ABSTRACT

Title of Dissertation: A CASE STUDY OF A DISTRICT'S INTENDED AND UNINTENDED RESULTS CONNECTED TO THE IMPLEMENTATION OF A REQUIRED NINTH-GRADE ALGEBRA 1 STRATEGIC INITIATIVE

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There is a long history of debate around mathematics standards, reform efforts, and accountability. This research identified ways that national expectations and context drive local implementation of mathematics reform efforts and identified the external and internal factors that impact teachers' acceptance or resistance to policy implementation at the local level. This research also adds to the body of knowledge about acceptance and resistance to policy implementation efforts. This case study involved the analysis of documents to provide a chronological perspective, assess the current state of the District's mathematics reform, and determine the District's readiness to implement the Common Core Curriculum. The school system in question has continued to struggle with meeting the needs of all students in Algebra 1.

A CASE STUDY OF A DISTRICT'S INTENDED AND UNINTENDED RESULTS CONNECTED TO THE IMPLEMENTATION OF A REQUIRED NINTH-GRADE ALGEBRA 1 STRATEGIC INITIATIVE

by

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Dedication

This dissertation is dedicated to my loving family and friends who have always believed in me and supported me in reaching my goals.

To my devoted parents, Lagha Kashanian and Mahmoud Mirshah, who stressed to me all my life the importance of getting an education. You have been my teachers for all of the important things in life.   I thank you for your selflessness in making the decision to immigrate to the United States so that Hasti and I could have a better life. I am honored to have you both as my parents. Thank you for the many gifts you have given me and for always believing that I would complete this dissertation.

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The love and encouragement I have received from my family is the reason that I am finally Dr. Afsaneh Afie Mirshah-Nayar.

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Chapter 1: Introduction

In secondary education, mathematics stands out from other content areas because it is considered more closely tied to international competitiveness, technological and economic growth, and the development of a highly skilled workforce. Due to its significance, and in response to national and international student achievement data, mathematics has become the focus of national, state, and local policy reform efforts for decades. But reform recommendations are seldom accepted and implemented as envisioned. They often face resistance from teachers, parents, and students who are comfortable with or emotionally attached to traditional goals and practices of mathematics education.

In secondary school mathematics, Algebra 1 stands out as a significant course because it can serve as an entry point or gatekeeper to higher levels of math and science. As a result, education policy reform recommendations have focused on increasing access and success in that critical course. The broad goal of this dissertation research was to provide an informative case study of challenges in school reform by documenting and analyzing experiences in one large, diverse school district that attempted an algebra-for-all initiative. It is one thing for school system leaders to declare their intent to reach an ambitious goal such as success for all in Algebra 1 and quite another to turn that ambition into reality. Implementation of reform in curriculum and teaching of critical school subjects is deeply affected by the factors upon which the reform efforts focus. In the case of the algebra-for-all initiative in the district under study, the implementation involved changes in teaching and assessment practices, revised Algebra 1 curriculum, and accelerated pathways for students in secondary mathematics. As a result, the District received pushback from a variety of stakeholders during the implementation process. Specifically, the researcher examined teacher resistance or acceptance of policy change by looking at external and internal factors impacting their responses to the policy reform efforts. Subsequent sections of this chapter include a description of the national and local contexts for mathematics education reform, an overview of the research questions and methods for the study, and a discussion of the significance of the problem and findings.

Historical Context of Mathematics Education Reform

In 1981, Secretary of Education T. H. Bell established the National Commission on Excellence in Education (NCEE). The commission's report, *A Nation at Risk: The Imperative for Educational Reform,* identified a number of risk factors related to high school mathematics and science education:

> Only a third of 17-year-olds in the United States could solve multiple-step mathematics problems on national assessments and science achievement trends for 17-year-olds were also on the decline. Additionally, in the period from 1975 to 1980, public 4-year colleges experienced a 72% increase in remedial mathematics courses. (Plunk, Tate, Bierut, & Grucza, 2014, p. 231)

Although a detailed analysis of the findings reported in *A Nation at Risk* is outside the scope of this research, it has been argued that the decreases in student achievement noted in that report were tied to increased student access. For example, in 1951 and 1952, there were 1,196,000 students who graduated from high school. Thirty years later, that number was nearly 3,000,000. During this same period, the number of students who took the SAT increased from 81,000 to nearly 1,000,000. In a 30-year period, there was a 1,188%

increase in the population of students tested on the SAT, but there was only one-quarter to one-half a standard deviation decline in scores. It can be argued that the decline in SAT scores did not represent a failure of public education; instead, the American public education system at that time was preparing larger numbers of students than before for admission into colleges and universities (Austin, 1986). It is critical to note, however, that the findings of *A Nation at Risk* had national significance and impacted the American educational system. In response to the call for a more challenging high school experience and better preparation for college, 42 states increased high school graduation requirements in mathematics, science, or both between 1980 and 1989 (Plunk et al., 2014).

In 1989, the National Council of Teachers of Mathematics (NCTM) changed the debate about mathematics with their publication of *Curriculum and Evaluation Standards for School Mathematics*. The standards set forth by NCTM were a call for reform in the teaching and learning of mathematics. They were designed to address new societal goals for education, including mathematically literate workers, lifelong learning, opportunity for all, and an informed electorate. The NCTM standards articulated five general goals for all students: (a) to learn to value mathematics, (b) to become confident in their ability to do mathematics, (c) to become mathematical problem solvers, (d) to learn to communicate mathematically, and (e) to learn to reason mathematically (National Council of Teachers of Mathematics, 1989).

The NCTM standards called for changes not only in the content being taught but also in the teacher's role in the classroom; teachers were asked to shift from dispensing information to facilitating learning, and students were to become active and engaged in problem solving. NCTM claimed that if the opportunity to learn the mathematics represented in the standards was not available to all students, there was a danger of creating an intellectually elite class and a polarized society (National Council of Teachers of Mathematics, 1989). The NCTM standards identified significant changes in the secondary mathematics classroom; however, they did not identify how school systems should support or provide professional development for mathematics teachers to build their capacity in implementing the standards.

The No Child Left Behind (NCLB) Act of 2001 (Public Law 107-110), the eighth reauthorization of the Elementary and Secondary Education Act (ESEA), was designed to address the unique needs of educationally disadvantaged children through the provision of federal funds to school districts. The goal of the legislation was to address an achievement gap that impacted students of color, those receiving special services, and students living in poverty. To enhance the accountability requirements of ESEA, the NCLB legislation was passed and signed into law in January 2002. NCLB replaced norms-based testing with standards-based assessments. To receive funding under NCLB, states must (a) have in place content standards and a testing program to test the attainment of those standards in the core academic subjects; (b) disaggregate student performance data by major student subgroups and report statewide, district, and school-level performance data for each subgroup; (c) set annual objectives to increase the number of students meeting standards, with the goal of reaching 100% proficiency by 2014; (d) implement sanctions for schools not meeting adequate yearly progress (AYP) goals; (e) participate yearly in the National Assessment of Educational Progress (NAEP) math and reading tests at the fourth and eighth grades; and (f) require that all individuals teaching core academic subjects be designated as “highly qualified” by the end of the 2005-2006 school year (Streckfus, Thornton, & Foerster, 2007 p. 18). The NCLB legislation used mathematics standards as one means of holding schools and districts accountable as well as providing a vision for what students should know and be able to do (Confrey, 2007). It is important to point out the fact that the goal of 100% proficiency by 2014 was not reached by most schools. Additionally, some people in the education community have been critical of the high-stakes assessment and accountability connected with NCLB, and debates about the future and effectiveness of this legislation have continued.

In 2010, the Common Core State Standards (CCSS) were released by the National Governors’ Association and the Council of Chief State School Officers. Initially adopted by 45 states and the District of Columbia, a number of states have subsequently withdrawn from the participation in the program. The Standards document includes the following statement:

> Mathematics education in the United States must become substantially more focused and coherent in order to improve mathematics achievement in this country. To deliver on this promise, the mathematics standards are designed to address the problem of a curriculum that is a mile wide and an inch deep. (Common Core State Standards Initiative, 2014, p. 1)

In other words, instead of a lengthy or all-encompassing list of topics, the CCSS have identified a few critical concepts that should be learned in depth by all students. These standards define the knowledge and skills students should master to graduate from high school prepared to enter college or the workforce. Implementation of the CCSS is designed to create the opportunity for students to have consistent learning experiences regardless of where they live, provide for meaningful understanding of core concepts and skills, and engage students in the application of their learning to real-world situations. The CCSS identify eight Standards for Mathematical Practice which "describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise" (Common Core State Standards Initiative, 2014, p. 5). The CCSS "define what students should understand and be able to do in their study of mathematics"; however they "do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations" and "they do not dictate curriculum or teaching methods" (Common Core State Standards Initiative, 2014, p. 5)

The NCTM standards and the CCSS were both developed at the national level and influenced mathematics education at the state and local levels. These reform efforts drew both support and criticism from university professors, mathematics teachers, policymakers, and parents. What they have in common is that both efforts were aimed at defining and changing the standards and practices used in the mathematics classrooms across the United States. Many state and local educational agencies responded to these initiatives by trying to align their own reform efforts to the national expectations.

As districts and schools have begun implementation of CCSS it is important to consider in their totality the impact of the national, state, and local policies of the past 3 decades. The hope is that local implantation of national and state expectations will lead to positive outcomes for students; however, there are also some data showing unintended effects of increased expectations at the state level:

> Some have argued that requiring more demanding mathematics and science coursework for all high school students provides students with greater access and opportunity to learn cognitively challenging content aligned with college readiness. However, other scholars propose that more challenging graduation requirements might lead to increased high school dropout. (Plunk et al., 2014, p. 231)

In a recent study, researchers used historical census data from 1983 to 1999 regarding the educational attainment of subjects (high school dropout, college enrollment, college degree) and compared that with the number of state-mandated course graduation requirements (range of 0 to 6). The research showed that “individuals who were exposed to higher course graduation requirements (CGRs) were more likely to drop out of high school” (Plunk et al., 2014, p. 237). Therefore, as school systems implement policy expectations in response to state and national reform efforts, it is important to consider both the intended and unintended consequences of their efforts.

Reform in the Case Study Context

The studied school system was a large and diverse system with a growing student population and changing demographics. In October of the 2002-2003 school year, the superintendent provided an update to the larger school community regarding key areas of progress in secondary schools. Data regarding Algebra 1 completion by Grade 9 was a significant component of this update. Then, in strategic planning documents for the 2003-2008 school years, the superintendent identified the expectation that all students would successfully complete algebra by the end of Grade 9 and geometry by the end of Grade 10 (District, 2005). A school system report justified that expectation by arguing, "Success in Algebra 1 is necessary to gain access to higher level mathematics and science courses and to prepare for the mathematics portion of the SAT" (Steinberg & Gumula, 2004, p. 1).

There is a variety of mathematics pathways for students in the District that determine the grade in which they complete Algebra 1 and then more advanced courses. Students on an advanced pathway are able to complete algebra in middle school, as early as seventh grade, and have the option of 2 years of Advanced Placement or other college-level courses before finishing high school (see Table 1). Students who complete Algebra 1 in ninth grade are able to reach precalculus only and do not have the option of Advanced Placement or other college-level courses before finishing high school. The highest level of math students take is an important factor in the college admissions process as well as preparation for the world of work.

Table 1. *Mathematics Pathways from Middle*[1] *to High School*

	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
Option 1	Math 7	Math 8	Algebra 1	Geometry	Algebra 2	Precalculus
Option 2	Investigations in Math	Algebra 1	Geometry	Algebra 2	Precalculus	Advanced Placement
Option 3	Algebra 1	Geometry	Algebra 2	Precalculus	Advanced Placement	Advanced Placement

[1] In the school system students are in middle school in Grades 6-8 and in high school for Grades 9-12.

Enrollment in Algebra 1 is often impacted by the skill and readiness levels of students; accelerated students are on a mathematical pathway that has them completing Algebra 1 in middle school or, in some rare cases, in elementary school, whereas those who have struggled with mathematics might take Algebra 1 as late as the ninth grade. Students who take Algebra 1 in the ninth grade may have been historically challenged in mathematics, may be learning English as a second language, or may have special learning needs that impact them in the classroom. To allow for student differences in readiness, some students might take an on-level class, some students might be in a co-taught class[2], and a few might be in sheltered[3] sections based on student readiness.

The scheduling of content classes for ESOL (English for speakers of other languages) students is based on their level of English language proficiency, not their age or grade level. At the high school level, students with very limited English language proficiency have been designated as ESOL Level 1 students and those with the highest level of proficiency have been designated as ESOL Level 5 students. Students with an intermediate level of proficiency have been placed in ESOL 2, 3, or 4 classes as appropriate.

When the Algebra 1 initiative began, students who were ESOL Level 1 (regardless of age or grade) typically were scheduled for a course called MAPS

[2] Classes that are co-taught are taught by two teachers. One teacher is typically the content teacher for the course. The second teacher is typically dual certified in special education as well as the content for the course. The goal of co-taught classes is to ensure the least restrictive setting for students with IEPs (Individualized Educational Plans) and to ensure that these students receive the accommodations required by their IEPs during instruction.

[3] Sheltered classes are usually smaller in size so that the teachers can provide targeted interventions for a specific population of students. Most of the sheltered classes in the District were designed to meet the needs of ESOL students. In these classes all of the students would be English language learners. In a few cases, the District offered sheltered classes for students with IEPs who had complex learning needs beyond what could be accommodated in the on-level or co-taught classes.

(Mathematical Applications and Procedures). The goal of this course was to provide students with the time they needed to develop their English language proficiency, to introduce students to the academic language of mathematics, and to provide students with the mathematical background they needed to be successful in Algebra 1. Exceptions were made on a case-by-case basis for students with transcripts showing they had reached higher levels of mathematics in their native countries, but even for those students, lack of proficiency in the English language impacted their ability to communicate their mathematical understanding and be active participants in class. As a result, the scheduling of ESOL students was a complicated process that involved discussions among ESOL teachers, ESOL resource teachers,[4] and counselors. ESOL Level 1 students typically took all of their nonelective classes with ESOL teachers who paid special attention to their language learning needs. By the time students reached an intermediate level of proficiency (ESOL 3) they were scheduled in some content classes with non-ESOL peers. ESOL Level 5 students typically took only their English class with an ESOL teacher and took all of their other classes with non-ESOL peers. This process allowed students to progress from a more sheltered instructional approach to a more inclusive setting as their language proficiency and cultural awareness[5] improved.

During the 2002-2003 school year, this researcher was a school-based ESOL specialist in a high school in the District under study. Previously, the researcher worked as an ESOL teacher at the high school level. In this capacity the researcher was able to

[4] ESOL resource teachers served as the supervisors for the department. Each high school in the District with an ESOL program had an ESOL resource teacher who was also a member of the school's leadership team.

[5] ESOL students typically face having to learn the English language at the same time as they are adjusting to the American culture.

see the impact of the District initiative on ESOL students directly. Once it was determined that all students were required to complete Algebra 1 in the ninth grade, schools stopped offering the MAPS course as an option. The scheduling of ESOL students in mathematics became a frustrating process for school staff as all students were scheduled into Algebra 1 regardless of their language proficiency or previous course work in mathematics. Schools attempted to meet the mandate by having all of the ESOL students in sheltered Algebra 1 classes, but mathematics teachers who were faced with District curriculum and assessments were often frustrated with the lack of English and mathematical proficiency of these students.

It was during these early years in the implementation process that the researcher became interested in understanding the school system's expectations regarding mathematics pathways and their impact on all students. In particular, the researcher asked herself,

> Is it possible that the school system saw too many students being denied access to Algebra 1 until the 10^{th} grade and wanted to promote access to all students? Were students enrolled in remedial pre-algebra type courses when they should have been enrolled in Algebra 1? Did courses such as MAPS serve as a valuable place for students to build on their knowledge and skills before tackling the content of Algebra 1? Or were these courses dumping grounds where students were tracked and denied access to Algebra 1?

The purpose of this case study was to investigate those questions by analyzing implementation of the strategic initiative[6] requiring 100% of students to successfully complete Algebra 1 or a higher level mathematics course by the end of ninth grade.

Research Questions

The historical case study reported in this dissertation focused on two specific questions about the District algebra-for-all initiative:

1. How did the District's Algebra 1 strategic initiative evolve between the 2002-2003 and 2013-2014 school years?

2. How did secondary mathematics teachers and the larger school system community respond to the Algebra 1 strategic initiative between the 2002-2003 and 2013-2014 school years?

One focus of this case study was to conduct a historical study to review and analyze the District's responses to the various effects of the Algebra 1 strategic initiative as it evolved. Although the initiative initially targeted students in the ninth grade, successful completion of Algebra 1 quickly became an expectation for eighth-grade students. During the period in question (2002-2003 through 2013-2014) there were several revisions of the District's Algebra 1 curriculum, a change in the assessment used to measure mathematical proficiency at the state level, and questions involving the significance of the District's semester examination. Eventually the District received so much criticism from the community that it created two different workgroups to study the issues related to the implementation of the Algebra 1 strategic initiative and course semester examinations. The first workgroup, K-12 Mathematics, was initially convened

[6] The school system set expectations by identifying targets and data points in its strategic planning documents. The superintendent and board of education discussed the system's progress and the progress of individual schools in meeting these targets. Due to the fact that there was never an official policy tied to these expectations, the term strategic initiative is being used to describe the school system's expectations.

in January 2009 and the second, Math Semester Final Exam, in July 2013. This study provides a chronological review of key events in the implementation of these initiatives to determine if there are any policy implementation lessons to be learned.

Another aim of this case study was the identification of differences in perspectives of secondary mathematics teachers with regard to the ongoing implementation of an Algebra 1 strategic initiative. Extending the expectation of success in Algebra 1 to all students presented teachers with a challenge to reach students who in the past had not demonstrated aptitude for or interest in such advanced mathematics. So it seemed they needed new instructional strategies that would be effective for students with a wide range of abilities. Nevertheless, advocates of algebra-for-all have argued,

> Algebra has been too often misunderstood and misrepresented as an abstract and difficult subject to be taught only to a subset of secondary school students who aspire to study advanced mathematics; in truth, algebra and algebraic thinking are fundamental to the basic education of all students. (Burke, Erickson, Lott, & Obert, 2001, p. 1)

James Choike, who served as the chair of the National Mathematics Committee for The College Board's *Equity 2000*[7], suggested that algebra essentially involves just a few conceptual themes or big ideas, and by focusing instruction on these few big ideas, two important instructional goals are accomplished: First, all students understand how a topic they currently are learning connects to material previously learned; and second, it provides a conceptual framework for teaching a high-standards course without being bound to follow the text one section after another (Choike, 2000). What teachers

[7] *Equity 2000* is an algebra-for-all school reform project of the College Board.

believed about the content of an Algebra 1 class, how it should be taught, and to whom it should be taught were critical to forming their response to the initiative.

Overview of Research Strategy

To ensure maximum validity and reliability the researcher identified multiple data sources to be used to investigate each research question. Table 2 shows that both quantitative and qualitative data sources were used to answer each of the research questions.

Table 2. *Triangulation of Data Sources*

Research questions	Data sources	
	Qualitative	
How did the District's Algebra 1 strategic initiative evolve between the 2002-2003 and 2013-2014 school years?	Historical documents (strategic planning documents, memorandum, research reports, Board of Education meeting minutes) Work group reports Public or media reports	
	Quantitative	**Qualitative**
How did secondary mathematics teachers and the larger school system community respond to the Algebra 1 strategic initiative between the 2002-2003 and 2013-2014 school years?	Survey results	Phone interviews Interviews E-mails Postings on district discussion forum

This case study looked at a school district initiative focused on improving access to Algebra 1 for all students a decade after its implementation (2002-2003 through 2013-2014). In addition to reviewing District documents, this study involved analysis of survey data collected from secondary mathematics teachers in 2009, 6 years after the policy was initially implemented. The survey solicited teacher perspectives regarding their level of support for the initiative. The study also provided information regarding the perceived impact of the initiative on students and student achievement. Specifically, the research examined teacher resistance or acceptance to policy change by looking at external and internal factors impacting their responses to policy reform efforts.

External factors that impacted teacher attitudes toward change included time, school culture, resources, support structures, levels of collaboration, curriculum, accountability, and teachers' years of experience. Internal factors that impacted teacher attitudes toward change included understanding of goals, amount of change required, pace of change, beliefs about the change required, lack of models, teacher identity, beliefs about student ability, beliefs about the best interests of students, disposition, autonomy, level of engagement, motivation, understanding of teacher roles, feelings of loss, and stress or teacher vitality.

In Chapter 2, the researcher provides a detailed review of the literature connected to teacher resistance or acceptance of policy change or reform. A conceptual model using the available research is detailed in Chapter 3; the model was used in coding and analyzing qualitative data.

Significance of the Study

There is a long history of debate around mathematics standards, reform efforts, and accountability. This research identified ways that national expectations and context drive local implementation of mathematics reform efforts and identified the external and internal factors that impact teachers' acceptance or resistance to policy implementation at the local level. This research also adds to the body of knowledge about acceptance and resistance to policy implementation efforts.

This case study involved the analysis of documents to provide a chronological perspective, assess the current state of the District's mathematics reform, and determine the District’s readiness to implement the Common Core Curriculum. The school system in question has continued to struggle with meeting the needs of all students in Algebra 1. Therefore, the results of this case study will be useful to the District’s leaders as they include the compilation and analysis of a decade’s worth of data specific to Algebra 1.

Chapter 2: Literature Review

The education of students in secondary mathematics has been a critical topic in the United States. For decades, school systems have considered ways to implement national standards and expectations, respond to state-level accountability systems, and provide a meaningful secondary mathematics program that meets the needs of all students. Understanding mathematics policy and reform is a complex undertaking that involves the perspectives of a variety of stakeholders with deeply rooted beliefs about how to best educate students in secondary mathematics. The broad purpose of this research was to conduct a historical case study of one large and diverse school system's attempt to increase student achievement by implementing an algebra for all strategic initiative within a larger context of state and national standards, expectations, and accountability. The study focused on (a) how the strategic initiative evolved between the 2002-2003 and 2013-2014 school years and (b) how the community and secondary mathematics teachers responded to the initiative between the 2002-2003 and 2013-2014 school years.

Thus, in the design of data collection, data analysis, and interpretation of findings the researcher drew on literature related to the history of math reform, the development of national mathematics standards, the achievement gap, student achievement research, student attitudes toward algebra, and teacher efficacy. In addition, the literature related to policy implementation, the impact of teachers' career stage, accountability, professional development, and acceptance or resistance of policy implementation was reviewed.

Success in mathematics is important for students because it gives them college and career options, and it increases prospects for future income. A

> strong grounding in high school mathematics through Algebra II or higher correlates powerfully with access to college, graduation from college, and earning in the top quartile of income from employment. (National Mathematics Advisory Panel, 2008, p. xii)

The final report identified the significance of algebra, noting that the "falloff in mathematics achievement in the U.S. begins as students reach late middle school, where, for more and more students, algebra course work begins" (National Mathematics Advisory Panel, 2008). Algebra is seen as a gateway to later achievement and provides access to higher levels of mathematics and science. Addressing issues related to mathematics achievement at a national level is important to the wellbeing of the nation because "a large fraction of the current science and engineering workforce will be retiring." In addition, "growth in employment in science and engineering occupations tripled that in other occupations" and due to demand "the United States has imported a great volume of technical talent from abroad" (National Mathematics Advisory Panel, 2008, pp. 1-3).

History of Mathematics Reform

According to Woodward (2004), three themes in mathematics education since the 1950s have impacted mathematics reform: sociopolitical forces, trends in mathematics research, and the evolution of theories of learning and instruction. During the 1950s and 1960s there was extensive federal funding for research and training in mathematics because of the importance of mathematics in the development of atomic weapons in the 1940s and the reaction to the Soviet launch of Sputnik in 1957. The social and political forces of the time created an outcry for more rigorous mathematics education in response to a national security need. Programs were developed to identify the most talented students in mathematics and science so that they might be educated to a high level. This wave of reform, the *new math*, focused on the education of elite students with high levels of mathematical capability who were heading to college to study in technical or scientific fields. As a result, a number of federally funded, university-based curriculum reform projects were created that emphasized instruction in abstract mathematical concepts.

The *new math* was an attempt to introduce a formal understanding of mathematical principles and concepts. Although the instructional theory used in mathematics during the 1950s and early 1960s was an outgrowth of behaviorist pedagogy, which involved rote practice and memorization, the new math of the late 1960s was primarily about understanding versus manipulation of symbols. A key feature of this approach to math instruction involved students' analyzing mathematical problems while identifying and understanding significant patterns and structures in the problems. Instruction was organized around analysis of relationships, reorganization of knowledge, and discovery learning that allowed students to work in small groups. The goal of instruction was to ensure that highly capable students were able to explain the "why" as well as the "what" of mathematics. During this time, Piaget's theories of learning and Bruner's work in educational psychology also were influential in mathematics reform and the movement toward more abstract thinking. The new math of the 1960s floundered for a number of reasons, not the least of which was the abstract nature of the reformed mathematics curricula at the elementary school level. The lack of professional development for K-12 teachers also played a role in its demise. Teachers faced a situation in which they needed to reconceptualize their own understanding of mathematics; this phenomenon ultimately resulted in instances of failure in the implementation of the new curricula (Woodward, 2004). In 1975, the National Committee on Mathematics Education (NACOME) stated that teachers, administrators, and parents should not allow themselves to be manipulated into making false choices between (a) the old and the new math, (b) skills and concepts, (c) the concrete and the abstract, (d) intuition and formalism, (e) structure and problem solving, and (f) induction and deduction. NACOME suggested that every mathematics program should contain a combination of all of these elements (Confrey, 2007, p. 11). Despite these recommendations, in the late 1970s and early 1980s there was once again a shift in mathematics reform. The failure of the new math led to a back-to-basics movement that placed the teacher as the dominant figure in the classroom. In addition, there was an increased importance of standardized assessments as a means of evaluating the quality of education and holding schools accountable. During this time, instruction was delivered to whole classes of students, it moved quickly, and a progression of step-by-step processes was used to derive the correct answer. Generally, this was a period when the emphasis was on ensuring that all students met minimum standards in mathematics, while programs such as Advanced Placement and International Baccalaureate served the needs of elite students. Concerns about the behaviorist rote instruction of mathematics, similar to those concerns in the 1950s and 1960s that led to the creation of the new math, resurfaced; by the mid-1980s cognitive research became the dominant framework in mathematics reform, leading to a shift back to conceptual learning.

Once again the relationship and balance between formal (procedural and behaviorist) and informal (conceptual, cognitive, and constructivist) understanding of mathematics were being debated in the mathematics community, specifically, the relationship between content and pedagogy. Klein (2003) presented an analogy, asserting that, ideally, there should be no more "conflict between one's right foot and left foot. They should work in tandem toward the same end, and avoid tripping each other. The trouble comes with the first step. Do we lead with the right foot or the left?" (Klein, 2003, p. 2). If content comes first, pedagogical choices are limited to focusing instruction on concentrated content and do not provide sufficient time for student-centered discovery learning. If pedagogy comes first, however, the amount of content that can be presented to students is limited.

