes, even when controlling for projected performance. The research into this high school's participation rates revealed statistically significant differences in the participation rate of Race/Ethnicity and Socioeconomic subgroups in the various Academic Programs even when controlled by students' Predicted Performance Level. Basic predicted Minority and Economically Disadvantaged students were more likely to participate in General Level classes than their Basic predicted White/Asian and Non-Economically Disadvantaged peers, while Proficient and Advanced predicted Minority and Economically Disadvantaged students were less likely to participate in Honors/AP level coursework than their White/Asian and Non-Economically Disadvantaged peers. These results are even more significant when considering the analysis of the impact of the various Academic Programs which demonstrated that students in the more-rigorous Academic Programs experienced significantly higher Student Growth. Consequently the lack of equity that is present in
the placement of students into the various Academic Programs serves to further the gaps in Achievement and Student Growth rather than close them. These findings serve as a positive rationale for eliminating tracks or suggesting significant changes to the placement practices that result in the disproportionate participation.

Another result pertinent to the question of tracking and the General Level program elimination was the trend, albeit not a statistically significant trend, of the relative value of each successive Academic Program, particularly when controlled for Predicted Performance. With the exception of the Below Basic predicted students, each group of students at the respective Predicted Performance levels had higher Student Growth factors when taking the more-rigorous course offerings. While the result was only significant for Advanced students in Honors/AP courses as opposed to College Preparatory courses, that pattern was evident at each level. Students experienced more growth when they were challenged by a more rigorous course offering. This pattern is consistent with the research of Linn (1988) that found that students assigned to low track classes are worse off than they would be in other placements. It is consistent with Boaler et al. (2000) who “linked setting to underachievement” (p. 634) when referring to low level classes, and to Burris, Welner, and Garrity (2005) who determined that “when all students were taught the high-track curriculum, achievement rose for all groups of students (p. 595).” The only exception to the pattern is for the lowest-achieving students who were predicted to perform at a Below Basic level. While their results were not significant, they were the only group of students who had higher growth factors when they participated in lower-level offerings. However, there was statistically significant evidence that suggests that General Level classes are appropriate for Below Basic
predicted students, but not others, as Below Basic predicted students had significantly higher student growth factors than Basic or Proficient predicted students participating in General Level classes.

**Summary**

The research reveals that the elimination of General Level classes did not result in improved overall Academic Achievement and Student Growth. The PSSA Scores and Student Growth factors of the Three-Track Cohort of 2012, where a General Level program was present, were significantly higher than those of the Two-Track Cohort of 2013, where a General Level program was not present. While the elimination of General Level classes did not result in improved overall Achievement and Student Growth, the analyses revealed the benefit to students participating in more rigorous Academic Programs. Within each cohort, each successive more-rigorous Academic Program had larger and nearly always statistically significant larger, Student Growth factors. This remained true even when controlling for past academic performance by considering the students’ Predicted Performance Level. The only exception to this pattern was for lowest-achieving students who were predicted to score Below Basic. These were the only students who benefited from the General Level courses. The results provide a contradiction in regards to the merits of the General Level program elimination. The lowest predicted performance students (Below Basic) benefit from such General Level courses while the moderate and highest predicted performance students (Basic, Proficient, and Advanced) see the greatest growth when participating in the most rigorous Honors/AP program. The research also reveals the negative impact that the tracked program has upon Minorities and Economically Disadvantaged students. These students
are significantly more likely to participate in General Level coursework, and significantly less likely to participate in Honors/AP coursework than their White/Asian and Non-Economically Disadvantaged peers. This remains true even when considering the Predicted Performance Level of the students. However, a solution other than eliminating General Level classes is necessary to positively impact these students, because the research identified that the course elimination did not significantly change the participation rates of the students. Furthermore, the research identified that the gaps in Achievement remained significant between the Race/Ethnicity groupings and also that the gap in Achievement and Student Growth remained significant and actually increased between the Socioeconomic groupings.
Chapter 5

Interpretation of Findings and Results

The findings and results of the research provide clear evidence that the elimination of the General Level Mathematics program failed to improve the overall Mathematics Achievement and Student Growth of students in this particular school. The Achievement and Student Growth experienced by the Graduating Three-Track Cohort of 2012, who had access to a General Level program, was significantly higher than that experienced by the Two-Track Cohort of 2013, who did not have access to the General Level program. Furthermore, the General Level program elimination was not successful in closing the Achievement and Student Growth gaps present between Racial/Ethnicity and Socioeconomic groups, nor did it result in greater Minority and Economically Disadvantaged participation rates in the most rigorous Honors/AP program.