In the 1980s, the mathematics reform pendulum swung once again, as an effort to reemphasize meaning and the role of conceptual mathematics coincided with statements published in *A Nation at Risk*, which was critical of the back-to-basics movement. Around this time NCTM published several important documents, including *An Agenda for Action* in 1980 and *Everybody Counts* and *Curriculum and Evaluation Standards* in 1989. Primarily, the NCTM documents called for new ways of teaching and new directions in mathematics education. The technological advances of the time, such as graphing calculators, radically reduced the demand for some paper-and-pencil techniques. The NCTM standards were intended to create mathematically literate workers, encourage lifelong learning, provide opportunities for all, and support an informed electorate (Confrey, 2007, p. 13). These standards drew heavily on research about student thinking, student misconceptions, and the ways in which students learn particular ideas as they encounter challenging tasks. They warned against relying heavily on memorization and procedural understanding and instead stressed conceptual understanding, because research had found that students were not able to provide reasons and explanations to support their thinking (Confrey, 2007, p. 14). The SCANS report, Goals 2000, development of the Internet, disenchantment with standardized tests, and a call for more rigorous student outcomes pointed to a need for America's conversion from a postindustrial to an information economy. In many states this need led to the development of performance-based assessments and content-area standards in mathematics that were derived directly from the 1989 NCTM standards (Woodward, 2004, p. 22).

The timeline depicted in Figure 1 illustrates how movements in mathematics instruction and sociopolitical conditions have worked in tandem to shape the history of mathematics reform. In essence, the history of mathematics education can be told as a series of crisis pronouncements that are followed by reform proposals that were often weakly implemented, and then reacted to in the opposite direction. Since the 1950s there have been several pendulum shifts regarding what math to teach, how to teach it, and how should make those decisions. NCTM took the lead in determining what to teach by developing national standards for mathematics in the United States.

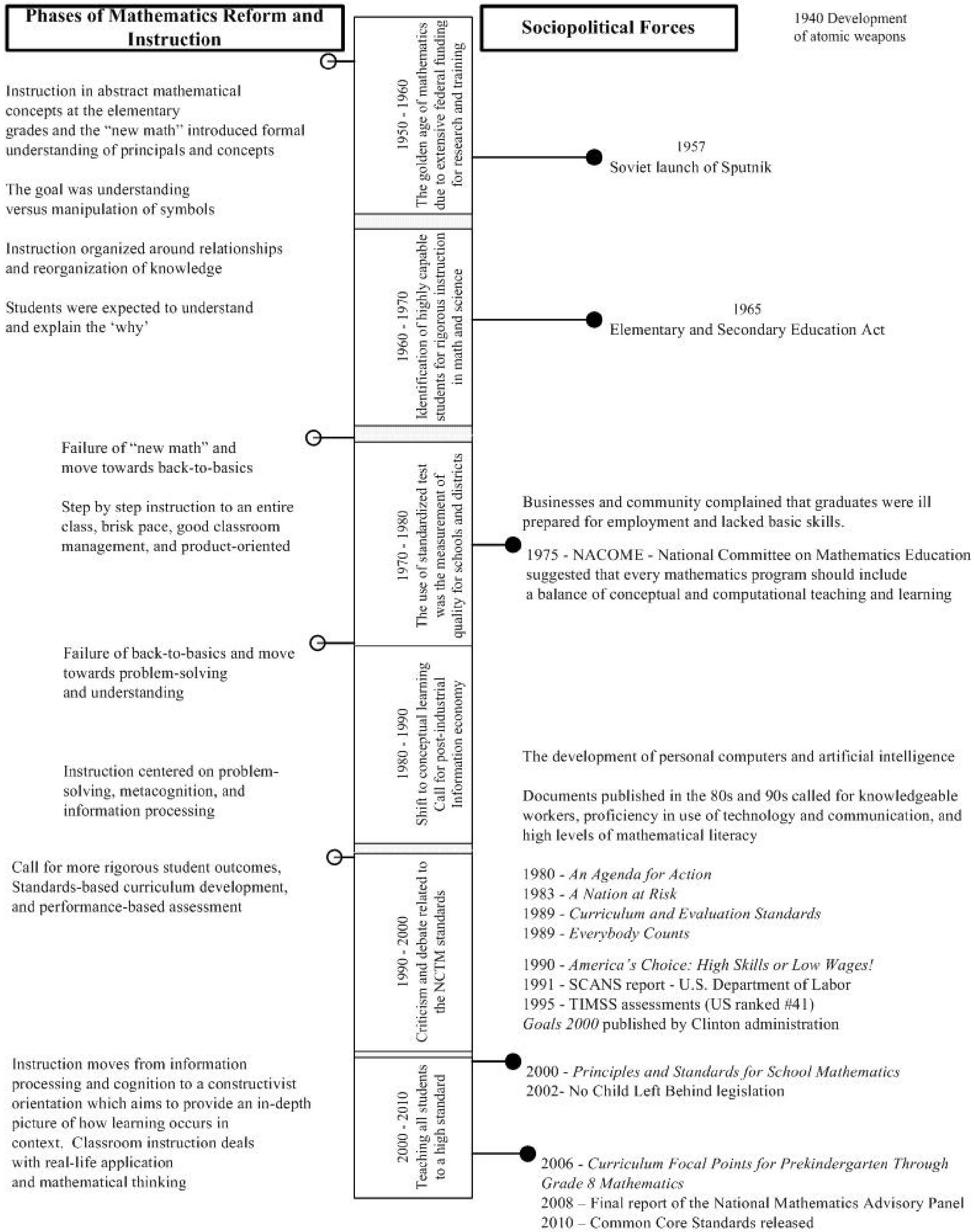

Figure 1. Phases of mathematics reform, instruction, and sociopolitical forces.

National Mathematics Standards

As a major national standard-setting body, NCTM technically and empirically determines the factors that (a) produce the best outcomes, (b) guide practice most effectively, and (c) can be mastered by practitioners. This process has involved NCTM's setting initial standards and making appropriate adjustments in response to feedback. The concept of standards development has evolved from an authoritarian proclamation to agreement within the context of measurement to a negotiated and political consensus that permits other kinds of innovation and progress to proceed (Confrey, 2007, p. 7). In the past 25 years, the United States as a nation has progressed from no standards to multiple sets of standards, with each standard being created with the belief that it promotes student learning. The NCTM standards, in addition to spurring the development of standards in other content areas, profoundly influenced the teaching and learning of mathematics. Nevertheless, they have not been free from criticism.

The NCTM standards were criticized as being elitist, too difficult to implement, devoid of a research foundation, too vague, too obscure and broad, too wedded to a specific pedagogy, without clear measurable criteria, and representative of discovery-oriented constructivism. Those opposed to the NCTM standards believed they were not really standards but NCTM's attempt to recast its own agenda under the label of standards (Klein, 2003, p. 11). Public resistance to mathematics programs based on the NCTM standards focused on the following assertions: (a) the programs failed to develop fundamental arithmetic and algebra skills; (b) the programs encouraged calculator use to excess; (c) guidelines for discovery group projects were at best inefficient and often aimless; (d) topics from statistics and data analysis were overemphasized and redundant from one grade level to the next; (e) some programs did not provide books for students, as they might interfere with student discovery (Klein, 2003, p. 19). Those who were critical of the NCTM-aligned curricula were portrayed as proponents of basic skills, whereas supporters were portrayed as proponents of conceptual understanding and higher order thinking.

In the mid-1990s, NCTM responded to some of the criticism of the 1989 standards, revising the standards with regard to the role of basic facts, memorization, use of technology, and pedagogy. NCTM published *Principles and Standards for School Mathematics*, following a collaborative and detailed process of gathering feedback from various constituencies. With the new publication, NCTM again faced criticism on new fronts. The following questions were posed:

> Should standards incorporate grade level rather than grade band specificity? How many standards should there be, and at what level of detail? Should pedagogy be included, or left to the practitioners to decide? How aggressive should standards be in relation to those of other countries? Should the strands of content, algebra, geometry, trigonometry, probability and statistics be integrated or kept distinct? Are calculators undercutting mathematical maturity or are they obligate tools of the trade? (Confrey, 2007, p. 25)

Criticisms of the research underpinnings of the NCTM standards and math reform began with a new force (Woodward, 2004). University professors, teachers, administrators, parents, and the larger community all had various views with regard to the standards.

The NCTM has found that state mathematics curriculum documents vary along several dimensions including the level of specificity of learning expectations, language used to convey learning outcomes, and grade placement of particular learning expectations. The NCTM report published in 2006, *Curriculum Focal Points for PreKindergarten through Grade 8 Mathematics*, identified three topics to be covered at each grade and described connections between the topics. To promote effective practices, the NCLB legislation called for scientifically based research principles; those opposed to the NCTM standards began calling for research into effective mathematics instruction with a possible shift back to a stronger focus on computational instruction. The idea that children should be taught as their parents were taught resonates with parents, most teachers continue to use textbooks and teach as they were taught, and some believe that the achievement gap in mathematics can best be addressed by advocating more explicit instruction that would serve impoverished children's needs better (Confrey, 2007, p. 22). Some agreements have been reached: There is consensus that statistics is significant in mathematics education, that technology in the form of graphing calculators plays a key role, and that automaticity in number facts remains critical to mathematical proficiency and cognitive ease (Confrey, 2007, p. 29). There is growing consensus that a combination of both computational and conceptual components is needed for effective mathematics instruction; nevertheless, the possibility remains for the mathematics reform pendulum to swing in favor of either conceptual and constructivist or procedural and behaviorist frameworks for mathematics reform.

Areas that are still being debated include content priorities and the level of rigor to be expected of students. Mathematics pathways are also a topic of debate. Due to the range of fields that require mathematical competence, some educators argue that the current design of secondary mathematics, which leads all students toward calculus, is flawed and narrow. Moreover, concerns exist regarding the use of the NCTM standards in meeting the needs of diverse students. Some educators believe that a diverse student body might be better served in a system with more alternative paths and careful attention to stimulating students' interest and engagement (Confrey, 2007, p. 36).

Confrey posed several questions: (a) Are we making progress fast enough? (b) Are the standards successfully serving the different needs of different populations of students? (c) Do the standards permit us to provide teachers with the necessary instructional guidance? (d) Are teachers provided adequate professional development to improve instruction? (Confrey, 2007, p. 42). In contrast to the controversies of the 1970s and 1980s, proponents of varying perspectives regarding mathematics education have become more sophisticated by employing media, private sources of funding, and political channels for communication. These debates are no longer simply about what should be in the standards, but who should possess the authority to make the decisions, which stakeholders are heard, and definition of the role of outside organizations, foundations, and the media (Confrey, 2007, p. 23).

In May 2006, the 17 members of the National Mathematics Advisory Panel were charged with identifying national strategies for improving student performance in mathematics. The panel's purpose was to explore math teaching and learning from basic math to calculus, with a focus on algebra. Educators and researchers who once disagreed about the balance between conceptual and computational instruction in mathematics have come to the general agreement that students need a balance between knowing number facts and basic procedures and having an abstract and broader understanding of math concepts. Confrey wrote, “We are increasingly able to craft language of mathematics learning that incorporates both content and pedagogy in a more integrated way. Mathematics is not solely about exhibiting performances to produce correct answers; it is a language of explanation, justification, and sense-making” (Confrey, 2007, p. 40).

In 2008, the final report of the National Mathematics Advisory Panel was published. The report stated that it is “fundamental to recognize that the safety of the nation and the quality of life—not just the prosperity of the nation—are at issue” and that societies with capable mathematicians can have “advantages in medicine and health, in technology and commerce, in navigation and exploration, in defense and finance, and in the ability to understand past failures and to forecast future developments” (National Mathematics Advisory Panel, 2008, p. xi). The panel reported that there were genuine opportunities for improvement in mathematics education in the United States. The report identified six elements that needed to be addressed to improve the mathematical education system:

- The mathematics curriculum in Grades PreK-8 should be streamlined and should emphasize a well-defined set of the most critical topics in the early grades.
- Use should be made of what is clearly known from rigorous research about how children learn, especially by recognizing a) the advantages for children in having a strong start; b) the mutually reinforcing benefits of conceptual understanding, procedural fluency, and automatic recall of facts; and c) that effort, not just inherent talent, counts in mathematical achievement.

- Our citizens and their educational leadership should recognize mathematically knowledgeable classroom teachers as having a central role in mathematics education and should encourage rigorously evaluated initiatives for attracting and appropriately preparing prospective teachers, and for evaluating and retaining effective teachers.
- Instructional practice should be informed by high-quality research, when available, and by the best professional judgment and experiences of accomplished classroom teachers. High-quality research does not support the contention that instruction should be either entirely "student centered" or "teacher directed." Research indicates that some forms of particular instructional practices can have a positive impact under specified conditions.
- NAEP and state assessments should be improved in quality and should carry increased emphasis on the most critical knowledge and skills leading to algebra.
- The nation must continue to build capacity for more rigorous research in education so that it can inform policy and practice more effectively.

  (National Mathematics Advisory Panel, 2008, pp. xiii-xiv)

The report also outlined concrete findings and recommendations in the areas that were researched by task groups. The areas identified by the panel were curricular content, learning processes, teacher and teacher education, instructional practices, instructional materials, assessment, and research policies and mechanisms.

The ultimate goal in mathematics education is to improve learning outcomes for students. Both the history of mathematics education and national standards development show how attempts have been made to improve student access and achievement.

Achievement Gap

Historically, lack of access to higher mathematics has served as a means of tracking students as well as a gatekeeper for admission to higher education. Early access to algebra is a prerequisite for enrolling in higher mathematics and therefore "algebra-for-all" has become a catchphrase for educational reformers. Traditionally, the high school mathematics curriculum sorts ninth-grade students into courses such as general math, pre-algebra, algebra, and geometry. These courses make different levels of knowledge available to students, and they lead students in different directions for subsequent years. Students who are initially assigned to college-preparatory courses such as algebra and geometry not only learn more but they are also more likely to seek postsecondary degrees and pursue higher mathematical studies (Gamoran & Hannigan, 2000, p. 241).

Across K-12 education there has been a consistent achievement gap between White and Asian students and their Black and Hispanic peers. Byrnes (2003) conducted a study designed to provide insight into ethnic differences in 12th-grade math achievement. The researcher reviewed commonly cited explanations for the achievement gap in mathematics: (a) unequal access to quality schools; (b) within-school bias in the assignment of students to academic tracks; (c) within-classroom disconnects between teacher and students; (d) differences due to home environment, parent education, beliefs, expectations, and home environment; and (e) differences in aptitude or expertise.

The 1992 NAEP included data from 318 high schools and 9,499 students. The students responded to questions about themselves, their home lives, classroom practices, prior coursework, attitudes towards math, and ability in math as measured in the five main areas of mathematics (numbers and operations, measurement, geometry, data analysis and statistics, and algebra and functions). Byrnes (2003) compared data from White, Black, and Hispanic students, using hierarchical linear models to determine if ethnicity explained additional variance in math performance. The results indicated that nearly 50% of the variance in 12th-grade mathematics performance could be linked to indicators of socioeconomic status (parent education), exposure to learning opportunities (high school programs, course work, calculator use, and worksheet frequency), and motivational aspects of math (positive perceptions of one's own ability and use of math) (Byrnes, 2003, p. 325). Although educators cannot address parent education, the remaining factors easily can be addressed. The study found a correlation showing that student proficiency would be 27 points higher if there were an increase in one of the following variables: additional algebra and calculus courses, additional geometry and trigonometry courses, more frequent calculator use, less frequent worksheet use, stronger agreement with items related to math ability and math liking, and stronger disagreement with the claim that math is mostly memorizing facts (Byrnes, 2003, p. 325).

Ding and Davison (2005) studied 716 individual students in a single school district to examine longitudinal growth patterns of student math achievement between 1997 and 2000. The central research questions addressed in the study were (a) What math growth or achievement patterns should be expected from elementary and middle students? and (b) How do math achievement patterns differ between students receiving special services such as special education and English for speakers of other languages (ESOL) and students not receiving these services? (Ding & Davison, 2005, p. 84). The data analyzed in the study included school mathematics test results from the Stanford Achievement Test, 9th edition (SAT-9), administered to the same students between 1997 and 2000. Over the 4 years, the average scaled scores reflected an increase in mathematics achievement for each cohort. The researchers found a significant difference between the student subgroups with regard to their initial SAT-9 levels due to the fact that students receiving special services had significantly lower initial achievement scores than their counterparts; however, the mean growth rate for these students did not differ significantly from the rate of their peers who were not receiving special services. As the students receiving special services started at a lower achievement level than their peers, they would have needed to achieve a faster growth rate to catch up (Ding & Davison, 2005, p. 92). All student groups, regardless of initial achievement, made similar progress with regard to growth over time; a concern of the researchers was that students who initially scored lower on the SAT-9 were not able to catch up to the achievement of their peers (who had initially scored higher on the SAT-9) (Ding & Davison, 2005, p. 94).

As educators consider the impact of access and the achievement gap on students who are racially or ethnically diverse or receiving special services, they also need to consider how the beliefs of teachers impact student achievement.

Student Achievement Research

Gamoran and Hannigan (2000) conducted research to determine the benefits of an algebra-for-everyone reform regardless of the students' prior math performance. Although algebra is a graduation requirement in most states, there is usually no requirement to take algebra early rather than later in high school. Ninth-grade students are sorted into mathematics courses such as general math, pre-algebra, algebra, and geometry based on their mathematics experiences in middle and elementary school. Not only do these courses make different knowledge available to students, but they also lead students in different directions for subsequent years:

> Unequal access to college-preparatory mathematics is a persistent problem that begins at high school entry or even earlier, as fast-track students gain access to higher level mathematics in elementary or middle school, while their low-track counterparts either wait years for algebra or never enroll at all. (Gamoran & Hannigan, 2000, p. 242)

To determine the contribution of algebra to increased cognitive skills among students who differed in their prior preparation, the researchers used the National Educational Longitudinal Study (NELS) data. The NELS study followed students who were eighth graders in 1988 to their tenth-grade year in 1990. The sample represented more than 1,000 schools and 12,500 students. The 10^{th}-grade achievement of students was measured with a 40-item multiple-choice assessment. Researchers identified students who had no algebra, those who took algebra in the ninth or tenth grade, those who took algebra in the eighth grade, and those who took algebra in both eighth grade and high school. Gamoran and Hannigan reported,

> Although achievement growth is evident for each category, the average levels of growth range from less than four points among those who took no algebra to about eight points in the other three categories. Differences in achievement growth between those who did take algebra and those who

> did not are much greater than the differences among those who took algebra at different points in time. (Gamoran & Hannigan, 2000, p. 246)

In short, taking algebra in eighth, ninth, or tenth grade contributes positively to student achievement:

> The benefits of taking algebra in high school are weaker for students whose initial scores were at the 20th percentile or lower. Still, the weaker effects for students at the low end of the achievement distribution do not cancel out the benefits altogether; such students still gain more than students who do not take algebra at all. (Gamoran & Hannigan, 2000, p. 246)

The study concluded that all students benefit from taking algebra in high school. There are several possible reasons for the smaller gains of lower achieving students enrolled in algebra. First, students may have less capacity to learn the academic content of algebra. Second, these students may have been placed in watered-down versions of algebra with weaker curriculum and instruction; this practice represents tracking, both across and within subjects. Third, instruction in regular algebra classes is not well suited to all students. Instruction that focuses on memorization and procedures may be advantageous to students who are adept at these skills. Fourth, there may be a widely held belief among teachers of mathematics that low-achieving students are not capable of studying algebra. Finally, the teachers who teach these students may not be proficient in either the content or pedagogy of algebra. Although students at the lower end of the achievement distribution gain less than others, they still benefit in comparison to students who do not take algebra in high school. Gamoran and Hannigan asserted, "It is essential to maintain quality in algebra courses as the population of algebra-takers expands and becomes more academically diverse" (Gamoran & Hannigan, 2000, p. 251).

Stone (1998) conducted a study to determine if access to certain college preparatory mathematics courses was denied (through course enrollment) to students from certain segments of society. Specifically, race, gender, socioeconomic status, and school assignment were considered. The researcher viewed typical paths that provide access to higher level mathematics for ninth-grade students as stratifiers, contributing to the reproduction and perpetuation of the existing social order and arbitrarily depriving students of valuable learning experiences. While controlling for academic ability, this study compared two groups of students—those who had and those who had not been given access to Algebra 1 or geometry. The 1993 standardized Comprehensive Test of Basic Skills (CTBS) was used to control for academic ability; this assessment was given throughout the United States in second through 10^{th} grades. The research population consisted of students in the ninth grade in 1994. The study was conducted with 16 high schools in a large urban school system with a total student population of more than 120,000 students. Students were chosen who scored within the upper quartile on the 1993 eighth-grade CTBS test in mathematics computation, mathematics concepts and applications, or total mathematics. Of the 7,745 students whose records were examined, 1,611 met the required mathematics proficiency as determined by their CTBS scores. The demographic makeup of the students included 835 females and 776 males. With regard to race or ethnicity, the group included 242 Black, 88 Asian, 32 Hispanic, 4 Native American, and 1,245 White students.

Of the 1,611 students, 433 (27%) were denied admission to the gatekeeping mathematics courses. Stone wrote, “In this study, school assignment, socioeconomic status, and the combination of gender and socioeconomic status were found to be significantly related to students’ placement into gatekeeper mathematics” (Stone, 1998, p. 299). The variables of race and gender were not found to be statistically significant in determining access to college preparatory mathematics courses. Low-socioeconomic students were three times more likely to be denied admission to gatekeeper mathematics courses than were high-socioeconomic students. School assignment also played a role in determining which students had access to higher level courses in high school. Of the 16 high schools in the district, 8 were significantly more likely to schedule students into algebra or geometry, and 3 schools employed practices that positively and significantly promoted admission into higher level mathematics. The characteristics of schools most likely to promote admission into higher level mathematics for students were the following: (a) the faculty viewed their student body as members of society for whom educational opportunities were inequitably provided, (b) the school personnel and community expressed a determination to give their students wider options and opportunities by encouraging them to enroll in higher level mathematics, (c) support was offered to students who were struggling with mathematics, (d) students understood that they could enroll in a higher level math course even if they did not meet the objective entrance requirements, and (e) schools were recognized as having progressive and forward thinking leadership (Stone, 1998, pp. 303-305).

Because ability alone does not guarantee appropriate placement and access, reforms aimed at detracking and providing access to higher level mathematics will not be successful if educational institutions fail to engage their educators in a process of confronting the real problems of detracking, which are difficult to solve (Stone, 1998, p. 306). In summary, this study found that educational opportunities were neither equally available to all students nor determined by a student's previous educational achievement, but were impacted by a student's school assignment and socioeconomic status.

An investigation of teachers' beliefs conducted by Nathan and Koedinger (2000) examined the relationships among algebra teachers' judgments, actions, and beliefs. Previous studies had found that teachers' interpretations and implementations of mathematics curricula were influenced by their knowledge and beliefs about instruction and student learning (Nathan & Koedinger, 2000, p. 210). The study was designed to look specifically at the relationship between teachers' beliefs and student reasoning and problem-solving behaviors with regard to start-unknown versus result-unknown and verbally presented problems versus symbol equations. Typically, start-unknown (algebra) problems are considered to be more difficult than result-unknown (arithmetic) problems. Table 3 presents an example of a verbal start-unknown problem and an example of a result-unknown problem.

Table 3. *Start-Unknown and Result-Unknown Verbal Problems*

Start-unknown (algebra)	Result-unknown (arithmetic)
When Ted got home from his waiter job, he multiplied his hourly wage by the 6 hours he worked that day. Then he added the $66 he made in tips and found he earned $81.90. How much per hour does Ted make?	When Ted got home from his waiter job, he took the $81.90 he earned that day and subtracted the $66 he received in tips. Then he divided the remaining money by the 6 hours he worked and found his hourly wage. How much per hour does Ted Make?
Solve for *X*	Solve for *X*
X x 6 + 66 = 81.90	(81.90-66) / 6 = X

(Nathan & Koedinger, 2000, p. 212)

In the study conducted by Nathan and Koedinger (2000), the data revealed that high school mathematics teachers considered the easiest problems for students to solve to be arithmetic symbol equations, followed by algebra equations and arithmetic story problems, with the most difficult problems for students being algebra story equations. Nevertheless, Nathan and Koedinger suggested the possibility that verbal problems are easier for students to solve than symbolic problems because such problems are more likely to elicit informal strategies and alternative problem-solving solutions. A belief instrument that included constructs directly examining teachers' alignment with either the symbol-precedence or verbal-precedence view of algebra development was used to examine teachers' beliefs about the difficulty of algebra problem solving and to investigate how general beliefs about mathematics teaching and student learning influence teachers' judgments.

A total of 105 K-12 mathematics teachers who had completed an obligatory school-district-sponsored workshop were asked to rank order six mathematics problems from easiest to most difficult; in addition, they were given 20 minutes to rate the degree to which they agreed or disagreed with each of 42 statements, using a 6-point Likert[8] scale. These items were chosen because they addressed reform-based issues of pedagogical practice, mathematical learning and development, problem solving, and the role of algebra in mathematics. The results indicated that, in general, the 105 teachers in the school district agreed with reform views of mathematics similar to those presented by NCTM and opposed views that challenged reform-based views such as algebra is best,

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[8] The 6-item scale consisted of 1 (*strongly agree*), 2 (*agree*), 3 (*agree more than disagree*), 4 (*disagree more than agree*), 5 (*disagree*), and 6 (*strongly disagree*).

product over process, and the notion that alternative-solution methods indicate knowledge gaps (Nathan & Koedinger, 2000, p. 221). High school teachers as a group, however, were the least likely to agree with reform views and less likely to agree with the view that students can learn effective problem solving on their own. High school teachers were more likely to agree with the view that students' answers were more important than their problem-solving processes. In addition, high school teachers assigned as much credit to students' invented strategies as did their colleagues in middle and elementary school. High school teachers were also most likely to agree with the view that alternative-solution methods are indicators of weak skills or poor conceptual understanding (hardly any middle or elementary school teachers agreed with this view). High school teachers were more likely than their counterparts to agree with the view that algebra is the most effective method for solving problems involving unknown values. Finally, high school teachers were more likely than their colleagues to agree with the symbol-precedence view that arithmetic is always easier than algebra and that symbol-manipulation skills are a prerequisite to verbal problem solving.

Teachers' beliefs about the difficulty of start-unknown algebra problems were consistent with student performance data indicating that students have more difficulty accurately solving start-unknown algebra problems. Teachers also tended to rank verbal problems as more difficult than symbolic problems; however, this view was at odds with student performance data indicating that students solved verbal problems far more readily than symbol equations (Nathan & Koedinger, 2000, p. 224). This symbol-precedence view impacts teachers' judgments regarding students' mathematical development, instructional practices, and students' learning experiences. The study highlighted a dichotomy between teachers' beliefs and their practices. Although the majority of teachers generally agreed with a reform-based view of mathematical learning and instruction, they did not seem to be guided by these beliefs when they were judging how students would perform on a set of arithmetic and algebra problems. Almost all of the teachers in the study agreed that student-directed reasoning is an important component of mathematical ability, yet most teachers did not take these ideas into account when formulating their judgments about the difficulty of problems for students. Instead, teachers' rankings exhibited a symbol-precedence view of mathematical development that appears to be at odds with their views on the importance of students' reasoning abilities. There are several possible reasons that teachers' professed beliefs may not always match their instructional practices: (a) they may lack sufficient content knowledge, (b) they may have inadequate pedagogical knowledge, (c) their instructional decisions may be based on the way material is organized in mathematics textbooks, and (d) they may develop an "expert blind spot" in that they are more distant from the difficulties of their novice students.

Not only are teacher beliefs impactful in student achievement, but also are student beliefs, motivation, and characteristics. A challenge that has been faced by mathematics teachers is how to meet the needs of underperforming students.

Poor Student Attitudes Toward Algebra

To understand the perspectives of algebra teachers in the classroom, the National Math Panel conducted a survey of 743 active teachers of algebra. In responding to the challenges they face, the majority of teachers rated "working with unmotivated students" as the "single most challenging aspect of teaching Algebra 1 successfully" (National

Mathematics Advisory Panel, 2008, p. 9). Their second highest rated challenge was making mathematics accessible and comprehensible. In written responses they mentioned handling different skill levels in a single classroom. Issues pertaining to mathematics and algebra achievement are not new:

> Walter Colburn in a paper presented at the Assistant Masters Society in 1893 stated that "by the old system the learner was presented with a rule, which told him how to perform certain operations on figures, and when they were done he would have the proper result. But no reason was given for a single step…. And when [the learner] had got through and obtained the result, he understood neither what it was nor the use of it. Neither did he know that it was the proper result, but was obligated to rely wholly on the book, or more frequently the teacher. As he began in the dark, so he continued; and the results of his calculation seemed to be obtained by some magical operation rather than by the inductions of reason." (Wilson, 2003, p. 9)

Cline (1937) described his experiences with a group of students in a 1st-year algebra class at Louisiana Polytechnic Institute. Each of the students in his class had a background of chronic failure in school; most of them were enrolled in the algebra class for a second time; the students had failed so frequently in school work that they had come to expect defeat; and they had been criticized and browbeaten by their teachers. Standardized tests indicated that these students were not significantly below the average level of intelligence of more successful students, and an analysis of the situation indicated to Cline that factors beyond intelligence were chiefly responsible. First, the students exhibited a lack of confidence in their own mathematical ability. Second, they reflected a consistent lack of satisfaction regarding their school experiences. Cline responded to the situation by simplifying the content of the algebra course to ensure that all of the students would be able to successfully accomplish the assigned tasks. Therefore, at the end of the class period the students perceived they had done a good job. Instruction in this class involved meticulously careful explanations, sufficient drill exercises, closely relating new content to previous lessons, and the liberal use of praise. As a result, Cline believed that he was able to provide the students with improved knowledge about algebra and improved attitudes toward schoolwork as a whole. He believed that "pupils who are chronic failures in their work need most of all to undergo a rehabilitation of their self-confidence and self-respect" (Cline, 1937, p. 22).

In the time since Colburn (1893) and Cline (1937) wrote about their experiences with low-achieving students in mathematics classrooms, there has been much debate about mathematics standards, computational versus conceptual learning, and the best pedagogical approaches to educating all students in mathematics. Nevertheless, many of their concerns are still relevant for students currently enrolled in mathematics and algebra classes across the United States.

> There are many gaps in the current understanding of how students learn algebra and the preparation that is needed before they enter algebra. What is known indicates that too many students in middle or high school algebra classes are woefully unprepared for learning even the basics of algebra. (National Mathematics Advisory Panel, 2008, p. 32)

Given that mathematics achievement may be impacted by both teacher and student beliefs, it is critical to consider how student achievement can be impacted by teacher actions.

Teacher Efficacy

Teacher efficacy has been defined as the extent to which a teacher believes that he or she has the ability to affect student performance (Tschannen-Moran, Woolfolk, & Hoy, 1998, p. 202). The concept of teacher efficacy was conceived by the RAND researchers in 1976.[9] Student motivation and performance were assumed to be significant factors impacting teaching behavior. Therefore, teachers with a high level of efficacy believe they can strongly influence student achievement and motivation. Self-efficacy beliefs influence how much effort people put forth, how long they persist in the face of obstacles, how resilient they are in dealing with failures, and how much stress or depression they experience in coping with demanding situations. It is critical to create situations in which teachers can talk honestly about their beliefs about students. The reality is that teachers may need to overcome negative beliefs about students:

> There is a notion that…different classes of people learn differently. Or we believe that some classes don't learn. People really believe that. They have these ongoing beliefs, and they may not even be aware of them until they've had to confront them. (Wilson, 2003, p. 82)

[9] The Rand researchers used Rotter's 1966 article "Generalized Expectancies for Internal Versus External Control of Reinforcement." Two items were added to a questionnaire that examined the success of various reading programs and interventions: (1) "When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment" and (2) "If I try really hard, I can get through to even the most difficult or unmotivated students" (Tschannen-Moran et al., 1998, p. 204).

Teacher instructional behaviors associated with high-efficacy beliefs are related to (a) the amount of effort a teacher expends in a teaching situation; (b) the persistence a teacher shows in the face of obstacles; (c) persisting with a student in a failure situation; (d) dividing the class for small-group instruction; (e) responding less critically to a student following an incorrect response; (f) being willing to conduct instructional experiments; (g) a willingness to try a variety of materials and approaches; (h) finding better ways of teaching; (i) implementation of progressive and innovative methods; (j) the levels of organization, planning, and fairness a teacher displays; and (k) enthusiasm for teaching (Tschannen-Moran et al., 1998). Various studies conducted in the past 30 years have pointed to a significant relationship between teacher efficacy and student achievement. As a follow-up to the two items in the RAND study, multiple instruments[10] were developed to measure teacher efficacy and its relationship to student achievement.

Teacher efficacy can be measured in terms of both personal teaching efficacy (PTE) and general teaching efficacy (GTE). PTE involves one's own feelings of competence as a teacher (I can), whereas GTE involves one's beliefs about teachers' general influence over external influences (teachers can). Teacher efficacy has been described as both context and subject-matter specific. Some research has focused on the level of specificity needed to appropriately measure teacher efficacy. For example, is efficacy specific to teaching mathematics, or more specific to teaching algebra, or even

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[10] The *Teacher Locus of Control (TLC)* is a 28-item measure developed by Rose and Medway in 1981. In the same year, the *Responsibility for Student Achievement (RSA)*, a 30-item measure, was developed by Guskey. The *Webb Efficacy Scale* was developed in 1982 by a group of researchers. The *Ashton Vignettes*, a 50-item measure, was developed in 1982. Gibson & Dembo developed the 30-item *Teacher Efficacy Scale* in 1984. The *Science Teaching Efficacy Belief Instrument*, a 25-item instrument, was developed in 1990 by Riggs & Enochs. *Bandura's Teacher Efficacy Scale* is a 30-item instrument.

more specific to teaching quadratic equations? In some studies, teachers' sense of efficacy changed based on the subject or group of students. School-level effects also have been identified in the research. Variables associated with efficacious schools include school climate, behavior of the principal, and sense of school community; decision-making structures also have been shown to impact teacher efficacy. Teachers' participation in the decisions that impact their work can positively impact teacher efficacy. Teachers who believe they have a greater influence in school-based decision making have a stronger sense of efficacy. In addition, greater opportunities for collaboration with other adults increase teachers' sense of efficacy. Secondary teachers have significantly higher self-efficacy when they perceive greater control over classroom and school policy. Mathematics and science teachers have significantly higher efficacy for honors and academic-track classes than for nonacademic classes. In general, teacher efficacy is context specific. Teachers feel efficacious in teaching particular subjects to certain students in specific settings, and they can be expected to feel more or less efficacious under different circumstances (Tschannen-Moran et al., 1998, p. 228).

Self-efficacy refers to a perception of competence rather than actual level of competence. People regularly overestimate or underestimate their actual abilities, and these estimations have consequences for the courses of action they choose to pursue and the effort they exert in those pursuits. Teacher efficacy is powerful because of its cyclical nature:

> Greater efficacy leads to greater effort and persistence, which leads to better performance, which in turn leads to greater efficacy. The reverse is also true. Lower efficacy leads to less effort and giving up easily, which

> leads to poor teaching outcomes, which then produce decreased efficacy. Over time this process stabilizes into a relatively enduring set of efficacy beliefs. (Tschannen-Moran et al., 1998, p. 234)

Once efficacy beliefs are established, they become resistant to change. One study (Ross, 1994) found that teachers who attended an "efficacy seminar" designed to increase their sense of efficacy had higher efficacy scores immediately following the seminar, but when efficacy was measured 6 weeks later the increases had disappeared. In addition, implementation of a reform or change initially has negative effects on teachers' personal efficacy, because raising standards challenges teachers' existing beliefs about the effectiveness of their teaching strategies. Teachers who were able to successfully implement new programs exhibited increases in self-efficacy, but those who were unsuccessful in their implementation attempts saw their level of self-efficacy decline (Tschannen-Moran et al., 1998, pp. 236-237).

In addition to challenging teachers' beliefs about the effectiveness of their teaching strategies, some reform efforts also may impact teachers' beliefs regarding students. A case study of pre-algebra teachers who began a reform effort in a professional community of high school mathematics teachers found that "teachers repeatedly expressed a common assertion that the students themselves were barriers to increased student learning" (Rousseau, 2004, p.793). The teachers described in the study expressed a desire to teach in reform-oriented ways aligned with the goal of NCTM and were a part of a supportive professional community. Nevertheless, even in the presence of a strong community, the teachers did not sustain their reform efforts. In "individual interviews and the shared discourse of the community, characteristics of students were often portrayed as the reasons for poor achievement and lack of understanding" (Rousseau, 2004, p. 793). When the teachers were presented with a video of an urban high school teacher successfully implementing the reform curriculum with a low-track math class, the teachers in the case study responded by suggesting that the students in the video were somehow different (i.e., better) than their students. These teachers could not be convinced that their own low-track students could engage in the same kinds of classroom activities and discussions associated with the reform effort. These high school mathematics teachers had expressed a desire to engage in reform and had volunteered to participate in the required professional development as evidence of their commitment to responding to student learning needs. According to Rousseau, however,

> the community showed no evidence of examining what they, as teachers, were doing and their own roles in the implementation. Their strategy was to give the students more time to adjust, to "come around to it." When this strategy failed to produce results, they placed the blame on the students and returned to a more traditional curriculum and set of classroom practices. (Rousseau, 2004, p. 794)

By placing blame on the students for the failure of the reform and arguing for a more skills-based approach, they were able to avoid acknowledging their role and beliefs about the teaching and learning of mathematics.

Given that teacher efficacy is contextual and can be impacted by outside forces, it is critical to consider how policy implementation can play a role in impacting teachers' actions, beliefs, and ultimately student achievement.

Policy Implementation

State legislatures typically exercise control in the areas of student standards, graduation requirements, teacher policies, certification requirements, monitoring, and alignment of tests and texts. "Educational reformers increasingly seek to manipulate policies regarding assessment, curriculum, and professional development in order to improve instruction. They assume that manipulating these elements of instructional policy will change teachers' practice" (Cohen & Hill, 2000, p. 294). The goal of both policymakers and educational reformers is to manipulate policy instruments in a manner that allows them to impact teaching and learning in thousands of classrooms. Teachers, however, are a key connection between policy and practice, and their response is critical to successful implementation of educational policies and reforms and the level of impact they have on teaching and learning in classrooms:

> Policy doesn't travel, like an arrow, directly to its target. Instead, teachers and administrators, students and communities, districts and leaders "mutually adapt." As David Tyack and William Tobin explain, reformers believe that their innovations will change schools, but it is important to recognize that schools change reforms. Over and over again teachers have selectively implemented and altered reforms. (Wilson, 2003, p. 205)

The translation of policies from the top to local action is a complex process and has created "the implementation" problem. Traditionally, policymakers at the top have relied on "specific legislation, tighter regulations and procedures, centralized authority, and closer monitoring of compliance" to ensure successful implementation of new reforms or policies (Elmore, 1983, p. 342). Successful implementation can be measured in a variety of ways:

> If we take a strictly regulatory view, our standard of success is compliance, and all variability is suspect because it suggests noncompliance. But if we take a programmatic view, our standard of success is the capacity of program participants to produce desired effects. If variability enhances the likelihood of program effectiveness, it is good; if it does not, it is bad. (Elmore, 1983, p. 350)

In addition, some variability in implementation may occur in cases in which there are disagreement and ambiguity over the aims of the policy. "By exploiting ambiguities in legislative intent, by pointing to particularly glaring practical problems in adjusting to a new policy, and by skillfully exercising delegated control, actors who disagree with the intent of a policy can blunt its impact" (Elmore, 1983, p. 351). Moreover, at times variations are caused by a lack of local capacity, rather than noncompliance:

> For many of the policymakers, the vision is of teachers who do not teach, or teach only what they please to those who please them; who prefer the transient kicks of frills and fads to the tougher, less rewarding regimen of achieving tangible results in the basic skills; who close their schoolhouse doors and hide their incompetence behind union-sheltered resistance to accountability and merit increase; whose low expectations for the intellectual prowess of poor children leads them to neglect their pedagogical duties toward the very groups who need instruction most desperately; or whose limited knowledge of the sciences, mathematics,

> and language arts results in their misteaching the most able. (Shulman, 1983, p. 484)

Teachers have their own beliefs about

> a besieged and beleaguered group of dedicated professionals, inadequately appreciated or compensated, attempting to instruct responsibly and flexibly under impossible conditions. They are subject to endless mandates and directives emanating from faceless bureaucrats pursuing patently political agendas. These policies not only dictate frequently absurd practices, they typically conflict with the policies transmitted from other agencies, from the courts, or from other levels of government. Each new policy further erodes the teacher's control over the classroom for which she is responsible. (Shulman, 1983, p. 485)

The reality is that there are several possible reasons for encountering difficulties when implementing an educational policy. Shulman (1983) suggested the following five possibilities: (a) inconsistencies among mandates; (b) limits on resources, time, or energy; (c) limits of teacher expertise; (d) limitations of working conditions; and (e) the self-defeating mandate. Shulman wrote, "In education, it is rarely products we disseminate; it is principles and practices. These depend critically for their efficacy on the minds and motives of the teachers and students who jointly produce the events of classroom life" (Shulman, 1983, p. 496).

According to Elmore (1983), in educational policy implementation teachers make most of the important discretionary choices in the implementation of policies. District strategic initiatives do not necessarily flow downward as intended. “In practice, policy is transformed as it moves through the system, receiving its final stamp at the hands of the ‘street-level bureaucrat’[11] with ultimate responsibility for taking the actions mandated by the directive” (Shulman, 1983, p. 500). Confrey wrote, “Local practice actually depends most on human sense-making and often leads to tendencies to misconstrue the intention of policy makers” (Confrey, 2007, p. 45). Teachers are more likely to change their practices when the goals and content of the strategic initiative are clear to them. Moreover, some aspects of reform are more resistant to change than others. Malen stated, “School systems have habits and histories, norms and traditions, rhythms and routines that can reduce or reinforce the ability of [district initiatives] to alter organizational priorities and practices” (Malen, 2005, p. 200). Further, the researcher noted, teachers “bring different orientations and dispositions, views and values, talents and energies to the educational enterprise” (Malen, 2005, p. 200). Therefore, schools and individuals within schools may react differently to the same strategic initiative. “When it becomes necessary to rely mainly on hierarchical control, regulation, and compliance to achieve results, the game is essentially lost” (Elmore, 1983, p. 358). The more responsibility is devolved toward the bottom of the system, the greater the number of people who will be actively involved in searching for a solution to the problem and the higher the likelihood that more effective programs will be designed and implemented at the local level. “Research on the implementation of new educational programs consistently finds that peer relationships—teachers training teachers, teachers working jointly on the development of materials, and so forth—are strongly related to success of

[11] Michael Lipsky introduced the term ‘street-level bureaucrat’ in 1980.

implantation and continuation of programs” and suggests that policymakers “begin with the assumption that implementation begins at the bottom, not at the top” (Elmore, 1983, pp. 359-360). “Policies are very much like laws and teachers like judges. Educational policies must be designed as a shell within which the kernel of professional judgment and decision making can function comfortably” (Shulman, 1983, p. 501). Teachers should be provided opportunities to respond to, make choices, and influence educational policy because “no microcomputer will replace them, no television system will clone and distribute them, no scripted lessons will direct and control them, no voucher system will bypass them” (Shulman, 1983, p. 504).

A national study of four federally funded programs (Title III, Title IV, 1968 Vocational Education Act, and Right-to-Read) found that local implementation choices were determined by local context and reflected local motivation, management style, expertise, capacity, and sophistication (McLaughlin, 1990, p. 12). The following strategies were generally effective in supporting local implementation: (a) concrete, teacher-specific, and extended training; (b) classroom assistance from local staff; (c) teacher observation of similar projects in other classrooms, schools, or districts; (d) regular project meetings that focused on practical issues; (e) teacher participation in project decisions; (f) local development of project materials; and (g) principal’s participation in training. In short, the study found that effective local implementation was characterized by a process of mutual adaptation rather than uniform implementation of an initiative. In considering building-level implementation of a strategic initiative, it is important to note that “local variability is the rule; uniformity is the exception” (McLaughlin, 1990, p.13). For example, an Algebra 1 course in a suburban community differs substantially from the same course offered in an urban community. Variability in how schools implement the strategic initiative can signal a healthy system, one that is shaping and integrating the strategic initiative in ways best suited to local resources, traditions, and clientele (McLaughlin, 1990, p.13).

Because teachers have a significant amount of control over the way policy is implemented, it is important to consider if there are any teacher characteristics that impact policy implementation. One consideration in examining the implementation of a strategic initiative, especially one related to mathematics reform, is the career stage of teachers.

Impact of Career Stage of Teachers on Policy Implementation

Two studies by Drake examined the relationship between career stage and the interpretation and implementation of mathematics reform. Drake (2002) found that teachers at varying career stages differed significantly in their approaches to mathematics education reform. Differences were seen in their willingness and ability to teach in reform-oriented ways, in their understandings of reform, and in how they integrated reform ideas into their practices. Implementation of a strategic initiative is impacted not only by cultural, organizational, and situational context but also by individual identities, prior experiences, and understandings of problems and proposed solutions (Drake, 2002 p. 313). Career stage was measured in terms of years of experience because it could provide researchers with indications of an individual's development within the context of schools and classrooms. The six stages identified were the following: 1 to 3 years, 4 to 6 years, 7 to 11 years, 12 to 20 years, 21 to 30 years, and 31 or more years.

Drake’s (2002) first study quantitatively measured teacher responses to a state policy consisting of a mathematics framework, followed by aligned assessment tools, professional development, and adoption of a textbook. Data were collected through a large-scale survey of several hundred elementary teachers in California 9 years after the passage of the statewide reform. The survey asked the 595 teachers about their beliefs and feelings related to the reforms, as well as the practice of reforms in their own teaching experience. The least experienced teachers were very positive about the reforms, although they had the lowest level of understanding of the reforms and felt least prepared to teach the reforms. The profiles of the next three groups, consisting of teachers with 4 to 20 years of experience, were very similar to one another with regard to reform variables. These teachers exhibited relatively high levels of understanding of and familiarity with the reforms. They were more prepared to teach in ways consistent with the reforms; consequently, they reported high levels of reform teaching and lower levels of traditional teaching. The two groups of late-career teachers reported low levels of positive disposition regarding the reforms. These groups of teachers were confident they understood the reforms and could teach accordingly if they chose to do so. Nevertheless, they were not very supportive of the overall notion of reform, and their reports of practice indicated great variety in the ways they understood mathematics (Drake, 2002). The researchers discussed the possibility of a cohort effect, in that early-career teachers were more likely to have been exposed to reform mathematics in their own learning or in their teacher education programs and, therefore, were predisposed to mathematics reform.

Drake’s (2002) second study involved the experiences of six teachers (representing early-career, early-to-midcareer, and midcareer teachers) in piloting the use of the *Children's Math Worlds* curricula designed for students in Grades 1 to 3. These teachers were interviewed and observed multiple times over the course of the school year. Classroom observations allowed the researchers to confirm, disconfirm, or elaborate on teachers' own descriptions of their instructional practices. Based on data collected in the case studies, teachers from different career stages varied in three key ways: (a) their goals for their students in mathematics, (b) their integration of reform teaching practices and traditional teaching practices, and (c) the connections between their own learning from mathematics education reform and their students' learning in mathematics (Drake, 2002). Early-career teachers in this study implemented the reform curriculum due to the fact that the prepackaged aspects of the materials relieved them of some of the burdens of planning and preparation. These teachers incorporated reform practices into their mathematics teaching very literally and with little adaptation. The core principles of the reform were not presented by the curriculum in a ready-to-use format and, as a result, were not adopted by the early-career teachers. New ideas about mathematics were in most cases dismissed and ignored or presented to students in a superficial way. Concepts or strategies in the curriculum that these teachers did not understand were viewed as flaws rather than as opportunities for learning. The midcareer teachers revealed a changing understanding of mathematics from a system of facts and standardized tests to a complex system of language. This understanding led teachers to new methods and new goals for teaching mathematics; therefore, these teachers adapted their teaching practices to reflect this new understanding. The midcareer teachers in this study were the most reflective about their process of change as they moved from traditional mathematics teaching to reform mathematics teaching practices. They were learning not to simply accept information but to deconstruct and reconstruct it in meaningful ways that allowed them to teach students in deeper, more meaningful ways. They expressed the desire to make mathematics fun, interesting, exciting, and enjoyable for their students. Based on data collected in these two studies, there is reason to believe that teachers' career stages can be linked to their patterns of reform implementation. The two studies were conducted within different contexts and required different actions from teachers (responding to statewide standards reform versus piloting a reform-oriented curriculum), yet they yielded complementary results (Drake, 2002).

Although there are data that suggest that teachers' career stages can be linked to their level of policy implementation, there is also the consideration that with increased accountability all teachers are held to the same level of expectations and accountability.

Impact of Accountability on Policy Implementation

It is important to examine the issues that arise when schools enroll increasing numbers of students who may not have taken Algebra 1 at all. In the past, many of these students would not have been enrolled in these classes and, therefore, they would not have impacted the school or district assessment data. Due to the sequential nature of mathematics, skills and concepts learned in earlier courses are required for success in Algebra 1. "Children's differing levels of education when they start school, their varying rates of development, the support they get at home and the quality of their teachers all combine to push some children along while others fall behind" (Bach, 2005).

The use of state-level student testing that provides both consequences for students and measures of school performance is not new; in the past, however, accountability and assessment were only loosely connected because assessment was used primarily to divide students into academic tracks. The National Commission on Excellence in Education set forth the purposes of assessment in the 1980s: (a) to certify the student's credentials, (b) to identify the need for remedial intervention, and (c) to identify the opportunity for advanced or accelerated work (Klein, 2003). Since 1994, increasingly rigorous exams have replaced minimum competency exams (Grubb & Oakes, 2007); 25 states require exit exams. Currently, standards-based testing can be used as an indicator to inform staff whether or not they are reaching the goals of the organization, to provide information about which elements of the curriculum are reaching students and which are not, to measure the success or failure of an incentive system, to gauge the effects of an increase in standards, to assess curricula, to provide technical assistance to staff, to allocate additional resources, and to improve outcomes for groups having difficulty reaching the standard (Carnoy & Loeb, 2002).

Grubb and Oakes (2007) suggested several possible responses to high-stakes assessment. Schools serving higher performing students, who are likely to pass the exams easily, will make few changes, whereas schools serving lower performing students will need to employ a variety of measures to increase student achievement on the exit exams. In schools with lower performing students, remediation and intervention plans will need to be put in place, some instructional time may be lost as students are prepared for the assessments, and educators may focus on teaching test-taking strategies rather than the curriculum.

A study examining the relationship between high school exit tests and graduation rates from 1975 to 2002 found that high school completion rates dropped by 2.1 percentage points. This negative effect increased as the difficulty of the exams increased;

further, the impact was stronger in states with higher rates of poverty and more racially and ethnically diverse students. Opponents of high-stakes exit exams claim (a) they are too costly,[12] (b) states have imposed requirements without increasing the capacity of districts or schools to meet those requirements, (c) they reinforce conventional academic curriculum as opposed to reform initiatives, (d) they distort curriculum and instruction, and (e) they lead to higher and more inequitable dropout rates (Grubb & Oakes, 2007).

Data collected through a 50-state survey conducted in 2000 by the Consortium for Policy Research in Education at the Graduate School of Education of the University of Pennsylvania were used to describe the types of state assessments and accountability measures in place across the United States. State assessment systems included a variety of tests and testing formats. In 1999-2000, 29 states administered a combination of criterion-referenced (measurement of knowledge and skills specific to the subject matter) and norm-referenced (measurement of knowledge and skills of students relative to other students taking the test) assessments, 17 states used only criterion-referenced tests, and two states used only norm-referenced tests (Goertz & Duffy, 2003). By 2001, 48 states had implemented required statewide assessments in reading and mathematics but did not allow districts any discretion in the selection of a test. The other two states, Iowa and Nebraska, required statewide assessment of students but left the choice of the assessment to the district. The assessment systems varied with regard to subject areas, grade levels assessed, type of test used, and use of the data.

No Child Left Behind requires states to delineate at least three levels of student performance: advanced, proficient, and basic. Tests can carry high stakes for students,

[12] Researchers have estimated that costs range from $171 to $557 per student per year and that the cost increases when states try to increase pass rates, raise required scores, or adopt a more challenging test.

for schools, or both. Negative consequences for students can result from the use of high-stakes assessments to assign students to programs or classes based on their performance (tracking), to make promotion decisions, or to determine whether or not a student will receive a high school diploma. Tests represent high stakes for schools when low test scores can be used as a criterion by the state to justify intervention in or taking over the administration of a school. In some cases, students are held accountable for performance but the schools are not. Educators in low-performing schools generally face few formal consequences for not meeting school, district, or state performance targets. Formal consequences for teachers generally take the form of professional development, coaching, and mentoring. When formal consequences exist, they fall more heavily on students and principals than on teachers. At the school level, principals are often the primary focus of accountability. A final consideration is that, most often, state departments of education lack the fiscal and human capacity to provide the necessary support to either improve student achievement or fully implement sanctions aimed at improving student achievement. In 2002, Maryland reconstituted only four of the 107 schools identified as eligible for reconstitution. In 2001, 28 states and the District of Columbia provided assistance to low-performing schools, 18 states offered rewards, and 20 levied sanctions such as school closure (9 states), reconstitution (15 states), and student transfers (11 states) (Goertz & Duffy, 2003).

Accountability under NCLB has resulted in several consequences for states: (a) states must absorb the burden of developing, administering, and scoring these assessments; (b) educators consider the curriculum to be narrowed and classroom instruction focused on the subjects (reading and mathematics) and standards assessed by the state; (c) districts with performance-based instructional assessments face the dilemma of continuing both their own assessment programs and those mandated by the states, thereby risking testing students too much or eliminating their own local tests; (d) questions arise about whether one test can serve multiple purposes (provide indicators of the performance of the educational system, hold schools and educators accountable, certify student performance, motivate students to perform better, motivate teachers to change their instructional practices, and aid in instructional decision making about individual students); and (e) districts must ensure that teachers have access to meaningful professional development to build their knowledge and skills. Although the intention of high-stakes assessments is to increase schools' focus on how much students learn, unintended consequences of increased accountability in the short term include the possibility of increased student retention, increased dropout rates, and decreased graduation rates.

Carnoy and Loeb (2002) examined factors associated with stronger external accountability to determine whether or not stronger statewide approaches to accountability resulted in improved student outcomes. The researchers used a variety of measures of average student performance at the state level, including NAEP math test scores, ninth-grade retention rates, and high school survival rates (the proportion of students who reach the 12^{th} grade). An index (0 to 5) was developed to rate the strength of accountability measures in 50 states based on the use of high-stakes testing to sanction and reward schools. The index captured the degree of external pressure on schools to improve student achievement. States receiving a rating of 0 either did not test students statewide or did not set any statewide standards for schools or districts. States receiving a rating of 5 tested students in primary and middle grades, strongly sanctioned and rewarded schools or districts based on improvement in student scores, and required a high school competency exit test for graduation. The relationship between the accountability index and student gains on the NAEP mathematics test in 1996 through 2000 was used to determine if (a) states with strong accountability measures have different characteristics from states without such measures, (b) states with strong accountability systems note larger increases in national assessment test results, (c) states with strong accountability note increases in the retention rates in ninth grade compared to states with weak accountability, (d) high school progression rates in states with strong accountability increase or decrease compared to progression rates in states with weak accountability, and (e) the relationship between accountability and student outcomes differs among racial or ethnic groups (Carnoy & Loeb, 2002, p. 306).