The statistically significant lower Mathematical Growth experienced by 2013 Two-Track students is notable not only for its suggestion that General Level program elimination was unsuccessful, it is also notable given the current emphasis of PVAAS in Pennsylvania’s accountability system. While the study utilized the growth measure as a means of “leveling the playing field” between low and high-achieving students for analysis purposes, the use of the growth measure has additional ramifications. The state has adopted PVAAS as a large portion of both teacher evaluation and school accountability. In 2016, fifteen percent of an individual teacher’s evaluation will come from the PVAAS measured growth that his/her students experience on the Keystone exams at the high school level. Additionally, in 2012-13 and in the years moving forward, forty percent of a school’s School Performance Profile will be made up of the
building’s aggregate PVAAS results. Consequently, considering how an effort such as the General Course Elimination impacts student growth has broader implications for schools than intended when the study was first conceived.

While the overall and demographic analysis demonstrates that the goals of the General Level program elimination were not met, the analysis does provide important context to consider regarding the various Academic Programs and their impact upon the achievement of all students regardless of ability or demographic background. It is reasonable to expect that students in the most rigorous Academic Programs will generally have the highest levels of Achievement as they are generally the most successful mathematics students and they often start with the strongest mathematical foundation gained from prior instruction in elementary and middle school. However, the analysis demonstrates that the effects of the most rigorous Academic Programs go even further than producing the highest levels of Achievement. The study finds that students in the most rigorous Academic Programs also experience more Growth than students in the less rigorous Academic Programs, when comparing the differences in students' Actual PSSA scores and their PVAAS predicted PSSA scores. Consequently, the result of the multiple Academic Programs is that the achievement gap between the highest-achieving and lowest-achieving students actually increases rather than closes.

Further problematic is the analysis demonstrating that Minority and Economically Disadvantaged students are significantly less likely to participate in the Honors/AP program where students experience the greatest growth, even when their Predicted Performance levels suggest they should be participating at this level. The combination of the disproportionate participation and the fact that the Honors/AP students experience
the greatest levels of growth serves to further the gap between Racial/Ethnicity and Socioeconomic groupings, leaving White/Asian and Non-Economically Disadvantaged students significantly more likely to experience higher levels of Achievement than their Minority and Economically Disadvantaged peers. Whether intended or unintended, there is a bias present in the placement of students into the various academic programs that is demonstrated in Tables 12 and 13. This bias is consistent with the research of Boaler et al. (2000), Oakes (1992), Linn (1998), Rees, Argys, and Brewer (1996), and Braddock (1990) who all found that a disproportionately high number of Minority and Economically Disadvantaged students are placed in the lowest classes and a disproportionately low number were placed in the highest classes, even when controlling for predicted performance. While the elimination of General Level courses did not improve participation rates of Minority and Economically Disadvantaged students in the most rigorous coursework as demonstrated in Tables 4 and 5, the analysis of the disproportionate participation demonstrates the merits of considering detracking and program-elimination efforts, as the current existence of multiple programs has embedded within it a bias against Minority and Economically Disadvantaged students like that found by other researchers. If eliminating courses does not lead to more proportional participation that is consistent with students' ability, other measures must be taken to ensure the appropriate students are placed into the appropriate Academic Programs.