The researchers found that states with a higher proportion of minority students and those with larger populations were more likely to implement strong accountability systems. States with lower achieving White students were also more likely to implement strong accountability systems. There was no relationship found between prior test-score gains in states and the strength of their accountability systems. In comparing the strength of a state's accountability system to student achievement, the researchers found that student achievement at higher levels of math was related significantly to stronger state accountability, thereby suggesting that a stronger focus on higher standards as well as how well schools do on the test may impact student achievement. Despite the general positive effects of increased accountability on math achievement, the researchers found a considerable amount of variation among states with similarly weak or strong accountability systems. There was also evidence that better performing schools had a greater capacity to respond to the increased external accountability pressures. The NAEP results suggested that students in states with strong accountability systems score well on their own state tests; however, the results do not provide clarification regarding whether students are actually learning more or just improving their test-taking skills.

Criticisms of the current high-stakes assessment practices have been based on the following beliefs: (a) the high-stakes assessments do not support school reform; (b) methods used for setting performance cut-points are pseudoscientific; (c) the refusal to use sampling techniques instead of a score for each individual student leads to a narrowing of the curricula; and (d) data-based reports are weak and slow to reach practitioners, and the practitioners lack the capacity to use the data (Confrey, 2007).

The goal of increased accountability, more rigorous exit assessments, and consequences for not meeting mandates is to focus educators on student learning outcomes and achievement. Additionally, increased accountability has led to increased efforts at building the capacity of educators to meet the demands of new standards and rigorous high-stakes assessments.

Impact of Professional Development on Policy Implementation

The field of professional development has evolved and is seen as a tool in helping to shape teacher beliefs and change teacher practices. It is important to understand that teachers are asked to master new pedagogical skills, deepen their content knowledge, and change their instructional practices; therefore, professional development is needed.

Professional development involves experiences ranging from academic training to job-embedded professional learning communities (PLCs) aimed at improving teachers' capacity, knowledge, and skills. The perspective about teacher change that is currently accepted is predicated on the idea of change as a learning process for teachers that is developmental and primarily experience based (Guskey, 1986, p. 7). Studies of school reform have indicated that, for reform to take place, teachers need to be provided professional development that promotes a change in their practices. Quality professional development should incorporate issues of content (what is taught), pedagogy (how it is taught), and equity (who is taught). Ham and Walker stated,

> Professional development itself is not the key. The key is application and figuring out how to stimulate and support teacher application of new skills. Professional development that doesn't have accountability and follow-up in classroom support is not going to result in application (Ham & Walker, 1999, p. 42).

The general elements of systemic reform (high standards, curriculum frameworks, and new approaches to assessment) create new expectations regarding teachers' classroom behaviors. The qualifications and effectiveness of teachers can impact, in part, their ability to carry out reform efforts. Therefore, professional development for teachers is a key component of a reform initiative.

In 1994, a study of 595 teachers of mathematics in California examined teachers' opportunities to learn mathematics and how to teach it to determine if practice would move in the direction of state policy with increased professional development. The study produced the following findings:

> The content of teachers' professional development makes a difference to their practice. Workshops that offered teachers an opportunity to learn

> about student math curriculum are associated with teacher reports of more reform-oriented practice. The average teacher who attended a Marilyn Burns or replacement unit workshop on student curriculum reports nearly a half of a standard deviation more of framework practice than the average teacher who did not attend those workshops. And the typical teacher who attended a weeklong student curriculum workshop appears about a full standard deviation higher on the framework practice scale than the teacher who did not attend this workshop at all. Moreover, the relationship works in both directions. Teachers who report an average amount of attendance at either Marilyn Burns or replacement workshops report fewer conventional practices (about a third of a standard deviation) than teachers who did not attend. These opportunities to learn seem not only to increase innovative practice but to decrease conventional practice; teachers do not just add new practices to a conventional core, but also change that core. (Cohen & Hill, 2000, p. 5)

In addition to structured professional development opportunities, state assessments can have a significant influence on building the capacity of teachers and impacting their instructional practices. Assessments can provide teachers with an opportunity "to think about, observe, and revise mathematics instruction" (Cohen & Hill, 2000, p. 6); in addition, teachers may be prompted by their students' performance on state assessments to seek ways to help improve student achievement. Reformers in California who wanted to impact mathematical instruction and student learning made new student curriculum units, encouraged professional development based on the curriculum units and reform ideas, and used state assessments as an incentive toward change. They believed that teachers would respond by learning about the new curriculum and assessments and implementing a new kind of mathematics instruction in their classrooms, which would result in increased student achievement (Cohen & Hill, 2000).

Researchers increasingly have sought to characterize the process of teacher learning: what leads to it, what supports it, and what it offers students (Franke, Carpenter, Levi, & Fennema, 2001, p. 655). Franke et al. conducted a study that documented how teachers who participated in a professional development program about understanding the development of students' mathematical thinking continued to implement the principles of the program 4 years after it ended. From 1990 to 1993, 26 first- through third-grade teachers in five schools were provided professional development focused on teachers' understanding of students' mathematical thinking and how it develops. The study examined how teachers understood and used knowledge of student thinking 4 years after their participation in the professional development. In 1997, data were gathered through interviews and observations of 22 teachers who were part of the original 26 participants[13]. The classroom observer followed each teacher and took notes on all teacher and student interactions; within 2 hours of each observation, an interview was conducted. The interviews were not scripted but framed by a list of specific questions. To classify teachers in terms of the level of teacher engagement with children's mathematical thinking, the interviewers cycled through questions about how teachers decided what, when, and how to teach. Data from the interviews were compared with observational data from classroom practices to determine the level of teachers'

[13] Three teachers were no longer teaching mathematics and one chose not to participate.

engagement with children's mathematical thinking. A series of graduated benchmarks[14] were developed to indicate skills and understandings teachers acquired and conceptions they had about the teaching and learning of mathematics.

Teachers at Level 1 did not believe that the students in their classrooms could solve problems unless they were taught how. Teachers with this belief did not provide opportunities for solving problems, did not ask children how they solved problems, and did not use children's mathematical thinking when making instructional decisions. At the other end of the spectrum, teachers at Level 4B believed that what an individual child knows fits in with how children develop mathematical understanding. The classroom practices that demonstrated this belief included creating opportunities to build on mathematical thinking of children, describing in detail individuals' mathematical thinking, and using mathematical thinking to drive instruction. The results of the study revealed that all 22 teachers maintained some level of implementation (Franke et al., 2001, p. 664). The practices of 16 teachers remained exactly the same 4 years after the professional development as they had been at the end of the experience. Only one teacher showed an increase in level of engagement, whereas five teachers dropped to lower levels of engagement.

In a national study (Garet et al., 2001) comparing effects of different characteristics of professional development on teacher learning, researchers identified components of professional development that had significant positive effects on teachers' self-reported increases in knowledge, skills, and changes in classroom practice. This study used data from a 1998 Teacher Activity Survey conducted as part of a national

[14] The graduated benchmarks used by the researchers combined belief and practice into five levels. The five levels were Level 1, 2, 3, 4A, and 4B.

evaluation of the Eisenhower Professional Development Program, a federal program that supports professional development for teachers of mathematics and science. Teachers were asked to respond to questions about professional development they had attended from July 1 to December 31, 1997. Teachers were then asked to provide an accounting of their own behavior and not to provide judgments regarding the quality of the professional development. Researchers received responses from 1,027 teachers (a 72% response rate) from 358 school districts. The researchers focused on structural features of professional development such as (a) the form of the activity, (b) the duration of the activity, and (c) the degree to which the activity emphasized collective participation of groups of teachers from the same school, department, or grade level. Three core features of professional development also were examined: (a) the degree to which the activity had a content focus, (b) the extent to which the activity offered opportunities for active learning,[15] and (c) the degree to which the activity promoted coherence in teachers' professional development by incorporating experiences consistent with teachers' goals and aligned with state standards and assessments (Garet et al., 2001, pp. 916-920). Teachers responded to survey items about the structural and core features of professional development activities they had attended; they were asked also to indicate the extent to which the professional development had brought about change in their practices.

The results of the study by Garet et al. (2001) indicated that reform activities such as study groups (in contrast to workshops or conferences) generated slightly more positive outcomes and tended to involve longer periods and a greater number of contact

[15] The following activities were considered to have components of active learning: observing expert teachers, being observed teaching, using planning time to incorporate new curriculum materials and teaching methods for classroom instruction, reviewing student work, engaging in writing, and leading discussions.

hours. Increased time span and contact hours had a substantially positive impact on opportunities for active learning and greater focus on mathematics and science content. A strong content focus also had a substantial positive effect on enhanced knowledge and skills, ultimately exerting a positive influence on change in teaching practices: Teachers who reported enhanced knowledge and skills were more likely to report a change in their practices. The researchers also learned that many professional development activities did not meet the criteria for high-quality professional development. Possible reasons for a lack of high-quality features in the professional development experiences of the teachers include the following: (a) providing activities with multiple high-quality features can be challenging, (b) providing high-quality professional development is expensive,[16] and (c) schools and districts may not have the time needed to plan such professional development. Data from this research suggest several ways to improve the quality of professional development: (a) sustained and intensive professional development; (b) professional development with a focus on content that involves teachers in hands-on learning and integration of the content into the daily life of the school; (c) activities linked to teachers' other experiences, aligned with curriculum efforts, and encouraging of professional communication among teachers; and (d) replacement of traditional professional development activities (workshops and conferences) with reform-oriented professional development activities such as study groups, coaching, and mentoring, which often take place during the school day.

[16] The researchers estimated that it costs an average of $512 per teacher to provide a high-quality professional development experience. This cost is more than twice the amount of money that districts typically spend (Garet, Porter, Desimone, Birman, & Yoon, 2001, p. 935).

There are different types of professional development experiences, and those experiences can result in varying levels of lasting impact on teachers' practices. The District under study made a commitment to reform-oriented professional development activities to build teachers' capacity and improve student achievement outcomes.

Teachers' Acceptance or Resistance to Policy Implementation

As policies are implemented in local school settings, they are filtered through teachers. Teachers have a high degree of autonomy in how they implement curriculum, standards, or other policy expectations in their classrooms. In this manner, they are both the targets of a policy reform as well as the agents of change required to implement the reform. Policy implementation can occur through a top-down or bottom-up model. In top-down models policy designers concentrate their attention on factors that can be manipulated at the local school system level. Bottom-up models see target groups as service deliverers and argue that policy is really made at the local level (Matland, 1995). In a top-down model the starting point is the policy decision made by national, state, or local decision makers that impacts teachers who are expected to produce the required results. This model is highly prescriptive and aims to concentrate on variables that can be controlled, provide clear and consistent policy goals, minimize the number of actors, and manage the extent of change necessary. It can be negatively viewed as purely an administrative process that ignores the political aspects of policy reform (Matland, 1995). Bottom-up models look at policy implementation from the perspective of the target population and the service deliverers as local organizations react and implement policy. "According to the bottom-uppers, if local level implementers are not given the freedom to adapt the program to local conditions it is likely to fail" (Matland, 1995, p. 148). Most researchers believe that some combination of a top-down and a bottom-up model would be most effective at providing clear and consistent policy goals while taking into consideration that “street-level bureaucrats do have great discretion in their interactions with clients” (Matland, 1995, p. 150). Matland further wrote,

> Berman argues that choosing a top-down strategy can lead to resistance, disregard, and pro forma compliance. Such dangers do exist. Choosing a bottom-up strategy, however, may lead to cooptation and pursuit of individual goals that run contrary to the policy objectives” (Matland, 1995, p. 153).

Is a policy successful due to its adherence to the designer’s plan or as a result of the consequences of implementation? Matland argued that policy ambiguity of goals and means directly impact successful policy implementation:

> The degree of ambiguity in a policy directly affects the implementation process in significant ways. It influences the ability of superiors to monitor activities, the likelihood that the policy is uniformly understood across the many implementation sites, the probability that local contextual factors play a significant role, and the degree to which relevant actors vary sharply across implementation sites. (Matland, 1995, p. 159)

Conflict also plays a role in policy implementation. When there is an incompatibility of objectives or when some see a policy as directly opposed to their interests, differences and disputes can arise regarding policy implementation, which is often thwarted as the actors are not able to reach any agreements. Matland proposed the following ambiguity-conflict matrix (see Table 4) regarding the policy implementation processes.

Table 4. *Ambiguity-Conflict Matrix*

		Conflict	
		Low	High
Ambiguity	Low	Administrative implementation	Political implementation
	High	Experimental implementation	Symbolic implementation

When there is low policy ambiguity and low policy conflict, "the desired outcomes are virtually assured given that sufficient resources are appropriated for the program" (Matland, 1995, p. 160). When there is low policy ambiguity and high policy conflict, there is dissention and debate regarding the defined policy goals. In these instances, the implementation outcome is determined by power and authority. In cases in which there is high policy ambiguity and low policy conflict, the outcomes will depend on the actors that are most involved. In these instances, "contextual conditions dominate the process. Outcomes depend heavily on the resources and actors present in the micro-implementing environment" (Matland, 1995, p. 166). Finally, when there is both high ambiguity and conflict regarding a policy, the result is outcomes that vary across sites. In these cases, "local level coalitional strength determines the outcome. The policy course is determined by the coalition of actors at the local level who control available resources" (Matland, 1995, p. 168). An awareness of this ambiguity-conflict matrix will allow policymakers to make predictions about the policy implementation process.

Effective policy implementation should consider individual incentives and beliefs and provide a balance of both support and pressure to support successful policy adoption (McLaughlin, 1987). Implementers do not always do as they are told, and there are issues related to local capacity and political will that impact policy adoption. Consequently, there is local variability, and uniformity is the exception. McLaughlin identified will, attitudes, motivation, beliefs, and administrative support as factors that impact teachers as they accept or resist policy efforts. Organizations do not innovate or implement change; individuals do. "The quality of individual-level responses determines the quality of policy implementation" (McLaughlin, 1987, p. 177). McLaughlin pointed out that school-based professional learning communities (PLCs) are critical in contributing to teachers' effectiveness and in promoting accountability. She also noted, however, that "the contemporary climate of high-stakes accountability can create disincentives for teachers to attend to more than standardized test scores" (McLaughlin, 2011, p. 67).

Gitlin and Margonis (1995) identified issues of time, autonomy, teacher understanding, school culture, support, availability of resources, levels of engagement, and motivation as issues that impact teachers' acceptance or resistance to change. In their resistance teachers can demonstrate a range of behaviors from ambivalence to direct obstruction of change. At times teachers resist change due to factors outside their control, such as a lack of support structures, or they resist due to conflicts in their fundamental beliefs about their roles and the change that is required. For reforms to be successful, it is recommended that closer attention be paid to teachers' understanding of reform and to the ways that a culture of teaching enables or limits the reform process (Gitlin & Margonis, 1995).

Margolis and Nagel (2006) found that teachers perceived loss, anxiety, and ambivalence associated with the amount and pace of change required, thereby resulting in their resistance. They also found that teachers experienced insufficient time, lack of professional development, lack of resources, and poor relationship with administration that impacted their overall cumulative stress, loss of vitality, and physical exhaustion. These researchers noted that stress increased due to teachers' physical and mental exhaustion, which impacted their job performance: Teachers' physical exhaustion "increased in relation to the scope and pace of change and the extent to which teachers perceived the changes to be imposed rather than communally owned" (Margolis & Nagel, 2006, p. 150). This research also found that teachers were most resilient when they felt valued, appreciated, and trusted by school leadership and perceived that school administration had their long-term personal best interests in mind: "Perceived day-to-day validation and support from administration was the greatest determinant" of their continued support of reform efforts (Margolis & Nagel, 2006, p. 154). When administration acknowledged the issues related to teacher physical and psychological resistance and praised teachers for their efforts, implementation outcomes improved. "High ideals without sufficient human resources and positive human relations may undermine intended school and educational reforms" (Margolis & Nagel, 2006, p. 157).

Teachers' resistance to change can be connected to their sense of agency and capability. Resistance can be an attempt to regain some of their perceived lost autonomy. "Research on teacher resistance has shown that instances of opposition, confrontation, or conflict might involve teachers' attempts to claim or recover a sense of agency and capability" (Musanti & Pence, 2010).

Knight (2009) defined resistance as dissonance because it requires at least two people to not cooperate (push–pull factors). He shared that often teachers are asked to make changes in ways that they do not think will make a difference for students. Often they are not provided with the support (models, demonstrations, experiences, professional development, lessons) they need to make changes in their habits and practices. Moreover, teachers face pressing realities in their work lives (grading, meetings with parents, chaperoning) that impact their ability to put energy into new programs and practices. The researcher asserted that when teachers perceive that their autonomy is taken away or their identity as a teacher is under attack, their most likely reaction will be to resist (Knight, 2009).

Policy acceptance or resistance in mathematics can be tied to many of the same issues as those previously listed. There are additional content-specific considerations in mathematics, however, that also impact teachers' responses to policy and reform efforts.

Teachers' Acceptance or Resistance to Policy Implementation Specific to Mathematics

Kilpatrick wrote about varying opinions regarding the teaching of mathematics:

> Some favor pure mathematics; others applied. Some want mathematics taught as they learned it; others want a different approach. Some are concerned primarily with developing the next generation of mathematicians; others are concerned primarily with mathematical literacy for all. For some, the deductive side of mathematics is what counts; others

> prefer the empirical, fallibilist, culturally determined side. (Kilpatrick, 1997, p. 960)

There have been debates regarding mathematics curriculum, standards, and assessments for decades; what teachers believe about these topics also shapes their acceptance or resistance to mathematics policy and reform efforts.

To support implementation of math reform and provide students with access to best practices and instructional efforts, policymakers need to understand the context of teacher resistance to reform so that barriers can be removed. Two important elements of context are race and the socioeconomic status of students. Rousseau and Powell (2005) pointed out that minority students and those with lower socioeconomic status may be exposed to different types of classroom instruction. Teachers with high proportions of African American and Latino students are more likely to focus on low-level skills. In addition, students in high-poverty classrooms are less likely to engage in problem solving or reasoning and are more likely to experience curriculum and instruction focused on remediation and basic skills (Rousseau & Powell, 2005). Other factors that play a role in teacher acceptance or resistance include issues of time (class and planning time, standardized testing, class size, and student mobility or absenteeism), quality (curriculum, teacher preparation, and professional development), and design (effective and equitable systems of mathematics reform). The goal is to “better understand not only individual responses to reform, but also the systemic conditions that might impact teacher change” (Rousseau & Powell, 2005, p. 30). For new policies and reforms to be fully implemented as intended it is important to understand the barriers to change as experienced by teachers. Understanding the contexts and conditions that lead to teachers’ acceptance or resistance to reform helps policy implementers to better support the implementation of reform efforts in schools with the ultimate goal of providing students with improved educational opportunities and outcomes.

Increased accountability in reading and mathematics is another factor that impacts teachers' response to policy and reform efforts. "A deep-rooted disagreement exists in the United States as to what schools are for, what a good education includes, and what skills and content children need to know. Efforts to impose statewide agreement will inevitably offend some constituencies" (Hess, Wurtzel, & Rotberg, 2002). Increased accountability challenges teachers' sense of duty and commitment to students; it mandates content and skills to be covered by assessments regardless of teacher preference. Standards allow for schools to provide all students with a common set of experiences and a basic level of knowledge; however, at times those standards may be at odds with teachers' sense of their personal philosophies and professional purpose, thereby causing them to feel a loss of control or power in their classrooms. Hess et al. wrote,

> American schools have been built on a premise of professional, autonomous teachers who operate out of a sense of duty and commitment. The premise of high-stakes testing challenges this culture by pressing teachers to teach the content and skills mandated by the state, regardless of their personal preferences. (Hess et al., 2002, p. 74)

High-stakes accountability is seen as an effective and coercive method of impacting teacher behaviors. "When jobs or working conditions are at stake, educators can no longer close their classroom doors and wait out reforms. Educators are compelled to cooperate by relentless monitoring and concrete threats" (Hess et al., 2002, p. 97). Resistance or acceptance of high-stakes accountability and standards in mathematics is influenced by teachers' years of experience. New teachers are more accepting of the standards and expectations, and they may find that they have an enhanced sense of clarity and purpose. Veteran teachers with developed philosophies of teaching may find themselves more at odds with expectations implicit in high-stakes accountability and may feel they have lost control, power, and professionalism (Hess et al., 2002).

School systems currently use professional development, curriculum adoption, teacher evaluation systems, and instructional coaching as tools in changing teacher practice. "Infrastructure is often taken for granted and overlooked…formal structures get corrupted, intentionally or unintentionally, making changes in instruction difficult" to implement (Hopkins, Spillane, Jakopovic, & Heaton, 2013, p. 202). To promote policy acceptance and implementation, school systems should support teacher leadership and peer coaching as a means of impacting teachers' instructional practices and beliefs in mathematics reform efforts. The study by Hopkins et al. found that teacher leadership was associated with increases in staff interactions and discussions, and teacher leaders became central actors and influential brokers that impacted policy and reform implementation in mathematics. The researchers noted that teacher leadership in conjunction with peer coaching had the ability to increase teachers' access to information and expertise (Hopkins et al., 2013). In schools that promoted teacher leadership and peer coaching, "on average, teachers developed more inquiry oriented beliefs about teaching mathematics, and they reported an increased use of practices that aligned with these beliefs" (Hopkins et al., 2013, p. 218).

Teachers' interpretation and implementation of curriculum are influenced by their beliefs and knowledge about instruction. These beliefs shape teachers' decisions and actions. Specific to algebra, teachers' beliefs regarding the perceived difficulty of algebraic concepts and their beliefs regarding student ability and performance impact their acceptance or resistance to reform-oriented mathematics. Nathan and Koedinger (2000) reviewed teacher perceptions and student performance on different types of mathematical problems (result-unknown or result-known problems, verbal-precedence or symbol-precedence problems, algebraic-procedures and invented-solutions problem solving, and product- or process-oriented student answers). The results of the study showed that teachers were least likely to agree with reform-oriented views, high school teachers were more likely to agree that students' answers were more important than their problem-solving processes, high school teachers did not give students' invented strategies as much credit as did their colleagues in middle and elementary school, high school teachers were less likely to disagree that alternative-solution methods adapted by students were indications of weak skills or poor conceptual understanding, and high school teachers tended to rank symbolic equations as easier than verbal problems (however, students ranked verbal problems as easier and were more successful on those types of questions) (Nathan & Koedinger, 2000). Mathematics reform efforts call for students to develop conceptual understanding and promote students' reasoning and problem solving over rote memorization; however, teacher perceptions and beliefs about mathematics can predispose them to resist these reform efforts. Even in cases where teachers held reform-based views regarding mathematical learning and instruction they were not guided by those reform-oriented views when judging how well students would perform on a set of algebra problems. “Instead the teachers’ rankings exhibited a symbol-precedence view of mathematical development that seems at odds with their view of students’ reasoning” (Nathan & Koedinger, 2000, p. 227).

Summary

For decades, the education of students in secondary mathematics has been a critical topic in the United States. School systems have considered ways to implement national standards and expectations, respond to state-level accountability systems, and provide a meaningful secondary mathematics program that meets the needs of all students. Since the 1950s there have been shifts regarding what math to teach and how to teach it. In 1989, NCTM took the lead in determining what to teach by developing national standards for mathematics in the United States. The development of the NCTM standards incited debate regarding the content and pedagogy of the secondary mathematics classroom with differing ideas about the best way to improve learning outcomes for students. Both the history of mathematics education and national standards development show how attempts at reform were made with access and student achievement in mind.

Student achievement data show an achievement gap in mathematics, as well as other content areas, for racially or ethnically diverse students or those receiving special services. Therefore, policy implementers need to consider how the beliefs of teachers impact student achievement. Additionally, not only are teacher beliefs impactful in student achievement, but also are student beliefs, motivation, and characteristics. A challenge that has been faced by mathematics teachers is how to meet the needs of underperforming students.

Given that mathematics achievement may be impacted by both teacher and student beliefs, it is critical to consider how student achievement can be impacted by teacher actions. Teacher efficacy has been defined as the extent to which a teacher believes he or she has the ability to affect student performance. Given that teacher efficacy is contextual and can be impacted by outside forces, it is critical to consider how policy implementation can play a role in impacting teachers' actions and beliefs, as well as student achievement.

State legislatures typically exercise control in the areas of student standards, graduation requirements, teacher policies, certification requirements, monitoring, and alignment of tests and texts. "Educational reformers increasingly seek to manipulate policies regarding assessment, curriculum, and professional development in order to improve instruction. They assume that manipulating these elements of instructional policy will change teachers' practice" (Cohen & Hill, 2000, p. 294). The goal of both policymakers and educational reformers is to manipulate policy instruments in a manner that allows them to impact teaching and learning in thousands of classrooms; however, there is variation in implementation as teachers have a significant amount of control over the way policy is implemented. Therefore, it is important to consider whether or not there are any teacher characteristics that impact policy implementation. One consideration in examining the implementation of a strategic initiative, especially one related to mathematics reform, is the career stage of teachers.

Teachers in various stages of their careers differ in their willingness and ability to teach in reform-oriented ways, in their understandings of reform, and in how they integrate reform ideas into their practices. The individual contexts, beliefs, experiences, and identities of teachers determine to some extent their willingness and ability to adapt and implement policy initiatives. Although there are data suggesting that teachers' career stages can be linked to their level of policy implementation, there is also the consideration that with increased accountability all teachers are held to the same level of expectations and accountability. The goal of increased accountability, more rigorous exit assessments, and consequences for not meeting mandates is to focus educators on student learning outcomes and achievement. Additionally, increased accountability has led to increased efforts at building the capacity of educators to meet the demands of new standards and rigorous high-stakes assessments.

The field of professional development has evolved; it is seen as a tool in helping to shape teacher beliefs and change teacher practices. It is important to understand that teachers are asked to master new pedagogical skills, deepen their content knowledge, and change their instructional practices; therefore, professional development is needed. There are different types of professional development experiences, and those experiences can result in varying levels of lasting impact on teachers' practices. The District under study made a commitment to reform-oriented professional development activities to build teachers' capacity and improve student achievement outcomes. Nevertheless, professional development, which is one of the tools that systems use to build the capacity of teachers, change their practice, and, as a result, improve student achievement, has not been proven to be an effective means of changing teacher practice in ways that improve student achievement. Perhaps it is important to consider that teachers' responses to reform are based on their beliefs and are not merely tied to a lack of capacity. There are factors that impact teachers' acceptance or resistance to policy.

As policies are implemented in local school settings, they are filtered through teachers. Teachers have a high degree of autonomy in how they implement curriculum, standards, or other policy expectations in their classrooms. In this manner, they are both the targets of policy reform as well as the agents of change required to implement the reform. Policy acceptance or resistance in mathematics can be tied to teachers' reaction to a variety of factors, such as top-down or bottom-up policy implementation models, ambiguity, conflict, will, attitudes, motivation, beliefs, and administrative support. Nevertheless, additional content-specific considerations in mathematics also impact teachers' responses to policy and reform efforts: for example, teachers' beliefs about curriculum, standards, and assessment. Other issues that play a role in teacher acceptance or resistance include issues of time (class and planning time, standardized testing, class size, and student mobility or absenteeism), quality (curriculum, teacher preparation, and professional development), and design (effective and equitable systems of mathematics reform).

Research Questions and Conceptual Framework

This study focused on the following research questions. How did the District's Algebra 1 strategic initiative evolve between the 2002-2003 and 2013-2014 school years? How did secondary mathematics teachers and the larger school system community respond to the Algebra 1 strategic initiative between the 2002-2003 and 2013-2014 school years?

The literature on policy implementation reviewed in Chapter 2 identified both internal and external factors that impact teacher acceptance and resistance to policy implementation efforts. The researcher used the major themes identified in the literature to code the qualitative data. The following categories were created to organize, sort, and analyze qualitative data:

- Time
- Resources or curriculum
- Support structures or accountability
- School culture
- Levels of collaboration
- Amount of change required
- Pace of change
- Beliefs about change required
- Teacher identity
- Beliefs about what is best for students
- Beliefs about student ability
- Stress or teacher vitality
- Motivation
- Autonomy
- Feelings of loss

The researcher organized the categories into external versus internal groupings. The external impacts were then organized by tangible and intangible factors. Tangible factors were identified as time, resource or curriculum, and support structures or accountability. Intangible factors were school culture and levels of collaboration.

Internal factors were grouped according to understanding of goals, math content-specific considerations, and individual disposition. Understanding of goals included data on amount of change required, pace of change, and teacher beliefs about the change. Teacher identity, beliefs about what is best for students, and beliefs about student ability were math-specific considerations. Individual disposition consisted of level of engagement and understanding of teacher's role. Level of engagement took into consideration stress, teacher vitality, and motivation, whereas understanding of teacher's role referred to autonomy and feelings of loss.

Chapter 3 presents the rationale for a historical case study, the study setting, program description, an overview of the District and study participants, research procedures for collection of qualitative and quantitative data, a conceptual framework, delimitations, and limitations of the study.

Chapter 3: Methodology

This chapter outlines the methods used to conduct a historical case study of the issues related to the implementation of a suburban-urban district's required ninth-grade Algebra 1 strategic initiative. Qualitative and quantitative data were collected to determine (a) how the District's Algebra 1 policy evolved between the 2002 and 2014 school years, and (b) how secondary mathematics teachers and the larger school system community responded to the initiative during those years. This chapter provides a rationale for use of historical case study methods, describes the school district setting for the study and the reform initiative whose implementation was studied, and explains the qualitative and quantitative methods used to gather and analyze data.

Rationale for Historical Case Study

In this research, the scope of a mathematics policy implementation in a school district between the 2002-2003 and 2013-2014 school years was studied through a historical case study lens. Conducting the research as a historical case study allowed the researcher to trace changes in individuals and the organization over time. The following statement by Yin supports the decision to use historical case study:

> Major public initiatives deliberately aim at improving schools by encouraging the reform of entire systems. However, neither the business transformation nor school reform processes are linear, in at least two ways. First, changes may reverse course and not just progress in one direction. Second, the completed transformation or systemic reform is not necessarily an end point implied by the linear model; continued

> transforming and reforming may be ongoing processes even over the long haul. (Yin, 2009, p. 154)

This method allows the researcher to explore individuals or organizations, simple through complex interventions, relationships, communities, or programs using a variety of data sources to ensure that the issue is explored and understood through a variety of lenses (Baxter & Jack, 2008). The researcher collected data regarding individual behaviors, attitudes, and perceptions of secondary mathematics teachers. In addition, this case study approach allowed the researcher to answer “how” and “why” questions specific to the school system’s policy implementation over time. One strength of a case study approach is that it allows for analysis of a variety of evidence (documents, artifacts, interviews, and observations) beyond what might be available in other forms of research (Yin, 2009). Historical case study methodology allowed this researcher to explore the phenomena related to the Algebra 1 policy implementation in the District under study between the 2002-2003 and 2013-2014 school years to understand how the policy evolved over time and to explain how the teachers, students, and the larger school community responded to the policy. The Algebra 1 strategic initiative was described in the real-life context in which it occurred.

As are experiments, case studies are generalizable to theoretical propositions. The goal in conducting a case study is to expand and generalize theories. Therefore, theory development as a part of the design phase of a case study is essential (Yin, 2009). In historical case study research it is possible to triangulate data by using multiple sources such as documents, archival records, interviews, physical artifacts, and direct observations (Baxter & Jack, 2008). Documents used in case study research are stable and can be reviewed repeatedly; they are exact with names, references, and details; and they provide broad coverage over time across different events and settings (Yin, 2009). In addition, case study interviews provide context, targeted and insightful inferences, and explanations. "Unique in comparison to other qualitative approaches, within case study research, investigators can collect and integrate quantitative survey data, which facilitates reaching a holistic understanding of the phenomenon being studied" (Baxter & Jack, 2008, p. 554).

To organize and analyze a large collection of qualitative data it is critical to use a computer software program to help manage the data. In this study, the researcher used NVivo for Windows, which is a platform that was created in 1999 to analyze all forms of unstructured or nonnumerical data. This software, which is produced by QSR International, is able to interrogate data using powerful search, query, and visualization tools. Researchers are able to collect, organize, and analyze content from interviews, focus group discussions, surveys, audio, social media, videos, and Web pages. "Using a database improves the reliability of the case study as it enables the researcher to track and organize data sources including notes, key documents, tabular materials, narratives, photographs, and audio files" (Baxter & Jack, 2008, p. 554). Researchers can enter data, identify and define codes, and then use the software to locate all textual data matching the requested codes. The resulting output of codes and frequency of codes then can be studied to determine whether any meaningful patterns emerge. The software allows the researcher to put qualitative information into different arrays, place evidence in different categories, create data displays, tabulate the frequency of key terms, and examine the relationships between key terms (Yin, 2009).

In addition to improving the reliability of a case study, a database improves transparency of the study and facilitates its replication (Gibbert, Ruigrok, & Wicki, 2008). According to Baxter and Jack, it is the researcher's

> responsibility to convert a complex phenomenon into a format that is readily understood by the reader. The goal of this dissertation was to describe the study in such a comprehensive manner as to enable the reader to feel as if they [*sic*] had been an active participant in the research and can determine whether or not the study findings could be applied to their own situation. (Baxter & Jack, 2008, p. 555)

To enhance the validity of case study research it is important to formulate a clear research framework, use pattern matching to analyze and sort data, and verify findings through theory triangulation by adopting multiple perspectives (Gibbert et al., 2008). The researcher in this study ensured adherence to commonly used social science research methods by using case study tactics recommended by Yin (2009) to address construct validity, internal validity, external validity, and reliability. To ensure construct validity the researcher used multiple sources of data, established a chain of evidence, and had key informants review a draft case study report. Internal validity was addressed through pattern matching, explanation building, and addressing rival explanations. To address external validity the researcher used a theory model in a single-case study approach. Reliability was ensured through the development of a case study database and use of a case study protocol (Yin, 2009).

Setting

This study examined the implementation of a ninth-grade strategic initiative in relation to secondary mathematics teachers' attitudes and practices over time. The District considered success in Algebra 1 necessary for students to gain access to higher level mathematics and science courses. The issues faced by the District in the implementation of the required ninth-grade Algebra 1 strategic initiative are not unique. In fact, across the nation many other school districts grapple with identifying best instructional strategies for algebra, working with school staff on building-level implementation, and managing diversity in teacher, class, and student characteristics. As schools implemented the District's strategic initiative, decisions were made at the school level regarding the logistics and delivery of Algebra 1 for ninth graders. Individual schools made choices regarding the number of sections of Algebra 1, provisions for common planning time for algebra teachers, class size, the percentage of the mathematics department staff teaching Algebra 1 classes, identification of teachers to teach Algebra 1, ways to provide support for struggling students, scheduling students with a range of skills and abilities, and consideration of the types of classes to be offered. Later in this chapter these school-based decisions are explained in greater detail.

The District under study was a large county-based school system serving both suburban and urban school communities located in an area encompassing approximately 500 square miles. To protect the confidentiality of the District, demographic information from internal and public documents was generalized. In addition, student achievement data were pulled from District documents, but specific sources for the data were not cited, as an additional way of protecting the identity of the school system.

The District saw steady student achievement and enrollment growth under the leadership of two superintendents in the previous decade. In the 2002-2003 school year the official student enrollment was approximately 140,000, and by the 2013-2014 school year the student enrollment had increased by 12,000 students to more than 150,000 (approximate growth of 8.5%). During this same period the District opened a dozen new schools to meet the demands of the growing student population. The distribution of students (Table 5) across elementary, middle, and high school shows that the increases in student enrollment occurred most significantly at the elementary school levels with more than a 12.5% increase between 2002-2003 and 2012-2013 in the number of students enrolled in elementary schools.

Table 5. *Approximate Enrollment by School Level*

	2002-2003	2012-2013
Elementary	64,000	72,000
Middle	32,000	32,000
High	42,000	45,000

(District, 2002-2003, 2012-2013)

The District's demographics changed during the decade with an increase in Hispanic-Latino students and a decrease in White students. These changing demographics may indicate a pattern of "White flight" from the District, with families moving students into private schools or neighboring school districts in less diverse communities (see Table 6).

Table 6. *Approximate District Racial or Ethnic Demographics*

	2002-2003	2013-2014
White	46%	33%
Hispanic-Latino	18%	27%
Black-African American	21%	21%
Asian	14%	14%
Multiple races	NA	≤5%

(District, 2002-2003, 2012-2013)

During the decade the District also experienced increase in the percentage of students served in the English for Speakers of Other Languages (ESOL) program. In 2013-2014 there were students from 160 counties speaking 140 languages. These changes over the past decade indicate that what was already a large and diverse school system continued to increase in diversity and size over a 10-year period (see Table 7).

The District saw an increase in the percentage of students currently receiving free or reduced-price meals (FARMS) and students ever having received FARMS. The FARMS rate referred to the percentage of students currently receiving services. The Ever FARMS rate referred to the total percentage of students who at some point received FARMS services. The increases in the FARMS rates during this time indicate an increase in District students impacted by poverty. The FARMS rates are connected with the increases in student enrollment at the elementary school level as students and families are more likely at that level to self-identify as impacted by poverty and needing support. To receive support a family of four would need to provide documentation of a combined yearly income at or below $43,568 ($3,631 monthly or $838 weekly).

Table 7. *Approximate Demographics for Students Receiving Special Services*

	2002-2003	2013-2014
ESOL	8%	13%
Special education	11%	11%
FARMS	22%	34%
Ever FARMS	35%	43%

(District, 2002-2003, 2012-2013)

Table 8 shows that during this same period the most significant increases occurred in the prekindergarten and kindergarten student populations. These data indicating an increase in the number of young students entering the public school system were tied to the increases in the Hispanic-Latino population in the District.

Table 8. *Student Enrollment by Grade*

	2002-2003	2012-2013
	2,417	3,767
Half-day K	4,342	
Full-day K	5,066	11,650
Grade 1	10,215	11,782
Grade 2	10,342	11,397
Grade 3	10,356	11,416
Grade 4	10,367	11,191
Grade 5	10,868	10,886
Grade 6	10,759	10,517
Grade 7	11,034	10,617
Grade 8	11,009	10,395
Grade 9	11,736	12,453
Grade 10	10,856	11,645
Grade 11	10,021	10,701
Grade 12	9,491	10,351
Totals	138,879	148,768

(District, 2002-2003, 2012-2013)

During the decade the school system saw a steady increase in its operating budget, funded by the local, state, and federal governments. For the 2003 fiscal year the school system was funded at approximately $1.5 billion. The operating budget for the fiscal year for 2014 was more than $2 billion. The greatest increase occurred in the FY 2009 operating budget due to the need to consider the healthcare costs of employees who were retired or close to retirement. In addition, during FY 2012 and FY 2013 the District was impacted by economic issues that were impacting the entire country. There was a decrease from the FY 2011 to the FY 2012 budget whereas the budget for FY 2013 remained the same as the FY 2012 budget. As economic conditions improved locally the District began to ask for and receive budget increases from the county government. The school system's funding is significant because as a well-funded system, the District had the necessary capital to promote implementation efforts by providing support, resources, and professional development for staff.

The schools in the District frequently have been listed in local and national rankings as amongst the top in the United States. The majority (68%) of high schools in the District consistently have received recognition as being amongst the best in the nation by *U.S. News and World Report* on its list of America's Best High Schools. The students in the District have been recognized as among the best in the nation with nearly $300 million in scholarships awarded to the students in the class of 2013.

All students have been held to high expectations and the District has placed a strong emphasis on rigor. The District has devoted money and effort to promoting academic rigor and has been largely successful. More than 10,000 students in the class of 2013 took approximately 34,000 Advanced Placement (AP) exams. The students earned a college-ready (3 or higher) score on 73% of those exams. The students in the class of 2013 (71% of graduates) took the SAT and earned a 1,648 average combined score. In comparison, the national average was 1,498.

Although growth has not been the same across all groups, the District has taken pride in promoting and providing a rigorous education for all students with a focus on reducing the racial or ethnic achievement gap. The District's African American male students had the highest 2009-2010 graduation rate (52%) in the nation, when compared with their peers in the nation's largest school districts. In 2013, nearly 50% of the

District's African American students who took an AP exam scored a 3 or higher. The state average was 30% and the national average 28%. In 2013, nearly 60% of the District's Hispanic students who took an AP exam scored a 3 or higher. The state average was 51% and the national average 41%.

Mathematics Program Description and Overview of the District

In 2003, the school district under study used the NCTM Standards and the State Department of Education standards in algebra and data analysis as guiding documents for development of a new algebra curriculum and a related document setting forth instructional look-fors. The instructional look-fors represented a compilation of recommended instructional strategies and skills designed to support implementation of the District's Algebra 1 curriculum. The look-fors were intended to be used by school staff in planning and by school leadership teams during observations of mathematics lessons. In the summer of 2003, the District offered professional development for the new algebra curriculum to all algebra teachers; this was the 1st year that the school system required summer training for teachers. As this was a new expectation for teachers, the percentage of teachers who completed the required summer training was only 50%. Perhaps teachers thought the curriculum training was voluntary, the training conflicted with summer vacation plans, or teachers thought the training would be offered again during the new school year. In terms of school-based, ongoing, and job-embedded professional development experiences, there was variation in the opportunities available to teachers based on the needs, resources, and priorities of individual schools. Nevertheless, most school-based opportunities for algebra professional development were focused on the format and content of high-stakes state accountability assessments. The majority of teachers focused heavily on preparing students for the high-stakes assessment, which was a graduation requirement for students and was used as a measure of mathematics accountability for the schools and the District.

Across the District and within schools there were differences in the gender, age, teaching experience, certification, and content knowledge of individual algebra teachers (see Table 11). At the building level, there were differences in the ways in which teachers were selected to teach algebra. Although some teachers volunteered for sections of Algebra 1, others were assigned to teach the course. In some departments, decisions regarding the assignment of teachers to Algebra 1 classes were determined collaboratively. Algebra 1 at the high school level is an entry-level course, and many of the veteran teachers preferred to teach higher levels of mathematics. Therefore, often the newest teachers were responsible for teaching ninth-grade algebra. There were also differences in the number of algebra classes assigned to a given teacher, with a possible range of one to five classes in a five-teaching-period schedule.

There is a variety of class structures for delivering Algebra 1 content (see Table 9). It can be offered as a single 45-minute class, a 90-minute block, or as a section of Algebra 1 tied to a Related Math[17] section. Very often, in a single school, a range of these options was offered. For example, schools could have a single period of algebra for students with more advanced algebra skills and a double period of Algebra 1 with a Related Math section for English language learners, students with special needs, or students with weaker algebra skills. Students in Algebra 1 and Related Math sections

[17] Related Math is a pre-algebra high school course.

may have had the same or different teachers for the double period. They also may have had the two courses back to back or spaced out across different periods during the day.

Table 9: *Summary of Teacher and Course Characteristics*

Characteristics of teachers	Age		Gender		Years of experience				
	Content knowledge		Certification		Beliefs				
	Full time	Part time	Second career		Long-term substitute				
Selection of Algebra 1 teachers	Volunteer		Collaborative decision		Assigned by supervisor				
Number of Algebra 1 sections per teacher	1	2	3	4	5				
Structure of Algebra 1 classes	Same teacher for 1A and 1B	Algebra 1 and Related Math	Same teacher for Algebra and Related Math	Algebra and Related back to back	Algebra and Related not back to back	Class size	Single period	90 minute block	Extend 2-3 weeks into June
Summative assessments in Algebra 1	Quarter 1 grade	Quarter 2 grade	Quarter 3 grade	Quarter 4 grade					
	Ongoing unit assessments in curriculum guide				State Algebra Assessment (SAA)[18]				
	Semester 1 grade	County final exam (Algebra 1A)	Semester 2 grade	County final exam (Algebra 1B)					

[18] To maintain the confidentiality of the District the State mandated assessment is referred to as the State Algebra Assessment.

In most cases, students in the District took Algebra 1 in the eighth grade. Students on an accelerated pathway might take Algebra 1 as early as seventh grade. There were multiple pathways that brought students to Algebra 1 in ninth grade; as a result, students taking the course in the ninth grade possessed a wide range of characteristics. Some of the students taking ninth-grade Algebra 1 had the opportunity to take a pre-algebra course in the eighth grade. Other students might have been unsuccessful when they took Algebra 1 in the eighth grade and repeated the course in high school. These students had not been on an accelerated mathematics pathway and might be students who historically had struggled with mathematics. In 2013, District data showed that 41% of students had not successfully[19] completed Algebra 1 or a higher level course before the end of their eighth grade year, and 36% of ninth graders had not successfully completed Algebra 1 or a higher level course (see Table 12). Students entered the classroom with a range of knowledge and skills spanning fifth- to tenth-grade mathematics ability. Previous level of mathematics attainment can impact students' confidence levels in algebra as well as provide indications about the level of support they may need both within and outside the Algebra 1 class to be successful. In addition, ninth-grade algebra classes are more likely to consist of diverse student populations; students may be part of the FARMS program, special education, or English language learner subgroups.

Students in ninth-grade algebra were formatively and summatively assessed via marking period and semester grades throughout the year, District end-of-semester exams in the winter and spring, and the state assessment in the spring (see Table 11). For each

[19] This number included data on students who took the course and were not successful as well as students who did not attempt to take the course.

unit of the curriculum, a District unit assessment was administered. The unit assessments, in addition to quizzes, homework, and other teacher-produced assessments, combined to make up the quarter grade. The semester grade was determined by the grades earned during the two quarters as well as the grade earned on the District end-of-semester exam. Therefore, in addition to covering the curriculum, teachers needed to prepare students for the types of problems they would confront on multiple assessments.

Teachers

All of the teachers included in the quantitative portion of the case study were high school mathematics teachers who worked in the District under study during the 2008-2009 school year. The perspective of teachers during this period is significant because during this time the school system faced disagreement from secondary mathematics teachers and parents with regard to the implementation of the strategic initiative.

In the 2002-2003 school year, the school system began an Algebra 1 strategic initiative aimed at helping to address the racial or ethnic achievement gap in mathematics by requiring all students to complete Algebra 1 by the end of their ninth-grade year. This initiative quickly moved into middle schools in which students were encouraged to complete Algebra 1 by the end of eighth grade (see Table 12). According to the baseline data, there was a 16% increase in number of students completing Algebra 1 or higher in the eighth grade and a 7% decrease in completion by the end of ninth grade. It is possible that as more students had the opportunity to be accelerated and took the course in eighth grade, the remaining students who took the course in ninth grade represented the students with the most significant academic needs. It is important to note that the data in Table 10 include completion of Algebra 1 or a higher level math such as geometry or, in some cases, Algebra 2 in either eighth or ninth grade.

Table 10. *Algebra or Higher Level Mathematics Completion Rates by Year and Grade Level*

	Eighth grade %	Ninth grade %
2001	43	71
2007	55	76
2008	59	77
2009	65	78
2010	63	67
2011	62	68
2012	62	66
2013	59	64

(District, 2006, 2009, 2011, 2013)

In the previous decade the system had seen student achievement and enrollment grow and decline with regard to the Algebra 1 strategic initiative, which began in the 2002-2003 school year. Nearly 60% of Grade 8 students in 2013-2014 completed Algebra 1 with a C or higher or were enrolled in a higher level math course. In comparison, slightly more than 40% of eighth-grade students had completed Algebra 1 in 2001-2002, thereby representing approximately a 20% increase in Grade 8 completion of Algebra 1. The increases in students' completing Algebra 1 in Grade 8 were counterbalanced by decreases in Grade 9 completion. The above data show that the initiative, which began as an algebra-for-all policy aimed at ninth-grade students, moved down into the eighth grade. As more students took the course in middle school, it is possible that there were fewer students who needed to complete the course in high school. Nevertheless, the students who had not completed the course in eighth grade might have represented the most challenging population of mathematics learners.

Although more students were successfully completing Algebra 1 earlier in their secondary[20] school careers, there was still an unchanging gap in achievement for diverse students (see Table 13). More than a decade after the initiative was implemented, the percentages of Black and Hispanic students who successfully completed Algebra 1 or a higher level math class by the end of ninth grade remained essentially unchanged. It is possible that the strategic initiative that promoted early access to Algebra 1 did not promote the types of instructional changes in the classroom that would translate into increased student achievement for Black and Hispanic students. The data show that there were some increases for all student groups up to the 2009 school year data, but starting with the data for 2010, the successful completion rates began to decline. There may have been changes in the District's curriculum or end-of-semester assessments that impacted student achievement data. A comparison of the 2013 data to the 2001 baseline data shows that the gap between Black and Hispanic students and their Asian and White peers remained essentially unchanged.

In 2013, more than 80% of White and Asian students successfully completed Algebra 1 or a higher level math course by the end of their ninth-grade year. In comparison, only 51% of Black students and 44% of Hispanic students were able to successfully complete Algebra 1 or a higher level math course by the end of their ninth-grade year. It is important to note that the school system combined the data of students

[20] Students in Grades 6-12 are considered secondary school students. Students in Grades 6-8 are in middle school, and students in Grades 9-12 are high school students.

who had successfully completed Algebra 1, Geometry, or Algebra 2 in one calculation. This is significant information because successful completion of Algebra 2 reflected a student on an accelerated pathway, whereas completion of Algebra 1 by the end of ninth grade was a minimum requirement. Combining the data does not provide a clear demographic picture of which students were being accelerated and which students were meeting only basic competencies. In addition, the school system data show that from the baseline year of 2001 there was a decrease in the percentage of Asian students completing Algebra 1 or a higher math course by the end of Grade 9 and minimal growth in the percentages of White, Black, and Hispanic students successfully completing Algebra 1 or a higher course by the end of ninth grade (Table 11). Data also indicate that there was a decrease in the completion percentages for students of multiple ethnicities. Table 11 also indicates that after the 2009 results, there were decreases for all student groups. There are two possible explanations for these decreases. It may be that the creation of the multiple-ethnicity demographic negatively impacted the data for other student groups. Additionally, based on a review of available public-release test items, it appears that after the administration of the test in 2009 the high-stakes assessment used by the State was changed so that it no longer included short-answer questions. Starting in 2010 students received only multiple-choice questions and that this change in the types of questions on the assessment impacted student achievement. In order to determine if other districts in the state had a similar decline in student achievement after 2009 the researcher attempted to access data on other districts through the public student achievement website for the State Board of Education. This researcher was not able to find archived data from other districts in order to compare the data.

Table 11. *Grade 9 Algebra or Higher Level Mathematics Student Completion Rates: Percentage by Race or Ethnicity*

	White	Asian	Black	Hispanic	Multiple Ethnicity[21]
2001	83	89	48	44	
2007	90	91	61	55	
2008	88	88	65	62	
2009	89	89	66	63	
2010	82	84	51	51	77
2011	85	83	52	53	78
2012	83	83	53	49	74
2013	83	82	51	44	76

(District, 2006, 2009, 2011, 2013)

As previously noted, this was a dynamic District committed to excellence and focused on promoting access to college for all students who wanted it and working on addressing the racial or ethnic gap in student achievement. Although there were many successes to celebrate, it is critical to point out that the District has continued to struggle with the challenge of closing the racial or ethnic achievement gap. The students in the District had faced progressively more challenging and high-stakes assessments in the previous decade. To continue to support student achievement, the District planned to continue to discuss best practices for addressing the persistent demographic achievement gaps in secondary mathematics as it implemented the Common Core and the Partnership for Assessment of Readiness for College and Careers (PARCC) assessments.

[21] There are no data for students in the category of multiple ethnicity prior to 2010 as the category did not exist as a demographic option prior to 2010.

Procedures

To ensure maximum validity and reliability, the researcher identified multiple data sources (see Table 2) to be used in response to each research question.

Quantitative Data – Survey Development

To gather quantitative data reflecting teacher perspectives toward the strategic initiative, the researcher reviewed previously developed surveys and used them as guides in the development of an original survey specific to the research questions being studied. To improve the survey, the researcher conducted interviews with school-based and central-office staff to identify specific topics related to the implementation of the strategic initiative. At the time of the implementation of the strategic initiative there was a sense that secondary mathematics teachers did not support the ninth-grade initiative. In order to gather teacher perspectives for a pilot study, the researcher conducted semistructured interviews with three algebra teachers to clarify issues related to the implementation of the strategic initiative. The researcher met with each of these teachers individually at their respective schools. The three different interviews took different amounts of time based on the amount of information being shared by the teacher. The shortest interview took 30 minutes, another interview took 45 minutes, and the longest interview took 2 hours. The researcher wrote notes during these interviews (see Appendix A) and sent the notes back to the teachers for verification. All three teachers responded to the following questions:

1. What are the characteristics of the students in your classes?
2. What instructional strategies do you use to help students learn Algebra 1 content? Which strategies work the best? Which don't work at all?

3. How do you support limited English proficient (LEP) students during instruction?
4. What are your thoughts regarding the strategic initiative? What works well? What are some concerns?
5. What are your thoughts on the SAA[22]?
6. How has your instruction changed to prepare students for the SAA?
7. How did your school address the needs of students who failed the first semester for Algebra 1?
8. Do you have any concerns regarding making adequate yearly progress (AYP)?
9. What can you tell me about the algebra program at your school?
10. Are you impacted by students who took Algebra 1 in the eighth grade?
11. Which staff development, if any, prepares you for the issues you confront?

The following themes emerged from teachers' responses: impact on planning, evaluation of students, preparation of students, curriculum implementation, beliefs regarding the teaching and learning of algebra, high-stakes assessment, and beliefs regarding secondary mathematics pathways. These topics were then used in the development of a pilot study survey designed to better understand teachers' perspectives.

The researcher also conducted one semistructured interview with an evaluation specialist in the Department of Reporting and Regulatory Accountability, who had coauthored a District evaluation of the Algebra 1 curriculum implementation. In addition, the researcher had meetings with several other central office staff. At these

[22] To protect the confidentiality of the District, the state assessment is being called the State Algebra Assessment (SAA).

meetings a secondary mathematics content specialist and an in-District trainer for the Skillful Teaching and Leading Team provided the researcher with feedback regarding the clarity of instructions, wording, and response modes in her survey. The survey was then modified to reflect the respondents' comments.