To close the achievement gap and provide students with equitable access to the highest quality education, students must be challenged to participate in more rigorous academic programs; however, the analysis suggests that eliminating General Level courses may not have been the appropriate course to accomplish this means. The only
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group of students that benefited from a less rigorous program was those predicted to score Below Basic on the PSSA. These students, who traditionally take General Level classes, have the weakest mathematics backgrounds and are generally in need of the greatest level of support to successfully learn mathematics. Otherwise, students consistently experienced greater growth when they were challenged by a more rigorous program. The effect was most significant for students who were predicted to score Advanced on the PSSA. Students predicted to be Advanced who took Honors/AP level courses exceeded their predicted PSSA score by a statistically significant 123 points more than the Advanced predicted students who took College Preparatory level courses.

The research also demonstrates that in all but one case students predicted to perform at lower predicted levels actually outgrow their higher predicted peers in the same academic programs as demonstrated in Table 11. In three cases these differences were significant. Below Basic students outgrow, at significant levels, both Basic and Proficient students participating in the same General Level program. At the College Preparatory level, Basic predicted students significantly outgrow Advanced students. These results suggest a cap on growth exists within each program. Despite the fact that students who have higher Predicted Proficiency levels come into programs with a better foundation than students with lower Predicted Proficiency levels and therefore should be able to more easily learn content and extend their knowledge, the average Student Growth does not indicate that this is occurring. Rather, the lower Predicted Proficiency level students are experiencing greater growth. The cap suggests that each program can only extend student growth so far and that the programs are not able to enrich the learning of higher Predicted Proficiency level students.
Conclusion

The study's overall research question was: How have the practices of tracking and the elimination of general level courses impacted mathematics achievement and mathematics growth of students overall and have they impacted demographic groups differently?

The results indicate that the elimination of General Level classes was unsuccessful in positively impacting overall mathematics achievement and it also failed to positively impact the Achievement gap between different demographic groups. Overall, the Three-Track Cohort of 2012, where General Level classes were present, had significantly higher levels of Achievement and Student Growth than the Two-Track Cohort of 2013. Furthermore, Minority Achievement remained significantly lower than that of White/Asian students. Economically Disadvantaged students continued to have lower levels of Achievement and Student Growth than their Non-Economically Disadvantaged peers. Additionally, the elimination of General Level classes did not have a positive impact on the participation rates of Minority and Economically Disadvantaged students. Eliminating the General Level classes did not encourage greater participation in Honors/AP courses, and while the Minority participation remained similar, the Economically Disadvantaged participation actually declined.

A contradiction that exists in the results can be found in the examination of growth at the various program levels. While eliminating the General Level program did not result in improved overall results, the study reveals that students participating in more rigorous Academic Programs consistently had greater average growth than those in less rigorous Academic Programs. This remained consistent across the two cohorts and also
remained consistent when controlling for student ability by using the students Predicted Performance level. The only students that appear to benefit from a less rigorous program are the Below Basic predicted students who had a higher average growth factor when in a General class than in a College Preparatory class, although the difference was not significant. In all other cases, at all Predicted Performance levels, the students in the more rigorous Academic Program had higher growth factors than the students in the less rigorous program. So while these results would seemingly justify the elimination of General Level classes to force students into more rigorous programs; the Two-Track Cohort of 2013’s overall Achievement and Growth does not demonstrate that such an effort was successful.

The combination of these results suggests a solution that may have better results in accomplishing the goal of raising achievement for all. The study indicates a potential benefit for Below Basic predicted students having access to a General Level class. This may indicate that Below Basic predicted students need more direct attention than can be delivered in a more heterogeneous College Preparatory program. However, on the opposite end of the spectrum, the results indicate that the majority of students are better off in the most rigorous offering possible: Honors/AP. The more purposeful course elimination may have been to retain General Level classes for the neediest students and instead eliminate the College Preparatory program forcing all other students into the Honors/AP program. At the very least, the implications of the study suggest that students will meet higher expectations when they are subjected to such. Without eliminating any courses, a school may be able to get a similar impact by making the College Preparatory and General Level courses more rigorous. By embedding the higher
expectations directly within the courses, the students can gain experience similar to that which they would have in the next more-rigorous program. However, it is also important to note that these suggested modifications are not based upon statistically significant results; rather they are based upon patterns demonstrated in the comparisons. The one related statistically significant result has implications for the negative impact of lowering expectations. Students who were predicted to be Advanced had significantly higher growth factors when participating in Honors/AP courses than they did when taking College Preparatory courses. The Advanced predicted students who did not challenge themselves in the most rigorous offering available failed to reach their predicted PSSA scores.