Quantitative Data – Pilot Study of Survey

To refine the survey to be used in the study, an early version of the survey was piloted with eighth-grade mathematics teachers in June 2008. These teachers were identified through the Council for Teaching and Learning, which is an instructional component of the teachers' union in the District. An invitation (see Appendix B) was sent to all eighth-grade teachers who were involved in the pilot data collection that provided clarification regarding the pilot study. Teachers teaching Algebra 1 to eighth-grade students were selected so that their perspective as secondary mathematics teachers of Algebra 1 could be used to inform the development of a survey to be given to ninth-grade Algebra 1 teachers. Of 40 teachers, 14 (35%) completed the survey. There are two possible reasons for the low response rate: First, the pilot survey was administered at the end of the school year during a time when teachers had additional responsibilities and were preparing for summer break; second, the first page of the survey had too many questions on one page and therefore teachers did not begin the survey. Data gathered from this pilot survey were used to improve the instrument ultimately used as a part of the study. In the pilot survey, there were 21 questions on six pages. Page 1 of the survey asked teachers if they agreed to participate in the pilot study and page 6 thanked them for their participation. Therefore, the 21 questions were distributed over three pages. It appeared that the long lists of questions on the pages discouraged people from completing the survey. To improve the survey, the researcher created a revised survey presenting 24 questions on 11 pages so that on each visible page of the survey the number of responses required of teachers was not overwhelming. In addition, a page was added at the start of the survey defining the components of the strategic initiative because some of the feedback indicated that the teachers in the pilot study were not familiar with that information.

Quantitative Data – Final Research Survey

Prior to beginning this study, the researcher obtained permission from the dissertation committee members, the University Institutional Review Board (IRB), and the school system. In the spring of 2009, 370 high school mathematics teachers were provided with an opportunity to respond to the survey via an electronic link sent in an e-mail message. At that time predominantly the students in the District took Algebra 1 in the ninth grade, and only the most accelerated students took the course in the eighth grade. The teachers were provided with an explanation of the study as well as the link to the electronic survey instrument. Data were collected electronically via Survey Monkey,[23] an online data collection program. In the text of the e-mail communication,

[23] Survey Monkey was created in 1999 and enables researchers to quickly and reliably collect and analyze data. Researchers have a variety of question formats from which to choose, including multiple choice, rating scales, and drop-down menus. Survey Monkey allows researchers to view results in real time, as they are collected. In addition, the software creates graphs and charts, and it is able to drill down to obtain individual responses. The data collected can be securely shared with others. Powerful filtering allows the researcher to display only the responses he or she is interested in viewing. It is possible to quickly download a summary of results in multiple formats. For the purposes of statistical analysis it is possible to download all of the raw data that have been collected in either a spreadsheet or a database format. Finally, all the data collected remain private. Those interested in more information regarding this program should access the following Web site: www.surveymonkey.com

participants were informed about the study, assured confidentiality, and provided with instructions for completing the survey instrument.

The purpose of this researcher-designed six-part survey (see Appendix C) was to gather data from 370 teachers regarding their perspectives related to the implementation of the ninth-grade Algebra 1 strategic initiative. The first section of the survey provided participants with information similar to the information communicated via e-mail and asked participants if they were willing to participate in the study. If participants responded with a *yes* they were redirected to the survey. Those responding with a *no* were redirected to a screen that provided the contact information for the researcher and thanked them for their time. The second part of the survey focused specifically on perspectives related to general support, student impact, teacher impact, and curriculum impact. The third part of the survey also gathered data specific to teachers' responses regarding high-stakes assessment in the areas of planning, instruction, evaluation, and preparation of students for such assessment. The fourth part of the survey asked participants to indicate which professional development opportunities they had completed. The fifth part of the survey asked participants to provide demographic information. The sixth part of the survey thanked participants, provided contact information for the researcher, and provided participants with space to provide qualitative feedback regarding the content and organization of the survey. Most sections of the instrument used a 4-point scale with the following response options: *strongly agree* (4), *agree* (3), *disagree* (2), and *strongly disagree* (1). In the professional development and demographic areas of the survey, participants were provided with multiple options from which to choose their responses to specific questions.

Of 370 teachers, 104 (28%) completed the survey. Although there is no single rate that is considered the standard all surveys hope for a high response rate (Fink, 1995, p. 53). "High survey response rates help to ensure that survey results are representative of the target population. A survey must have a good response rate in order to produce accurate, useful results" (Instructional Assessment Resources, 2015, p. 1). According to the Instructional Assessment resources the following are acceptable response rates for different means of survey administration.

- Mail: 50% adequate, 60% good, 70% very good
- Phone: 80% good
- E-mail: 40% average, 50% good, 60% very good
- Online: 30% average
- Classroom paper: > 50% = good
- Face-to-face: 80-85% good

Quantitative Data Analysis

The researcher used the SPSS software program. To test the data regarding Research Question 2, correlation and regression techniques were used. Correlations were used to investigate the relationship between two or more variables. "Relationships are indicated by obtaining at least two scores from each subject. The pairs of scores are used to produce a scatter gram and to calculate a correlation coefficient. Each score represents a variable in the study" (McMillan, 2004, p. 183). The following statements further explain correlation:

> The purpose of the correlation coefficient is to express in mathematical terms the degree and direction of relationship between two (or more) variables. If the relationship between the two variables is perfectly positive, the correlation coefficient will be 1.00. If the relationship is perfectly negative, it will be -1.00. If there is no relationship, the coefficient will be 0. Thus the correlation coefficient is a precise way of stating the degree to which one variable is related to another, and the direction of the relationship (positive or negative). (Gall, Gall, & Borg, 2003, p. 322)

To compare two or more means, the researcher used a simple analysis of variance (ANOVA) procedure. The ANOVA equation uses the variances of the groups to calculate a value called the *F* ratio (McMillan, 2004). The researcher used the *F* ratio to determine whether statistically significant differences existed.

To compare the perspectives of teachers teaching ninth-grade Algebra 1 to those of teachers not teaching Algebra 1 during the 2008-2009 school year, the researcher compared demographic data regarding the respondent's current position, collected through Question 14 on the survey, with items on the survey related to general support, student impact, teacher impact, curriculum impact, impact on planning, impact on instruction, evaluation of students, and preparation of students. To compare the perspectives of teachers teaching in high-poverty to those in low-poverty schools, the researcher compared demographic data regarding student participation in FARMS, collected through question 13 on the survey, with items related to general support, student impact, teacher impact, curriculum impact, impact on planning, impact on instruction, evaluation of students, and preparation of students. To examine the perspectives of novice, experienced, and veteran teachers, the researcher compared data regarding teachers' age, years of teaching, years teaching Algebra 1, level of education, and certification with data related to general support, student impact, teacher impact, curriculum impact, impact on planning, impact on instruction, evaluation of students, and preparation of students.

Qualitative Data – Follow-Up Questions

To gather qualitative data, the researcher conducted semistructured interviews with nine of the 107 high school mathematics teachers[24] who completed the survey. Each of these nine volunteers had provided his or her name and contact information at the end of the survey and indicated a willingness to provide additional information to the researcher. The researcher acknowledges the possibility of bias in the information being shared by these volunteers. Had there been more teachers who volunteered, the researcher would have randomly selected a percentage to participate in the semistructured phone interviews. As there were only nine volunteers, the researcher contacted all of those who shared a willingness to participate. The goal of these interviews was to obtain more detailed information about teachers' perspectives related to specific aspects of the strategic initiative.

[24] The survey was emailed to 370 high school mathematics teachers.

The following questions were used in the interviews:

1. What are the benefits of the ninth-grade strategic initiative?
2. In what ways has the ninth-grade strategic initiative impacted your instructional practices?
3. What are the challenges you face in implementing the ninth-grade strategic initiative?
4. How could the strategic initiative be improved?

Qualitative Data Analysis

The researcher used qualitative data to better understand how the initiative evolved over time and to ascertain the perspectives of teachers and the school system regarding the implementation of the strategic initiative. The qualitative component of this historical case study provides insight into the perspectives of stakeholders spanning several years. Qualitative data from a variety of sources (board of education [BOE] memoranda, school system reports and research, researcher interviews, e-mails, postings on a public forum) were entered into a database. The software program NVivo[25] was used to organize and store the data.

Qualitative data collected from in-person or phone interviews were recorded in the form of notes. The notes were transcribed and sent to each participant so that they could be checked for accuracy and added to or revised as needed. These data were

[25] NVivo for windows is a platform that was created in 1999 to analyze all forms of unstructured or nonnumerical data. This software, which is produced by QSR International, is able to interrogate data using powerful search, query, and visualization tools. Researchers are able to collect, organize, and analyze content from interviews, focus group discussions, surveys, audio, social media, videos, and webpages. Those interested in learning more information about this program should access the following Web site: http://www.qsrinternational.com/

organized and categorized to identify emerging themes and generalizations. The researcher also asked a central office mathematics supervisor, a high school resource teacher, a central office content specialist, and a retired principal to independently identify themes and generalizations and to ensure the accuracy of information gained through qualitative data collection. Qualitative data collected from historical documents were organized chronologically. The researcher then read and wrote notes about all of the documents.

Conceptual Framework

The policy implementation literature reviewed in Chapter 2 identified both internal and external factors that impact teacher acceptance or resistance to policy implementation efforts. The researcher used the major themes identified in the literature to code the qualitative data. The following categories were created to organize, sort, and analyze qualitative data:

- Time
- Resources or curriculum
- Support structures or accountability
- School culture
- Levels of collaboration
- Amount of change required
- Pace of change
- Beliefs about change required
- Teacher identity
- Beliefs about what is best for students

- Beliefs about student ability
- Stress or teacher vitality
- Motivation
- Autonomy
- Feelings of loss

Qualitative data from historical documents, work group reports, public–media reports, phone interviews, interviews, e-mails, and postings on District discussion forums were entered into NVivo according to the aforementioned categories. The researcher then conducted an analysis to determine if there were any factors that were more impactful in determining teacher acceptance or resistance to this strategic initiative. In addition, the researcher looked for other themes or connections among the data.

The researcher first organized the categories into external versus internal groupings. The external impacts were then organized according to tangible and intangible factors (see Figure 2). Tangible factors were identified as time, resources or curriculum, and support structures or accountability. Intangible factors were school culture and levels of collaboration.

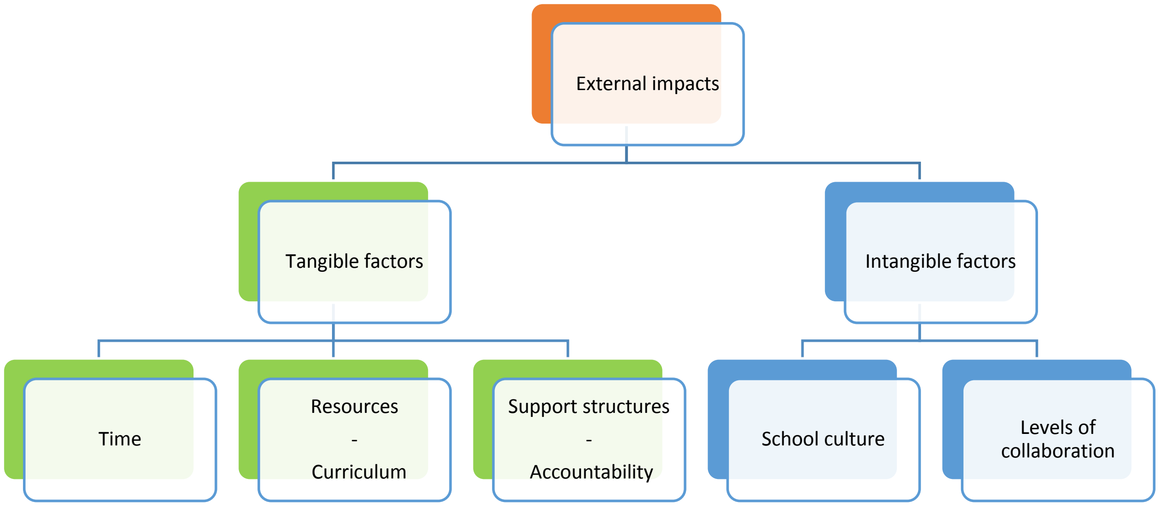

Figure 2. External factors impacting teachers' understanding, acceptance, or resistance to policy.

Internal factors were grouped according to understanding of goals, math content-specific considerations, and individual disposition (see Figures 3 and 4).

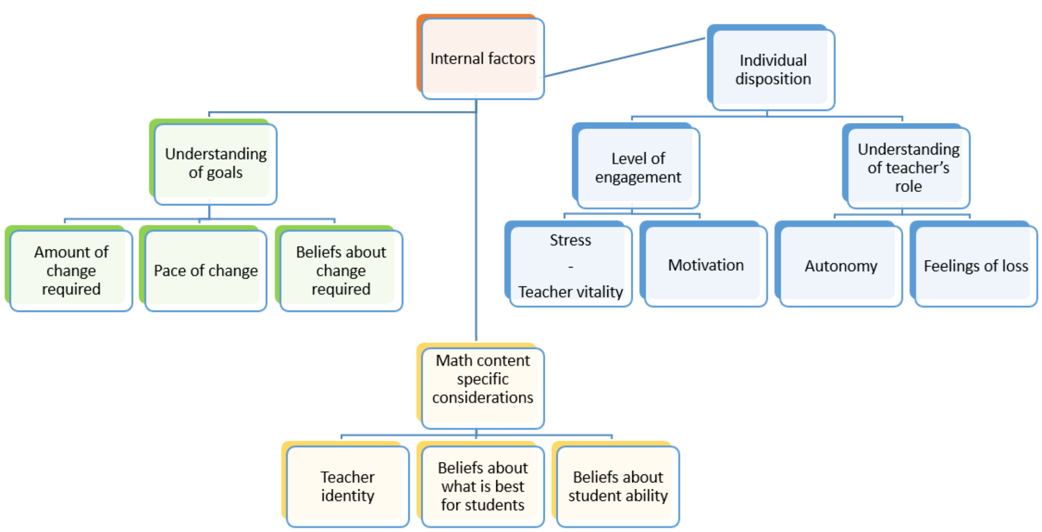

Figure 3. Internal factors impacting teachers' understanding and acceptance of or resistance to policy.

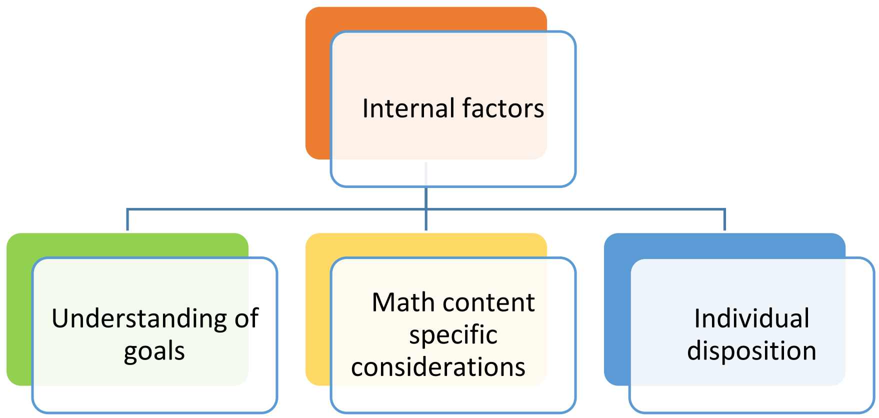

Figure 4: Internal factors impacting teachers' understanding and acceptance of or resistance to policy.

Amount of change required, pace of change, and teacher beliefs about the required change impacted their understanding of goals (see Figure 5).

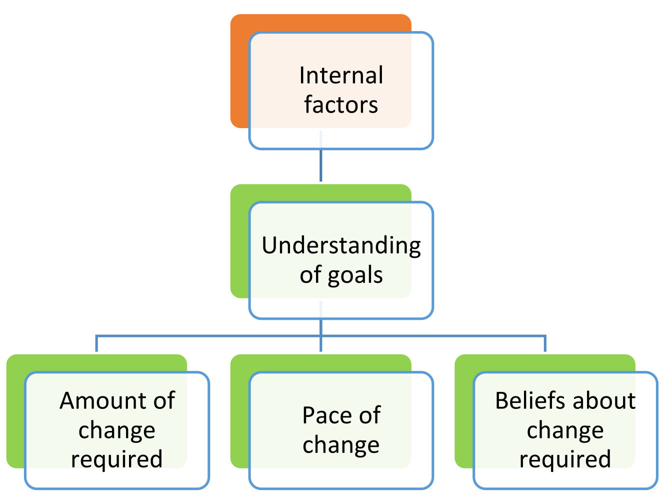

Figure 5. Internal factors – Understanding of goals.

Teacher identity, beliefs about what is best for students, and beliefs about student ability were math-specific considerations (see Figure 6).

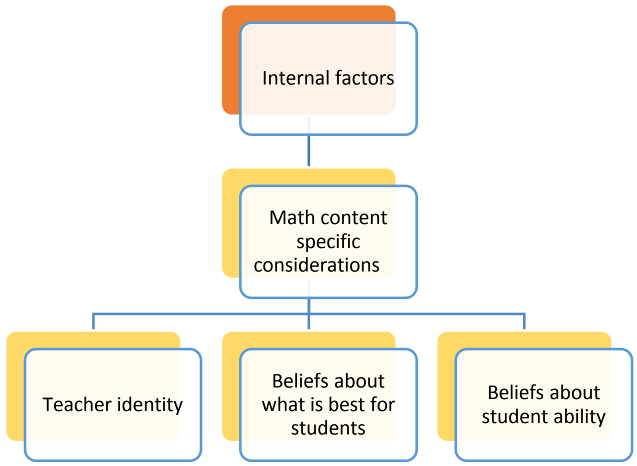

Figure 6. Internal factors – Math content-specific considerations.

Individual disposition reflected level of engagement and understanding of teacher's role (see Figure 7). Level of engagement took into consideration stress, teacher vitality and motivation, whereas understanding of teacher's role referred to autonomy and feelings of loss.

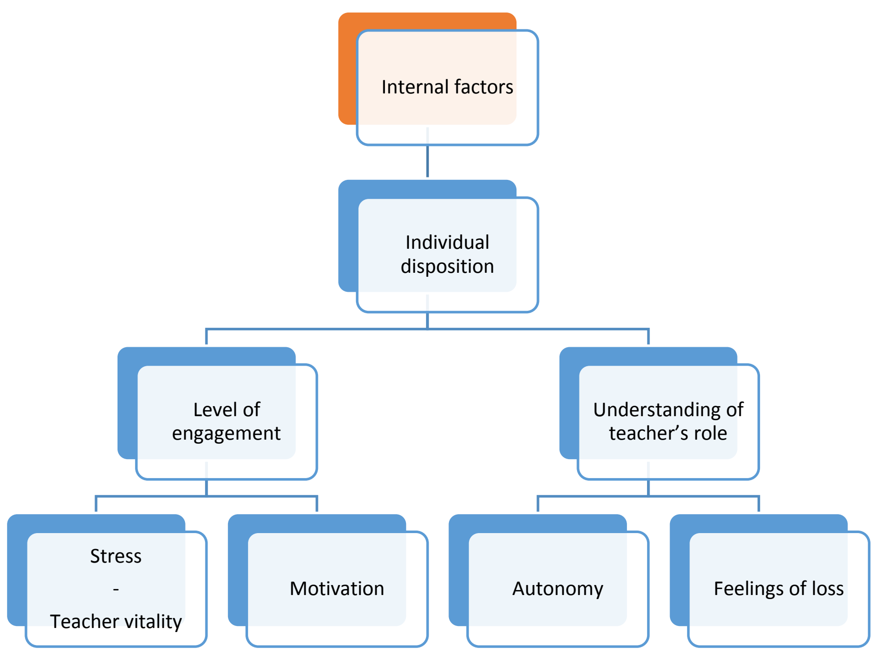

Figure 7. Internal factors – Individual disposition.

Delimitations of the Study

It is important to note that an underlying issue regarding the education of ethnic minority learners and tracking in secondary mathematics impacted the strategic initiative; however, this issue was not closely related to the research questions being examined. In addition, it should be noted that the implementation of this initiative caused a level of disagreement among educators in the District under study.

Limitations of the Study

The findings from this research are very specific to the setting and strategic initiative being studied. Additionally, this study did not focus on the perspectives of parents, students, university faculty, or the larger community. The data collected focuses on the perspectives of secondary high school mathematics teachers who responded to the survey and participated in interviews. It is possible that the data collected represent the perspectives and biases of those who were passionate about the topic.

Summary

In summary, this chapter outlines the procedures used to investigate teacher acceptance or resistance of a school system's implementation of a ninth-grade Algebra 1 strategic initiative. The chapter provides a description of the research design and methods used for collecting and analyzing the quantitative and qualitative data obtained for the study. In addition, a description of the themes identified and used as part of a conceptual framework is provided to explain the process used in organizing and analyzing the qualitative data.

Chapter 4: Results

Introduction

Historically, student success in mathematics has been an important goal in K-12 education. In the United States, there have been decades of discussions and debates regarding which standards to teach and the best way to teach them in the mathematics classroom. At the secondary level, Algebra 1 is a critical course that is typically a requirement for high school graduation. In addition, Algebra 1 serves as an entry point to higher levels of mathematics and sciences courses; therefore, it is a means of preparing students for career and college readiness.

To promote the achievement of students, policies have been enacted at the national, state, and local levels. Many school systems provide access to Algebra 1 for students as early as Grade 7 and require that students complete the course by their first year in high school. All of these policies require to some extent a change in the curriculum taught, the instructional practices of teachers, and teachers' beliefs about what students can accomplish. To implement these policies at the local level, school systems provide teachers with professional development opportunities, develop curricula aligned with the goals and standards of the reform, and mandate local expectations. Implementation of policy initiatives is a complex process, however, and teachers can accept or resist policy implementation based on a variety of factors.

This research is based on a historical case study of one school system's experience in implementing a strategic initiative aimed at providing access to Algebra 1 for all students between the 2002-2003 and 2013-2014 school years. The school system measured the percentage of students in the ninth grade successfully[26] completing Algebra 1 or a higher math by the end of their ninth-grade year. Chapter 4 presents the results of data analysis. This mixed-methods study was designed to investigate how a district's Algebra 1 policy evolved over time and how secondary mathematics teachers and the larger school community responded to the initiative. The research questions were the following:

1. How did the District's Algebra 1 strategic initiative evolve between the 2002-2003 and 2013-2014 school years?
2. How did secondary mathematics teachers and the larger school system community respond to the Algebra 1 strategic initiative between the 2002-2003 and 2013-2014 school years?

The research was conducted in two phases by the researcher. The first phase involved a quantitative design. In 2009, secondary mathematics teachers in the District completed a survey to provide their perspectives regarding the strategic initiative; the survey was sent to 370 secondary mathematics teachers. The second phase of the study focused on qualitative data collection. The researcher conducted in-person and phone interviews with District staff as well as high school mathematics teachers. In addition, written documents (strategic planning documents, memoranda, research reports, work group reports, public–media reports, e-mails, board of education meeting minutes, and postings on a District discussion forum) were analyzed (see Table 2). This study's protocols were found to be in accordance with the Federal Policy for the Protection of Human Subjects as defined by the Office for Human Research Protections (OHRP) and were approved by

[26] The District considered passing the course with a grade of C or higher as successful completion.

the researcher's dissertation committee, the Institutional Review Board of The University of Maryland, and the superintendent of the District in which the study was conducted.

Qualitative Data Collection

Qualitative data were gathered through a combination of semistructured and unstructured meetings and phone calls with secondary mathematics teachers and District central office staff (see Table 12).

Table 12. *Compilation of Qualitative Data Collection with District Staff*

Date	Process	Purpose	Minutes
May 26, 2006 May 31, 2006 May 31, 2006	In-person semistructured exploratory interviews with three secondary mathematics teachers	To gain an understanding of teachers' perspectives and to assist in the development of a pilot survey	30 45 120
September 18, 2007	In-person unstructured meeting with a central office secondary math content specialist	To gain an understanding of the District expectations specific to secondary mathematics and to assist in the development of a pilot survey	120
October 2, 2007	In-person unstructured meeting with a central office District professional development trainer and a former secondary math teacher	To gain an understanding of the District expectations specific to secondary mathematics professional development and to assist in the development of a pilot survey	90
May 18, 2008	Administration of a pilot survey to eighth-grade teachers in the District	To gain an understanding of teacher perspectives and to inform the development of a survey	
May 2009	Written remarks in comment areas of survey	To allow secondary mathematics teachers who participated in the online survey to provide written input	NA
June 3, 2009 June 7, 2009 June 8, 2009 June 11, 2009 June 16, 2009 June 18, 2009 June 19, 2009 June 21, 2009	Semistructured phone interviews with secondary math teachers	To better understand teachers' perspectives regarding the generally understood strategic initiative	60
March 2014	Unstructured phone conversation with District's content supervisor for K-12 mathematics	To better understand the District's expectations regarding secondary mathematics	30

Phone Interviews

Semistructured phone interviews were conducted over a period of several weeks in June 2009 with eight high school mathematics teachers who volunteered at the end of a research survey to identify themselves by name so that they could participate in the phone interviews. The sample included four male teachers and four female teachers, representing high schools across the school system, reflecting a range of student body demographics. A similar process and the same four questions were used with each teacher, and the interviews lasted approximately an hour for each respondent.

The process used in all eight phone interviews included thanking participants participating in the phone interview, letting them know that the researcher would be taking notes and that those notes would be transcribed and sent to the participants for review to ensure that their words were accurately captured, and informing them that the phone interview was confidential and that their names would not be used in any part of the dissertation. The teachers also were informed that the phone interviews would last about one hour including about 10-15 minutes on each of four questions. Before starting the interview, the researcher clarified and defined for the participants the following two terms, which had appeared in the survey: SAA (State Algebra Assessment) and the Algebra 1 strategic initiative (the District expectation that all students successfully complete Algebra 1 by the end of ninth grade). The four questions asked of each teacher were the following:

- What are the benefits of the ninth-grade strategic initiative?
- In what ways has the ninth-grade strategic initiative impacted your instructional practices?

- What are the challenges you face in implementing the ninth-grade strategic initiative?
- How could the strategic initiative be improved?

In addition, at the conclusion of the interview, each participant was asked if there were any general or closing remarks that he or she would like to make that were important but not covered in answers given to the interview questions.

The notes were transcribed and sent to the participants for review. Two of the teachers (one male and one female) responded electronically that the notes accurately reflected their recollections of the interviews in June and shared that they had nothing new to add. Six of the subjects did not respond to the e-mail.

Document Review

Additionally, qualitative data were gathered through a review of key documents (strategic planning documents, memoranda, research reports, Board of Education meeting minutes, work group reports, postings on District discussion forum, and public–media reports). Table 13 provides a summary of the number of sources that were cited specific to Algebra 1 policy in the District. The documents prior to 2002 provided some insight into preliminary discussions specific to meeting the needs of students that led to the District’s strategic initiative. A comprehensive timeline for all of the qualitative data sources can be found in Appendix G.

Table 13. *Compilation of Qualitative Document Data Collection*

Year	Number of sources cited for each year specific to policy in the District	Number of remarks cited for each year specific to policy in the District
1988	1	10
1990	1	3
1993	1	7
1994	1	6
1995	1	3
1998	1	1
1999	2	8
2000	4	51
2001	2	2
2002	8	22
2003	6	33
2004	13	99
2005	8	34
2006	9	44
2007	9	54
2008	10	42
2009	6	36
2010	9	51
2011	4	13
2012	4	20
2013	19	116
2014	11	50
2015	1	9
Total	131	714

Quantitative Data Collection

The participants in this study were high school (Grades 9-12) mathematics teachers who worked in the District under study during the 2008-2009 school year. The researcher-designed, six-part survey gathered data regarding teacher perspectives related to the implementation of the ninth-grade Algebra 1 strategic initiative. The survey included the following six sections:

- The first section of the instrument (a) provided participants with information similar to the information they received in the initial e-mail regarding the study and (b) asked participants if they were willing to participate in the study. If they responded with a *yes*, they were redirected to the survey questions. Those responding with a *no* were redirected to a screen that provided the contact information for the researcher and thanked them for their time.
- The second part of the instrument focused specifically on perspectives related to general support, student impact, teacher impact, and curriculum impact.
- The third part of the instrument gathered data specific to teachers' perceptions regarding high-stakes assessment in the areas of planning, instruction, evaluation, and preparation of students for such assessment.
- The fourth part of the survey asked participants to indicate which professional development opportunities they had completed.
- The fifth part of the survey asked participants to provide demographic information.
- The sixth part of the survey asked individuals to identify themselves by name if they were interested in participating in semistructured phone interviews.

At the end of the survey, the researcher included a statement of appreciation to participants, provided contact information for the researcher, and provided participants with space to provide qualitative feedback regarding the content and organization of the survey.

Most sections of the instrument used a 4-point Likert scale with the following response options: *strongly agree*, *agree*, *disagree*, and *strongly disagree*. In the professional development and demographic areas of the survey, participants were provided with multiple options from which to choose their responses to specific questions.

Response Rates

On May 5, 2009, 370 teachers were each sent an e-mail with a link to an online instrument. The researcher sent reminder e-mails on May 8, 2009, May 13, 2009, and May 19, 2009 in an effort to increase the response rate. A total of 135 teachers started the survey, 104 teachers completed the survey in its entirety, 31 teachers partially completed the survey, four teachers opted out of the survey, and 235 teachers were unresponsive. The response rate for the survey was 28%. Due to the low response rate, the data do not represent the rest of the population, only the views of teachers willing to respond.

Demographics

The demographics information presented represents the sample and may not be representative of the general population of secondary mathematics teachers in the District. The researcher was not able to obtain any comparison demographic data. Of the 104 teachers who completed the survey, 70.2% were female and 29.8% were male (see Table 14).

Table 14. *Gender*

Response options	Percent
Male	29.8%
Female	70.2%

The age ranges were fairly evenly distributed for the group of respondents (see Table 15).

Table 15. *Age*

Response options	Percent
21-31	25.0%
32-42	21.2%
43-53	25.0%
53+	28.8%

Table 16 presents a distribution of the number of years teaching.

Table 16. *Years of Teaching*

Response options	Percent
0-5	18.3%
6-11	31.7%
11-16	19.2%
17-22	8.7%
23+	22.1%

The teachers who responded to the survey were predominantly full-time teachers 96.2%; only 3.8% were part-time teachers. Most of the teachers (87.5%) indicated that, at the time of the survey, they were deemed by the State and District to be highly qualified to teach Algebra 1. At the time of the survey, 9.6% did not know if they were considered highly qualified to teach Algebra 1, and 2.9% were not considered highly qualified. Teaching was the first career for 68.3% of the respondents and a second career for 31.7%.

Table 17 presents the highest level of education, at the time of the survey.

Table 17. *Highest Level of Education*

Response options	Percent
Bachelor's	15.4%
Master's	35.6%
Master's plus 30	29.8%
Master's plus 60	18.3%
Doctorate	1.0%

Table 18 presents the certification status of the teachers, at the time of the survey.

Table 18. *Certification*

Response options	Percent
Not certified	1.9%
Professional Eligibility Certificate	2.9%
Standard Professional Certificate I	26.9%
Standard Professional Certificate II	8.7%
Advanced Professional Certificate	59.6%
Resident Teacher Certificate	0.0%
Conditional Certificate	1.0%

Table 19 presents the current positions of the teachers, at the time of the survey.

Table 19. *Current Position*

Response options	Percent
Algebra lead teacher	5.8%
Resource teacher	11.5%
Algebra 1 teacher	39.4%
Secondary mathematics teacher (not teaching any sections of Algebra 1)	44.2%

Table 20 presents the number of years teaching Algebra 1 for the teachers, at the time of the survey.

Table 20. *Number of Years Teaching Algebra 1*

Response options	Percent
Have never taught Algebra 1	5.8%
1-5 years	49.0%
6-11 years	23.1%
11-16 years	11.5%
17-22 years	5.8%
23+ years	4.8%

Table 21 presents the number of Algebra 1 sections being taught by the teachers, at the time of the survey.

Table 21. *Sections of Algebra 1 Being Taught*

Response options	Percent
0	49.0%
1	16.3%
2	25.0%
3	7.7%
4	1.9%
5	0.0%

Table 22 presents the number of Related Mathematics sections being taught by the teachers, at the time of the survey.

Table 22. *Sections of Related Mathematics Being Taught*

Response options	Percent
0	69.2%
1	21.2%
2	6.7%
3	1.0%
4	1.0%
5	1.0%

Table 23 presents the FARMS demographics for the schools where the teachers worked, at the time of the survey.

Table 23. *Student Participation in FARMS*

Response options	Percent
Approximately 0-12.5% of students are currently participating or at some point have participated in FARMS.	21.2%
Approximately 12.5-47.2% of students are currently participating or at some point have participated in FARMS.	60.6%
Approximately 47.2% or more of students are currently participating or at some point have participated in FARMS.	19.2%

Research Questions and Findings

The research questions and related findings are presented below for each of the research questions.

Research Question 1: How did the district's Algebra 1 strategic initiative evolve between the 2002-2003 and 2013-2014 school years?

Table 24 provides a historical context for some of the major themes related to algebra discussions and policy in the District. Sources prior to 2002 were included due to the fact that they showed that the District was focused on student achievement in algebra as early as 1988. A more comprehensive table can be found in Appendix H.

Table 24. *Historical Policy Themes by Year (Sources and Remarks Related to Algebra)*

Year	Policy themes found in sources and remarks
1988	Board of Education discussion of number of students taking algebra in the seventh grade, secondary math pathways, and student readiness.
1990	Board of Education discussion of curriculum and significance of algebraic skills.
1993	Board of Education discussion of mathematics pathways, increasing enrollment in Algebra 1 by ninth grade, curriculum revisions, and inclusion of African American and Hispanic students to accelerated pathways.
1994	Board of Education discussion of number of ninth-grade students successfully completing Algebra 1, state-mandated accountability, connections to SAT, PSAT, and college selection.
1995	Board of Education discussion of the number of students taking and successfully completing Algebra 1 in middle school.
1999	Board of Education discussion of student achievement on the District final examinations in Algebra 1, and student approach and attitude toward the final exam.
2000	Board of Education discussion of the failure rate (64%) on the Algebra 1 exams, review of audit by outside organization, which found unequal access and achievement for students of color in Algebra 1, widely varying curriculum implementation across schools with little system congruity, lack of policies providing long-range direction for alignment of the written, taught, and tested

Year	Policy themes found in sources and remarks
	curriculum in Algebra 1, inadequate direction and support to focus instruction, and lack of clearly articulated District program for K-12 mathematics.
2002	Board of Education discussion of new curriculum frameworks to be developed and implemented by January 2003 for Algebra 1, discussion of the goal of all children completing Algebra 1 by eighth grade, noting that the District had not clearly articulated the goal, discussion related to the percentage of students enrolled in Algebra 1 as ninth graders who passed the District's exam (59.6%), and data shared regarding the acceleration of students in mathematics in sixth, seventh, and eighth grades.
2003	Board of Education discussed review of the system's curriculum by an outside organization. The review was conducted to verify the rigor of the curriculum and ensure alignment with the SAA. The report noted items in the second semester final exam for Algebra 1 that extended beyond the expectations of the State. It was noted that the District's framework was more rigorous than the State's, discussion related to professional development for teachers and ongoing training to build staff capacity, discussion related to the goal of having students complete Algebra 1 by eighth grade, Board of Education approval of new curriculum in Algebra 1, Board of Education discussion of the State's accountability program, No Child Left Behind, and the SAA, discussion regarding the year that passing the State's accountability tests would become a graduation requirement (2009), and budget items included increased staffing so that class sizes could be reduced in Algebra 1.

Year	Policy themes found in sources and remarks
2004	Discussions around the achievement gap and lower achievement of African American and Hispanic students with regard to passing Algebra 1 and passing the District's final exam in Algebra 1; discussion regarding the achievement of ESOL students or those receiving FARMS services, discussion related to student achievement on the SAA in 2002 and 2003, the District began an evaluation study to determine if the implementation of the new Algebra 1 curriculum was achieving the desired goals of mastery of course content, success on District's final exam, and success on the SAA. The District stated in strategic planning documents that all students would successfully complete algebra by the end of Grade 9 and geometry by the end of Grade 10.The District stated in strategic planning documents that success in Algebra 1 was necessary to gain access to higher level mathematics and science courses, as well as to prepare for the mathematics portion of the SAT.
2005	Annual system targets set with the 2004 data as the baseline data and a goal of 100% success on the SAA for the 2009-2010 school year (in response to State and NCLB accountability). The Board of Education discussed the acceleration of students in mathematics starting in Grade 5. In the 2005-2006 school year, 37% of fifth-grade students (n = 3,800) were on an accelerated mathematics pathway. Of the 3,800 students, 500 were African American and 380 were Hispanic. Five years prior only 196 students were accelerated in Grade 5 mathematics and only a handful were African American and Hispanic students. The school system set a goal of 80% successful completion of

Year	Policy themes found in sources and remarks
	Algebra 1 by the end of Grade 8. Board of Education discussion of the Middle School Program Review conducted by an outside organization. The audit found a high percentage of Grade 8 students enrolled in and passing Algebra 1 and Honors Geometry.
2006	Discussion regarding the NCLB mandates and State accountability system. Students starting high school as ninth graders in 2006 needed to pass the SAA as well as other State high-stakes tests to graduate. Data shared system wide highlighting the work of schools that had significant percentages of students successfully completing Algebra 1 in eighth grade. Report from an advisory committee published on Gifted and Talented (GT) Education in the District. Report noted success in making accelerated mathematics accessible to African American and Hispanic students, but also noted that these students were underserved in GT programs. Data showed increases for African American and Hispanic students but reflected a continuing achievement gap. Target of 80% successful completion in Grade 8 not met and noted in District research report. Discussion of the role of Algebra lead teachers at high schools to support student achievement.
2007	Discussion of data related to the achievement of students on the SAA with a focus on the achievement of African American and Hispanic students. District targets developed for the next 5 years and tied to successful completion of Algebra by eighth grade. The importance of mathematics, specifically Algebra 1, was noted in school system documents as a means of preparing students for

Year	Policy themes found in sources and remarks
	higher level courses, the 21st century, and the mathematics portion of the SAT. District targets were set for middle and high schools with expectations for the percentage of schools meeting the District targets in Algebra 1 (for example, 19 of 38 middle schools met the target of 54.6% of students successfully completing Algebra 1 before the end of eighth grade). The data were reviewed by race/ethnicity as well for each school. Data on the school system's acceleration of students showed that 48% of fifth graders were on an accelerated pathway in comparison with 2% in 2001; additionally, 68% of eighth graders were taking algebra in comparison with 36% in 1999 and 49% in 2006. Discussion related to closing secondary learning centers (issues with least restrictive environment); considerations on how to best meet the needs of students with disabilities; information about schools' being able to co-teach in content classes such as Algebra 1 to meet the needs of all students.
2008	Public reports and pushback on the District's acceleration of too many students in mathematics at the expense of the curriculum; discussion related to gaps in the mathematical knowledge of students in higher levels of mathematics due to over acceleration. Discussion of the impact of the SAA on the District's Algebra 1 curriculum (lost time on curriculum due to focus on SAA preparation). Discussion of District's goal of having 80% of students completing Algebra 1 before the end of eighth grade by 2010. Continued sharing of District student achievement data and school system expectations

Year	Policy themes found in sources and remarks
	for acceleration in Algebra 1. Discussion related to system targets and question regarding their reasonableness.
2009	Continued emphasis of the District's expectation that all students successfully (C or higher) complete Algebra 1 by the end of eighth grade. Discussion related to the SAA and the requirement for students who started high school in 2009 to pass those assessments to graduate. Discussion related to the accountability models that hold individual schools accountable based on student performance on the SAA. Data shared regarding the continued growth in the number of students successfully completing Algebra 1 in the eighth grade; data shared regarding the increases for diverse student populations (for example, in 2006 21.2% of African American students successfully completed Algebra 1 in eighth grade, but in 2009 that number more than doubled to 46.6%). Continued discussion regarding addressing institutional barriers and the BOE's commitment to equity; discussion regarding closing the racial/ethnic achievement gap. Data showing that 4,962 students took advanced math in 2008 in comparison to 196 students 7 years prior.
2010	Continued district communication of expectation of successful course completion in Algebra 1 by the end of Grade 8; BOE discussion of definition of successful completion; BOE discussion of data showing decreases in achievement of White and Asian students in Grade 8 Algebra 1; BOE discussion of how students who had difficulty with basic mathematics could be successful in Algebra 1. District staff outlining supports available to students

Year	Policy themes found in sources and remarks
	who struggled in Algebra 1. BOE discussion of acceleration of students in mathematics in fifth grade; discussion regarding the target for algebra completion in eighth grade; BOE member's questioning if it was a realistic target; discussion regarding the impact of acceleration on placement of students at the high school level; discussion of tracking students by ability in mathematics. Review of upcoming Common Core expectations; District communication regarding the goals of conceptual and procedural fluency. Review of work conducted by the Mathematics Work Group. Report suggested that although institutional barriers and tracking mechanisms were effectively removed, some students were placed in courses for which they did not have adequate preparation. Some administrators shared that the District's performance targets had forced them to focus on the number of students enrolled in a course and may have had the unintended consequence of students' skipping grade-level material. District's pulled back on acceleration and skipping grades or units of mathematics at the elementary school level.
2011	Discussion of successful (C or better) completion of Algebra 1 in eighth grade and question about the final exam grade for eighth graders. District data showed that in 2011, 63% of students in eighth grade were completing Algebra 1 with a C or higher. Discussion of the SAA and the likelihood of students receiving special services (ESOL or Special Education) passing the assessment.

Year	Policy themes found in sources and remarks
2012	Discussion of completion of Algebra 2 by Grade 11 (49.0% in 2008 compared to 62.6% in 2012). Discussion related to achievement gap, specifically in middle school. Creation of the Mathematics Implementation Team that worked to support teachers, participate in school-based planning, model classroom instruction, and provide system-level professional development. Review of system targets and acceleration in mathematics pathways. Development of a model of acceleration and enrichment based on learning progressions. Building the capacity of teachers to develop conceptual understanding in their students across all five areas of mathematical proficiency. Communicating with stakeholders, including parents, the reason for this significant shift in mathematics teaching and learning and its benefits for students. Since the baseline year of 2001, Grade 9 algebra or higher level mathematics completion rates had climbed 10 percentage points from 71.5% to 81.5%. The achievement gap was narrowing, with gains of 23.5 percentage points for both African American and Hispanic students.
2013	Discussion of student failure rate on the Algebra 1 exam, school system development of plans at each high school to address student achievement in Algebra 1. Discussion regarding alignment of curriculum with Common Core State Standards. A review of student achievement data in Algebra 1 and Algebra 2 in recent years suggested that the 2001 mathematics curriculum—coupled with a procedure-based instructional approach and the practice of skipping grade-level mathematics content—does not prepare all students for

Year	Policy themes found in sources and remarks
	the 21st-century expectations for mathematics learning. Although the previous mathematics program resulted in improved performance district wide and across all subgroups, less than two thirds of the 2012 graduating class successfully completed Algebra 2. Similarly, 62% of students in 2012 successfully completed Algebra 1 by Grade 8 and only 68% by Grade 9. Discussion by the BOE that students needed deeper understanding to be successful on PARCC.
2014	Connection between Algebra 1 and new PARCC assessments noted in BOE discussion. Discussion of student achievement data: A total of 56% of Grade 8 students successfully completed Algebra 1 with a C or higher in 2013. Significant discussions related to possible causes for high failure rate for students on school system final exams. For final exams in June, about 70% of high school students failed in Algebra 1 and geometry. Several possible causes included course articulation practices, student preparation, system grading practices, and the need for additional professional development. The greatest concern highlighted by the work group was a consistent pattern of low grades by students who accounted for the majority of the exam failures; 80% to 90% of students who earned a grade of D or E in either marking period failed the semester exam. In many instances, students earning a grade of C fared better but failed the exams at a rate of more than 50%. These students were disproportionately Black/African American, Hispanic/Latino, or recipients of special services. Failure rates for June 2014 were so high (82%

Year	Policy themes found in sources and remarks
	for high school students) that the school district recalculated grades. The middle school failure rate was 23%.
2015	Continued discussion of high failure rate for students on school system final exams. In January 2015, 65% of high school students failed the final exam.

Finding 1.

The timeline presented in Table 26 captures some of the highlights and main discussions related to Algebra 1 in the District under study. The District first began discussing acceleration in mathematics in 1988. In 1995, the District first discussed the number of students taking Algebra 1 in middle school. Beginning in 1999, as the national NCLB legislation became a reality, the District responded to the accountability mandates by focusing discussions on student achievement on the SAA. For the next decade, the District discussed curriculum, secondary mathematics pathways, student achievement, and the achievement gap. A new curriculum was created to support Algebra 1 achievement in 2003, and some professional development on the new curriculum was provided for teachers. For the next few years, the school system focused on promoting an accelerated pathway by using data points and targets. In addition to the NCLB mandate that all students score proficient on the SAA by 2014, the school system's goal was to have 80% of students successfully complete Algebra 1 before the end of eighth grade. These two data points were the driving forces for much of the strategic initiative. As increasing numbers of students took Algebra 1, there was also discussion related to providing supports for students who struggled in the course or on the

SAA. Starting in 2010, the District began discussing ways to prepare for Common Core State Standards. The District also pulled back on what was referred to as an over acceleration in secondary mathematics. In 2013, the District aligned the Algebra 1 curriculum with the Common Core State Standards. In 2014-2015, the District faced widespread criticism regarding student achievement and readiness in connection to the high failure rates on the District's end-of-semester final exams in Algebra 1. However, it is important to note that the failure rate on the Algebra 1 final exam was discussed in 2000 when 64% of students failed the end of course exam.

Analysis of historical documents showed that the District's implementation and expectations specific to secondary mathematics pathways and Algebra 1 achievement were partially driven by NCLB accountability expectations. Table 26 outlines how the conversation by the Board of Education, starting in 1999, was connected to the State-mandated assessment required as a part of the No Child Left Behind legislation. During the years between 2003 and 2011, much of the discussion in the District was tied to student achievement on the State assessment in Algebra 1. The table also shows that starting in 2013 there was a shift to discussions about alignment with the Common Core.

Although the District pulled back on the over acceleration that was seen as harmful to students and their achievement in Algebra 1, the data showed that the District did successfully increase access and achievement in Algebra 1 for more students. In 1988, there were 70 students who took Algebra 1 in the seventh grade. In 2004, out of the 13,007 students enrolled in Algebra 1 there were 6,481 who were middle school students. During the 2005-2006 school year, 37% of fifth grade students were on an accelerated mathematics pathway. In 2007, data on the school system's acceleration of students showed that 48% of fifth graders were on an accelerated pathway in comparison with 2% in 2001. Additionally, 68% of eighth graders were taking Algebra 1 in comparison with 36 in 1999. In terms of the achievement of diverse student populations, in 2006, 21.2% of African American students successfully completed Algebra 1 in eighth grade, but in 2009 that number more than doubled to 46.6%.

Finding 2.

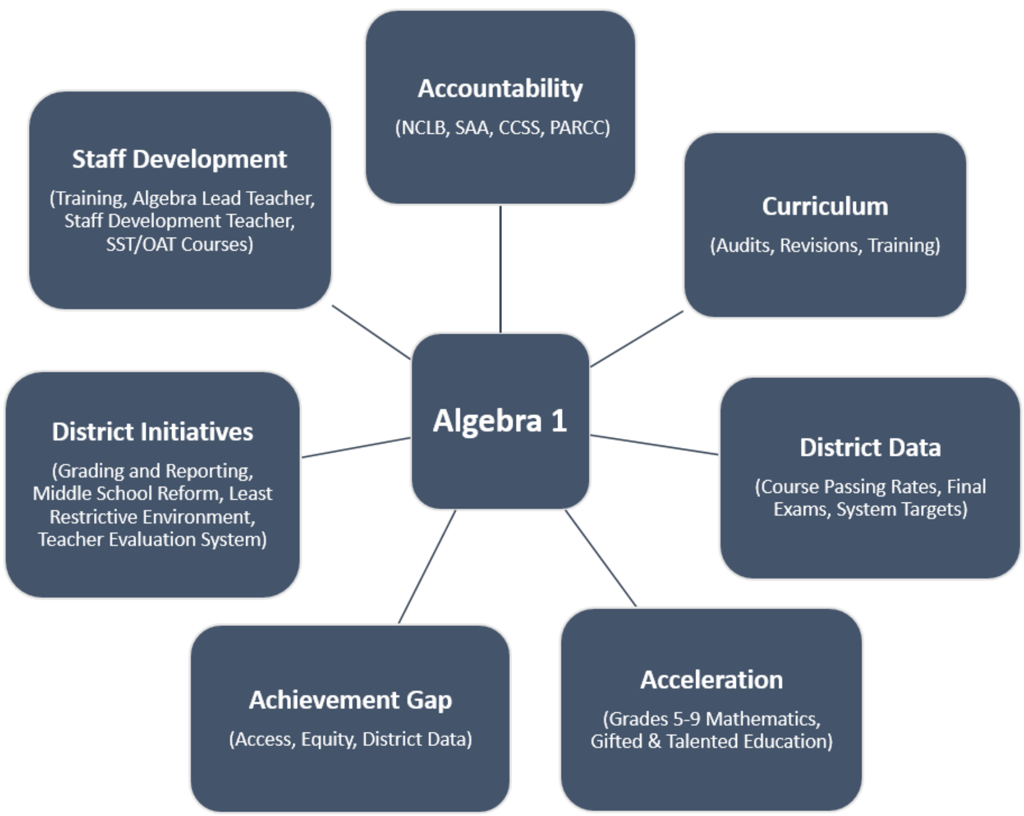

Figure 8. Connections to other district initiatives.

The researcher created Figure 8 to show the connection between the Algebra 1 strategic initiative and other major school system initiatives. Over the course of the decade being studied, Algebra 1 curriculum, instruction, achievement, and accountability touched on many other major school system initiatives. It is possible that the District attempted too many reforms at one time. The reform efforts listed below were all controversial and discussed in connection to Algebra 1. Most of these new efforts were implemented over several years. The intersection of these reform efforts with the Algebra 1 strategic initiative could have led to the District focusing on too many initiatives at one time. For example, in 2007, in addition to the pressures of NCLB and Algebra 1 achievement/acceleration, the District was still addressing each of the topics below to some extent.

- 2003: Focus on building capacity of staff through focused professional development efforts; grading and reporting reform policy passed by the Board of Education; newly developed Professional Growth and Evaluation System for staff
- 2005: External review of the middle school program which lead to the Middle School Reform initiatives
- 2006: Advisory committee report on Gifted and Talented Education in the District
- 2007: Closing of Secondary Learning Centers, discussion regarding least restrictive environment and best practices for co-teaching

As a result, a high school Algebra 1 teacher in 2007 might have been grappling the expectations around the Grading and Reporting policy. Many teachers in the system expressed concerns over the expectation that students should not be given grades lower than 50%. This same teacher might have a co-teacher to help with the instruction of students with special needs due to the closing of Secondary Learning Centers. In addition, in 2007, the same teacher might have been observed and evaluated using the guidelines developed in the new Professional Growth and Evaluation System. All of these system expectations would add to existing accountability demands of preparing students for a high stakes assessment while teaching Algebra 1 using a relatively new curriculum.

Research Question 2: How did secondary mathematics teachers and the larger school system community respond to the Algebra 1 strategic initiative between the 2002-2003 and 2013-2014 school years?

Survey results by frequency of responses. The following findings from the survey administered by the researcher in 2009 show the highest frequency of responses for each category. Table 25 shows teacher perspectives regarding general support for the ninth-grade Algebra 1 initiative.

Table 25. *Survey Responses Regarding General Support*

From the perspective of a high school math teacher, the ninth-grade Algebra 1 strategic initiative…	Strongly disagree	Disagree	Agree	Strongly agree	Rating average
is a necessary strategic initiative.	14.4%	40.0%	43.2%	2.4%	2.34
is an initiative that should be supported.	16.8%	36.0%	41.6%	5.6%	2.36
is aligned with my beliefs about mathematics pathways in secondary mathematics.	27.2%	41.6%	28.8%	2.4%	2.06
helps the school system meet State requirements in mathematics.	8.0%	17.6%	67.2%	7.2%	2.74

Table 26 shows teacher perspectives regarding the impact on students.

Table 26. *Survey Responses Regarding Student Impact*

From the perspective of a high school math teacher, the ninth-grade Algebra 1 strategic initiative…	Strongly disagree	Disagree	Agree	Strongly agree	Rating average
impacts all students positively.	28.0%	56.8%	12.7%	2.5%	1.90
is a desirable strategy for ensuring student mathematical competence.	24.6%	48.3%	26.3%	0.8%	2.03
prepares students for the 21st century.	17.8%	47.5%	31.4%	3.4%	2.20
removes barriers to higher mathematics.	26.3%	45.8%	25.4%	2.5%	2.04
prepares students for higher mathematics.	29.7%	30.5%	39.0%	0.8%	2.11
increases the numbers of students enrolling in colleges or universities.	14.4%	54.2%	30.5%	0.8%	2.18
promotes detracking of secondary mathematics.	22.0%	45.8%	30.5%	1.7%	2.12
enables more students to score *proficient* on the State Algebra Assessment.	10.2%	37.3%	47.5%	5.1%	2.47
reduces our school’s overall score on the State Algebra Assessment.	7.6%	47.5%	36.4%	8.5%	2.46
helped our school achieve Adequate Yearly Progress.	12.7%	27.1%	50.8%	9.3%	2.57

Table 27 shows perspectives regarding the impact on teachers.

Table 27. *Survey Responses Regarding Teacher Impact*

From the perspective of a high school math teacher, the ninth-grade Algebra 1 strategic initiative…	Strongly disagree	Disagree	Agree	Strongly agree	Rating average
enables me to be effective in my work.	15.7%	59.1%	24.3%	0.9%	2.10
has a negative impact with regard to my role as an Algebra 1 teacher.	2.6%	33.0%	49.6%	14.8%	2.77
positively impacts my instructional practices.	19.1%	53.9%	25.2%	1.7%	2.10
causes ambiguity related to my role as a teacher.	5.2%	40.9%	40.9%	13.0%	2.62
does not cause conflict related to my role as a teacher.	17.4%	48.7%	32.2%	1.7%	2.18

Table 28 shows teacher perspectives regarding the impact on their implementation of curriculum.

Table 28. *Survey Responses Regarding Curriculum Impact*

From the perspective of a high school math teacher, the ninth-grade Algebra 1 strategic initiative…	Strongly disagree	Disagree	Agree	Strongly agree	Rating average
allows me to focus on the conceptual portions of the curriculum.	18.5%	54.6%	26.9%	0.0%	2.08
allows me to focus on the computational portions of the curriculum.	23.1%	48.1%	28.7%	0.0%	2.06
gives me the opportunity to teach equal amounts of computational and conceptual mathematics.	18.5%	56.5%	25.0%	0.0%	2.06
positively impacts my implementation of the curriculum.	16.7%	52.8%	29.6%	0.9%	2.15
negatively impacts implementation of the curriculum.	0.9%	27.8%	52.8%	18.5%	2.89

Table 29 shows teacher perspectives regarding the impact on planning, instruction, evaluation of students and preparation.