**Recommendations**

Schools need to carefully consider the means in which students are placed into various academic programs, while being particularly conscious of the demographic make-up of the various academic programs. Demographic differences in the various programs are only appropriate if there is justification in the past academic performance of students. By ensuring students are placed in the appropriate Academic Program, regardless of Race/Ethnicity and Socioeconomic status, the achievement gaps that are present will begin to close. For all but the lowest-achieving students, challenging them to take the more rigorous courses has been shown to result in greater levels of growth and consequently also greater levels of achievement.

A recommendation for further study would be to consider these program changes in the context of the new Keystone exams administered in Pennsylvania. Rather than having students accumulate three years of mathematics knowledge prior to taking the
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PSSA during the students’ junior year, the Keystone exam evaluates students' knowledge of Algebra 1 content in the same year in which they take the Algebra 1 course. While the elimination of General Level classes cannot be studied over two cohorts as the program has already been eliminated, further examination of the impacts of the various Academic Programs could be studied. A comparison of the growth experienced in Honors/AP courses can be contrasted with growth achieved in College Preparatory courses while still controlling for Predicted Performance levels. If such an analysis indicates advantages for the students in Honors/AP courses over those in the College Preparatory courses, it suggests that there may be positive effects from implementing a complete detracking effort, where only one Academic Program is made available to students.

Another recommended area for possible further study is to consider the impact of acceleration within the context of the study, as suggested by Kulik and Kulik (1992). While this study focused on the contrast between the Honors/AP, College Preparatory, and General Level programs, the Honors/AP program could be further divided into those students that began their Honors/AP program in the middle school with instruction in Algebra 1 and Algebra 2 in contrast with those that began an Honors/AP level program in the high school. Many of the Honors/AP students experienced more mathematics content instruction in addition to more rigorous instruction prior to the PSSA than did their peers in the College Preparatory level. By further examining the effects of acceleration, a more purposeful program could be developed where students are placed properly in courses of appropriate rigor and also begin Algebra 1 instruction at the appropriate time in their mathematics development.
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Summary

Mathematics educators, and all educators regardless of discipline, have a responsibility to provide students with the highest quality education possible. While tracking and homogeneous grouping efforts are generally made under the best of intentions so that instruction can be focused on areas of common student needs, the practice has proven to have a negative effect on the mathematics achievement of students. While separated into different tracks or homogeneous groups, the brightest race off to higher and higher levels of achievement, while those students in “middle” or “low” groupings are left mastering the basics and having little opportunity for enrichment.

What is further disconcerting in the literature and in the experience of this school is that there continues to be a conscious or unconscious bias against Economically Disadvantaged and Minority students in programs where multiple course levels or tracks exist. Even when such students have demonstrated high levels of predicted achievement, they are less likely to take or be offered courses in the most rigorous Academic Programs. Meanwhile, White/Asian and/or Non-Economically Disadvantaged students with lesser demonstrated levels of achievement are often given opportunities to participate in the most rigorous Academic programs. Consequently, the system designed to close the achievement gap and make opportunity available to all in fact widens the achievement gap, leaving Minorities and the Economically Disadvantaged further behind.

If our schools are to ever close the achievement gap and make high quality education truly accessible to all students, they must develop programs that are Racial/Ethnicity and Socioeconomically neutral, where students are placed into courses based upon past achievement and ability while also ensuring no conscious or unconscious
bias based upon Race/Ethnicity or Socioeconomic status plays a role in the decision. No matter whether that school has one level or one hundred levels, the program can only be called successful once it ensures that every individual student is being challenged at a level consistent with his/her past achievement and ability. However while that program must meet students at their level of need, it must also focus on driving higher achievement and developing greater ability in its students. If any level of any program cannot meet such standards it must be eliminated and be replaced with an alternative program, so that all students have the best opportunity to raise their achievement, grow their mathematics ability, and benefit from the highest quality education possible.
References


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