Table 29. *Survey Responses Regarding Impact on Planning, Instruction, Evaluation of Students, and Preparation*

From the perspective of a high school math teacher, the ninth-grade Algebra 1 strategic initiative…	Strongly disagree	Disagree	Agree	Strongly agree	Rating average
influences the way that I plan.	1.9%	6.5%	64.5%	27.1%	3.17
impacts my ability to cover the Algebra 1 curriculum.	0.9%	14.0%	49.5%	35.5%	3.20
influences my selection of topics from the Algebra 1 curriculum.	1.9%	14.0%	50.5%	33.6%	3.16
causes me to teach topics that are not in the Algebra 1 curriculum.	8.4%	44.9%	29.0%	17.8%	2.56
influences the use of instructional time.	1.9%	2.8%	64.5%	30.8%	3.24
influences the use of instructional strategies during instruction.	1.9%	12.1%	67.3%	18.7%	3.03
positively influences the learning environment.	15.0%	58.9%	24.3%	1.9%	2.13
influences the informal assessments used to evaluate student learning.	2.8%	12.1%	61.7%	23.4%	3.06
influences the formal assessments used to evaluate student learning.	0.0%	5.6%	55.1%	39.3%	3.34
leads to instructional time being spent in preparation for The State Assessment.	1.9%	4.7%	43.0%	50.5%	3.42
leads to pressure on Algebra 1 teachers at my school to raise scores on the State Assessment.	0.0%	6.5%	43.0%	50.5%	3.44

Reliability

Reliability analysis was conducted to measure the internal consistency of the five scales of the survey instrument. Examination of Cronbach's alphas revealed excellent internal consistency for all but one scale: Impact on Planning, Instruction, Evaluation of Students, and Preparation, which fell just below the generally accepted benchmark of α = .70, with α = .69 (see Table 30).

Table 30. *Reliability Analysis: Cronbach's Alpha*

Scale	α
General Impact	.86
Student Impact	.85
Teacher Impact	.80
Curriculum Impact	.86
Impact on Planning, Instruction, Evaluation of Students, and Preparation	.69

Analyses

A series of one-way analyses of variance (ANOVAs) was conducted to determine whether there were differences of opinion regarding the required ninth-grade algebra strategic initiative between teachers teaching ninth-grade Algebra 1 and teachers not teaching ninth-grade Algebra 1. Results indicated differences between the groups in their perceptions related to general impact, ($F(2, 101) = 0.639$, $p = .53$); student impact, ($F(2, 101) = 0.465$, $p = .63$); teacher impact, ($F(2, 101) = 3.725$, $p = .027$); curriculum impact, ($F(2, 101) = 0.162$, $p = .851$); and planning, instruction, evaluation of students and preparation, ($F(2, 101) = 0.703$, $p = .498$). Therefore, there was one statistically significant difference in mean perceptions of teachers teaching ninth-grade Algebra 1 and teachers not teaching Algebra 1 with regard to their opinion of the ninth-grade algebra strategic initiative and its impact on teachers. Table 31 depicts survey responses based Algebra 1 teacher designations at the time of the survey. Analysis of variance results according to Algebra 1 teacher designation also are depicted in Table 31. It is possible that the teachers who responded that they did not know their designation were confused, substitutes, special education or ESOL teachers, or taught a course designed to support students in Algebra 1, but did not teach the Algebra 1 curriculum.

Table 31. *Response Statistics by Algebra 1 Teacher Designation*

	Algebra 1 teacher designation	*N*	Mean	Standard deviation	*F*	*P*
Scale of General Impact	Yes	91	2.3077	0.68219	0.639	.530
	No	3	2.6667	0.38188		
	Don't know	10	2.1750	0.50069		
Scale of Student Impact	Yes	91	2.1758	0.52501	0.465	.630
	No	3	2.4667	0.23094		
	Don't know	10	2.1700	0.47152		
Scale of Teacher Impact	Yes	91	2.1780	0.54768	3.725	.027
	No	3	2.9333	0.50332		
	Don't know	10	1.9600	0.48808		
Scale of Curriculum Impact	Yes	91	2.0791	0.57494	0.162	.851
	No	3	2.2667	0.30551		
	Don't know	10	2.0800	0.47329		
Scale of Planning, Instruction, Evaluation of Students, and Preparation	Yes	91	3.0297	0.32575	0.703	.498
	No	3	2.8333	0.23094		
	Don't know	10	2.9500	0.45765		

There are no statistically significant differences in mean perceptions of teachers by position at the time of the survey. Table 32 depicts survey responses based upon current teaching position. Analysis of variance results for current teaching position also are depicted in Table 32.

Table 32. *Response Statistics by Current Teaching Position*

		N	Mean	Standard deviation	*F*	*P*
Scale of General Impact	Algebra lead teacher	6	2.1667	0.43780	0.372	.774
	Resource teacher	12	2.1667	0.57735		
	Algebra 1 teacher	41	2.3659	0.70289		
	Secondary math teacher	45	2.3056	0.67607		
Scale of Student Impact	Algebra lead teacher	6	2.1833	0.60800	0.744	.528
	Resource teacher	12	1.9833	0.45092		
	Algebra 1 teacher	41	2.1878	0.50705		
	Secondary math teacher	45	2.2333	0.52657		
Scale of Teacher Impact	Algebra lead teacher	6	1.8000	0.35777	1.062	.369
	Resource teacher	12	2.2667	0.36515		
	Algebra 1 teacher	41	2.1805	0.60631		
	Secondary math teacher	45	2.2044	0.56486		
Scale of Curriculum Impact	Algebra lead teacher	6	1.8667	0.56095	1.104	.351
	Resource teacher	12	1.9333	0.27414		
	Algebra 1 teacher	41	2.0537	0.54777		
	Secondary math teacher	45	2.1822	0.61470		
Scale of Planning, Instruction, Evaluation of Students, and Preparation	Algebra Lead teacher	6	3.1167	0.33116	0.263	.852
	Resource teacher	12	2.9750	0.22208		
	Algebra 1 teacher	41	3.0268	0.38342		
	Secondary math teacher	45	3.0044	0.32471		

One-way analysis of variance was conducted to determine whether there were statistically significant differences in teachers' perceptions of the impact of the initiative across number of years of experience teaching Algebra 1. There are no statistically significant differences in mean perceptions of novice, experienced, or veteran teachers with regard to their opinion of the ninth-grade algebra strategic initiative. Table 33 depicts survey responses according to years of teaching Algebra 1. Analysis of variance results related to years of teaching Algebra 1 also are depicted in Table 33.

Table 33. *Response Statistics by Years of Teaching Algebra 1*

	Years	*N*	Mean	Standard deviation	*F*	*P*
Scale of General Impact	Never	6	2.4583	0.53424	0.173	.841
	1-5	51	2.2892	0.68076		
	6+	47	2.3032	0.66336		
Scale of Student Impact	Never	6	2.2167	0.42622	0.135	.874
	1-5	51	2.1569	0.55218		
	6+	47	2.2085	0.48760		
Scale of Teacher Impact	Never	6	2.2000	0.48990	0.280	.756
	1-5	51	2.1373	0.51612		
	6+	47	2.2213	0.61039		
Scale of Curriculum Impact	Never	6	2.2000	0.40000	0.154	.858
	1-5	51	2.0667	0.56804		
	6+	47	2.0894	0.57151		
Scale of Planning, Instruction, Evaluation of Students, and Preparation	Never	6	3.0833	0.30605	0.330	.720
	1-5	51	3.0333	0.34967		
	6+	47	2.9894	0.33116		

Additional analyses were conducted based on respondents' highest levels of education at the time of the survey. One-way analysis of variance was conducted to determine whether there were differences in the perceptions of teachers based on their levels of education. There are no statistically significant differences in mean perceptions of teachers based on level of education at the time of the survey. Table 34 depicts survey responses based upon highest level of education. Analysis of variance results for highest level of education also are depicted in Table 34.

Table 34. *Response Statistics by Highest Level of Education*

		N	Mean	Standard deviation	*F*	*P*
Scale of General Impact	BA	16	2.0938	0.67623	1.057	.351
	MA	37	2.3784	0.67346		
	MA plus 30+	51	2.3186	0.64629		
Scale of Student Impact	BA	16	2.1125	0.42720	0.344	.710
	MA	37	2.1595	0.57080		
	MA plus 30+	51	2.2235	0.50024		
Scale of Teacher Impact	BA	16	2.0875	0.66119	0.322	.726
	MA	37	2.2216	0.55334		
	MA plus 30+	51	2.1765	0.53013		
Scale of Curriculum Impact	BA	16	2.0000	0.57504	0.233	.793
	MA	37	2.1135	0.55285		
	MA plus 30+	51	2.0902	0.56471		
Scale of Planning, Instruction, Evaluation of Students, and Preparation	BA	16	3.0063	0.26450	0.182	.834
	MA	37	3.0432	0.38481		
	MA plus 30+	51	3.0000	0.32496		

One-way analysis of variance was conducted to determine whether there were differences in teachers' perceptions of the impact of the initiative across the poverty classification of the school. There are no statistically significant differences in mean perceptions of teachers teaching in high-poverty or low-poverty schools with regard to their opinion of the ninth-grade algebra strategic initiative. Table 35 depicts the statistics regarding teachers' perceptions across school poverty rates. Table 35 also depicts analysis of variance results related to poverty rates.

Table 35. *Response Statistics by Poverty Rate*

	Poverty rate	*N*	Mean	Standard deviation	*F*	*P*
Scale of General Impact	0-12.5%	22	2.1818	0.52430	0.649	.525
	12.5% to 47.2%	62	2.3145	0.69237		
	GE 47.3%	20	2.4125	0.70373		
Scale of Student Impact	0-12.5%	22	2.1364	0.37613	0.629	.535
	12.5% to 47.2%	62	2.2290	0.53574		
	GE 47. 3%	20	2.0950	0.57809		
Scale of Teacher Impact	0-12.5%	22	2.0909	0.43085	0.888	.415
	12.5% to 47.2%	62	2.2387	0.54423		
	GE 47. 3%	20	2.0900	0.70030		
Scale of Curriculum Impact	0-12.5%	22	1.9909	0.50701	0.406	.667
	12.5% to 47.2%	62	2.1032	0.58813		
	GE 47. 3%	20	2.1300	0.52825		
Scale of Planning, Instruction, Evaluation of Students, and Preparation	0-12.5%	22	2.9773	0.29910	0.190	.827
	12.5% to 47.2%	62	3.0290	0.36322		
	GE 47. 3%	20	3.0200	0.30192		

Qualitative Data Collection

The researcher used the major themes identified in the literature to code the data. The following categories were created to organize and analyze qualitative data:

- Time
- Resources or curriculum
- Support structures or accountability
- School culture
- Levels of collaboration
- Amount of change required
- Pace of change
- Beliefs about change required

- Teacher identity
- Beliefs about what is best for students
- Beliefs about student ability
- Stress or teacher vitality
- Motivation
- Autonomy
- Feelings of loss

Qualitative data from historical documents, work group reports, public–media reports, phone interviews, interviews, e-mails, and postings on District discussion forums were entered into NVivo according to the aforementioned categories. The researcher then conducted an analysis to determine if there were any factors that were more impactful in determining teacher acceptance or resistance to this strategic initiative. In addition, the researcher looked for other themes or connections among the data.

The researcher first organized the topics into external or internal categories. The external impacts were then organized according to tangible and intangible factors. Tangible factors were identified as time, resources or curriculum, and support structures or accountability. Intangible factors were school culture and levels of collaboration. Internal factors were grouped according to understanding of goals, math content-specific considerations, and individual disposition. Amount of change required, pace of change, and teacher beliefs about the required change impacted their understanding of goals. Teacher identity, beliefs about what is best for students, and beliefs about student ability were math-specific considerations. Individual disposition consisted of level of engagement and understanding of teacher's role. Level of engagement involved stress or teacher vitality and motivation, whereas understanding of teacher's role referred to autonomy and feelings of loss. The researcher created Figure 9 to depict the organization for external impacts.

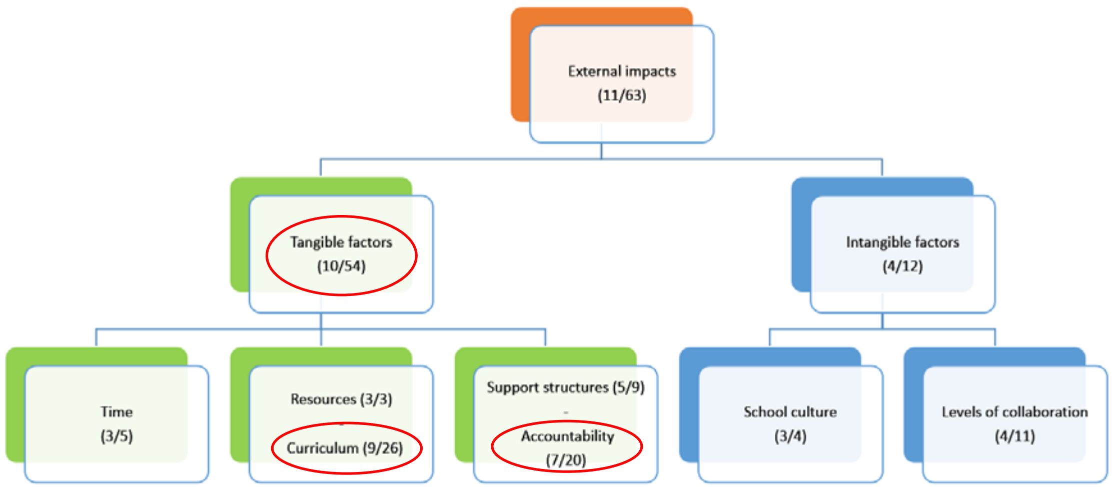

Figure 9. Organization of qualitative data by number of sources and remarks for each area of the conceptual framework – external impacts.
(# of sources / # of remarks)

Analysis of the qualitative data related to external impacts showed that tangible factors were more significant than intangible factors and that curriculum and accountability had the most significance for secondary mathematics teachers. In 2003, the Algebra 1 curriculum was revised. The new curriculum focused on conceptual as well as computational learning. In addition, teachers had to balance time on the curriculum with classroom time preparing students for the SAA. A central office staff member shared that "teachers might have a lack of comfort due to the pressure or need to get through the curriculum/content." A posting on a discussion forum noted, "Developmentally inappropriate tasks are written into the curriculum, but students are accelerated, skipping huge chunks of curriculum to get to even more inappropriate tasks." Another posting expressed,

> Much of the real algebra in a traditional Algebra 1 curriculum has been removed and replaced by data analysis. A course aimed at such a low level does not serve the needs of even the average student and falls far short of challenging our gifted students. Algebra 2 teachers now spend inordinate amounts of time teaching Algebra 1 and so the rigor of the Algebra 2 course is reduced. This effect is then passed on to Precalculus teachers who use their time to reteach Algebra 2. At AP Calculus it all finally comes together; or all too often, falls apart when students who have never faced a real challenge are asked to think. The District cannot lower the standards of the AP (Advanced Placement) test".

The posting above shows teachers' perspectives regarding content that should and should not be in the Algebra 1 curriculum, and how that would impact students when they reached higher levels of mathematics. In a phone interview, a secondary mathematics teacher captured similar sentiments regarding the changes in the curriculum,

> It's a tight curriculum—so much to cover. Nineteen years ago the curriculum focused on top kids and was a very rich curriculum. Now it is not the same curriculum. I don't want to use the term watered down—just not the same.

The revised curriculum also allowed students to use graphic calculators for some of the computational components of the curriculum. Regarding the use of technology in the

Algebra 1 classroom a teacher shared,

> The curriculum assumes that you have and are comfortable using a graphic calculator. There are people who can't afford the calculator. The curriculum is calculator dependent. Some kids have had them for 3 years and have games on them and are faster than the teacher. Others are not comfortable with the menus or screen.

In addition to facing a new curriculum with a focus on the use of technology and a balance between computational and conceptual learning, the teachers faced stronger accountability expectations. A central office specialist shared, "Assessments in Algebra 1 need to model the type of assessment that students will see on both the semester exam and the SAA." In order to for students to be successful, teachers would need to align their instruction and assessment practices with the curriculum as well as the SAA. In addition to the changes in the curriculum the increased NCLB accountability called for 100% of students to be proficient by 2014. Much of the remarks shared by teachers were specific to their perspectives of NCLB. A posting on a discussion forum stated,

> The target percentages are not being set by principals, community superintendents, or even by the Superintendent. I believe that it is NCLB that mandates that 100% of students will be on or above grade level in reading and math by 2014. If we are to hit the target according to the federal mandate we have no choice but to set targets—unrealistic as they may be.

Although some teachers had relatively accepted the NCLB mandates, others felt that the policies were well-intentioned but educationally misguided. A teacher posted the following on a discussion forum,

> The policies causing this decline are surely well-intentioned but, unfortunately, they are educationally misguided. These are the policy of aligning courses to standardized tests, the policy of zero impediments to upward mobility through the curriculum and the policy of wholesale acceleration. Therefore, not only has the Algebra 1 curriculum been aimed at that test, but there is also enormous pressure on teachers to focus only on objectives related to the test. What we must remember is that the SAA represents the minimum standard.

Teachers not only had concerns regarding the NCLB accountability and mandates, but they also questioned the format of the SAA. In 2009, the test was changed and essay questions were removed. Teachers were concerned about using a test that would focus entirely on multiple-choice questions. In a phone interview one teacher said,

> I'm really concerned about the testing being all [multiple choice] because it doesn't allow for partial credit. Students can make a math error that leads them to pick one of the distracters. Without a [written response section] the students will guess a lot more. There are kids who can think and the selected response doesn't get at that. It moved away from the idea of critical thinking and problem solving.

Another teacher stated during a phone interview,

> We're teaching to the test—especially the last couple of weeks. I know you aren't supposed to teach that way. Not having a [written response section] is a challenge. Without BCRs there's now a bigger chance that the kids are guessing.

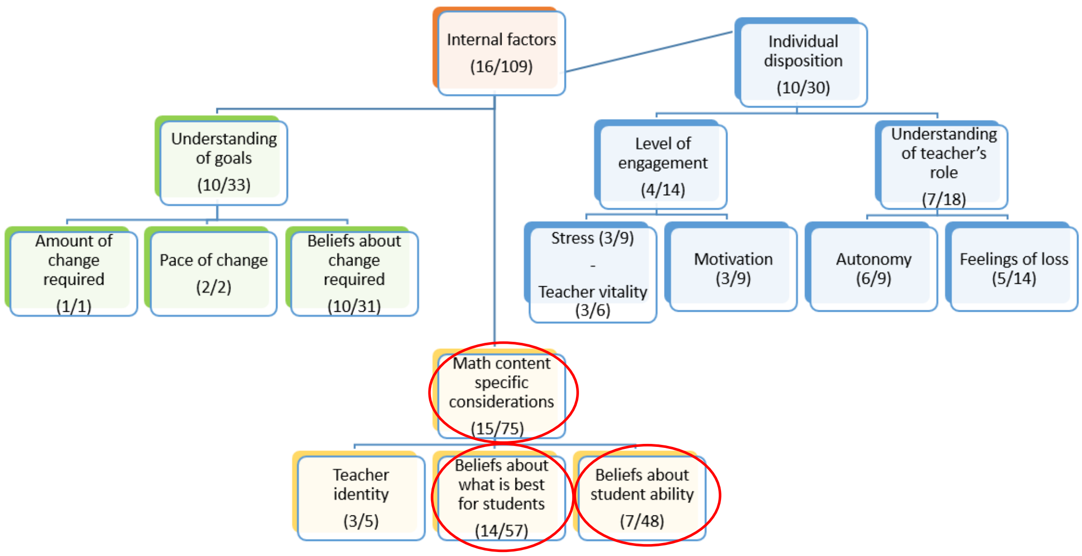

Figure 10. Organization of qualitative data by number of sources and remarks for each area of the conceptual framework—internal impacts.
(# of sources / # of remarks)

The researcher created Figure 10 to depict the organization for internal impacts. Analysis of the qualitative data related to the internal impacts showed that math content specific considerations were more significant than understanding of goals or individual disposition. Additionally, belief about what is best for students and beliefs about student ability had the most significance for secondary mathematics teachers. The following remarks show teacher perspectives regarding their beliefs about what is best for students. During a phone interview a teacher asserted, "It is an impossible policy—many kids will fail. The amount of time they have with the curriculum is not enough. It is hard enough to get through the curriculum but when you factor test-taking skills….” In addition, to the perceived detriment to students from the curriculum and accountability associated with the strategic initiative there was also a concern regarding the acceleration of students. A teacher stated on a discussion forum that,

> There is pressure at the MS to push kids into Algebra in eighth grade. Kids who are below grade level in 7th grade are being put in algebra to reach 80% goal. 100% of kids should take algebra when they are ready. I understand the policy but it hurts kids who are not ready for Algebra 1. They should take it when they are developmentally ready. 100% pass is not realistic—problem with NCLB.

Regarding the perspective of teachers and the increased access to Algebra 1, a central office staff member said, “You get to get at the belief system questions, who should take algebra and when and how should it be taught.” A posting on the discussion forum noted,

> There is a consensus among math teachers. Consensus that the massive, default acceleration is destructive and out of control; consensus that the current Algebra curriculum does not equip students with the skills necessary for higher math; consensus that the pacing is way too fast, consensus the curriculum in elementary and middle school is too crowded.

Another teacher posted,

> There is a policy that acceleration in math is always a good thing and something to be strived for. For the majority of students this is simply not true. A student's understanding of mathematics is usually not increased by acceleration and is often impeded. The effects of acceleration are: decreased retention of knowledge, procedural learning replacing conceptual understanding, decreased ability to think abstractly, decreased motivation for mathematics, decreased self-efficacy in mathematics, students electing not to take higher math, and declining SAT and AP scores.

Teachers saw the increased access to Algebra 1 in earlier grades as detrimental to students and not aligned with their beliefs. Another posting said, "Students are being pushed too far too fast without mastering fundamental number skills that will allow them to grasp concepts at a higher level." Much of the discussion related to the perceived lack of rigor in the new curriculum. Another posting on the discussion forum stated,

> It is time math teacher[s] stand up and say pay attention! I have 9th grade honors Algebra 2 students who can't solve problems that 8th grade Algebra 1 students were expected to solve ten years ago. Whom are we helping here: students or a misguided reputation for accelerating math students? Let's help the students by giving developmentally appropriate instruction.

Some teachers felt that students who were over accelerated lost motivation in Algebra 1. A posting on the discussion forum stated that the District policies

> are hurting some students. Students are feeling defeated and are dropping out—we are losing them. I see it on their first day in high school 9^{th} grade Algebra placement despite having failed math in middle school. Is this what is meant by acceleration. They show it by their attendance, they show it by acting out.

> When we examine data that say 55% of a cohort of eighth grade Algebra 1 students moved on to an honors course the next year we should be horrified. Yet this is presented as a good thing. What happened to the other 45%? Did the District really make a bad educational decision for that many students?

In some cases teachers felt that students who were not adequately prepared for Algebra 1 were at risk of not graduating due to course failure. During a phone interview, a teacher asserted,

> The high school diploma opens doors for kids—if they can't graduate because of this course, we're closing doors for them that they could have taken. There are 12^{th}-grade students who as seniors did not graduate because of this course. It has changed the expectation of what a high school diploma is. From my perspective as a resource teacher, I'm constantly concerned about whether students are prepared for the course. The kids don't know enough because of the way middle schools tend to operate. They move children to the next grade, 6-7, on to 8^{th}. The feeder middle school keeps putting kids in algebra. The students may be below

> grade level in 7th grade, not proficient on the MSAs, and being put into 8th grade Algebra 1.

In addition to a focus on high school graduation, teachers were concerned with ensuring that students learned basic computational skills. They felt that without a foundation in numeracy students left their classrooms lacking critical knowledge. Another teacher stated during a phone interview,

> A lot of kids don't know how to add, subtract, multiply, and divide and don't know what it means when you're trying to solve linear equations. They don't understand the order of operations. Some kids don't have a concept of what negative numbers are. Other kids can multiply in their heads. Other kids are so lost. Some kids do and some don't have an understanding of how numbers work. Because the curriculum is so packed I don't have time to teach them addition, subtraction, multiplication, and division. I taught them to use the calculator and sometimes they would still get the wrong answer because they typed incorrectly into the calculator. When you're graphing it makes a difference.

Teachers grappled with ways to meet the needs of struggling students. A central office specialist asserted,

> The plan for supporting students needs to involve all Algebra 1 students but focus primarily on 9th grade students who are in algebra for the first time. Active student participation, making lesson relevant for students,

> building relationships with students can all help improve student performance. Classroom environments need to build student confidence. Student schedules should be adjusted so that students have the same teacher for both semesters. Activities should be designed that motivate students.

While staff in central office could articulate how struggling students could be supported in an Algebra 1 classroom, teachers held different beliefs regarding student readiness. A posting on the discussion forum indicated,

> While the District has been accelerating students in math during elementary school without regard to arithmetic skills and readiness, the current math curriculum in high school is significantly easier than in the past. Our strong students are not challenged. Our weaker students have been trained that passing each lower grade level did not require learning since they pass without mastery of concepts. Students arrive to high school math and are shocked to discover that passing actually required mastery and many lack the math foundation skills needed for mastery.

During a phone interview, a teacher explained,

> Every child is different; some kids have difficulty getting abstract thinking. Not every child has been able to accomplish what is required: for example, ELLs who don't learn the way the teacher teaches. For students who are not successful we need a better back-up plan so that every kid gets it by the end of the course.

Teachers shared concerns regarding students how had been accelerated in middle school and came to high school unprepared, as well as, concerns over students taking the course for the first time in high school and struggling. High schools developed a double-period schedule in order to provide supports for struggling students. Another teacher stated,

> Students that have traditionally not been successful mathematically are now in the course. You can't build the second story without the first floor being there—the foundational understanding. The double period course helps build foundation, but due to the dynamics of scheduling, kids may be in a single period whether they need a double period or not. The double period gives teachers time to reteach and reassess.

Specific to the impact on student learning of English as a second language students or those receiving special education services, one teacher noted,

> This impacts instruction for ESOL 1s that come straight into Algebra 1 from their country. They fail because they don't have enough language. They need a year in [pre-algebra] to learn English and math words. ESOL 1 kids who have [pre-algebra] are passing algebra, but those without are not passing. It used to be that math was not filled with a lot of words—that's not true anymore. Algebra 1 now is very wordy and involves realistic situations, which is supposed to make it more interesting but hurts ESOL kids. For special education kids there is a [pre-algebra] course for special education. It is a sheltered course with a special education aide and math teacher. These students have a hard time if they move too

> quickly. For ESOL students, if they have several years in the country they are ready for 9th-grade Algebra 1. Algebra 1 moves fast for the ESOL and special education populations.

In some cases the high school teachers did not feel that the middle school teachers adequately prepared students who were on an accelerated pathway. During a phone interview, another teacher stated,

> The 9th-grade students are coming in without the background they need. We're finding that we have to do remedial Algebra 1 work like fractions, number sense, properties, negative numbers, division, manipulation of fractions, and order of operation things. We try to teach honors Algebra 2 with a lot of work with regular algebra topics.

Another teacher stated the following concerns during the phone interview,

> These are in no particular order. There's pushback from kids—why are we doing this—because they don't want to do it because they've failed once and keep doing the same thing. They think this is a form of craziness. "I'm not good at math; I can't do it" and it leads to behavior issues; they are bored and frustrated. They are demotivated; they've failed it before. They can't tell time on a clock, have low math skills, can't do multiplication tables, and don't have number sense (negative and positive numbers). There are retention issues; they are memorizing things to do. We're learning X then Y; if on a test they see Y, then X, suddenly there's an issue. Memorizing things—that doesn't last very long. [When

> you] revisit something 2 weeks later it's not there for them. For those kids who pass in middle school, this thing is great for them. Those who didn't make it in middle school and are having difficulty making it in high schools as well—we should see their behavior as raising a red flag at this problem. But in an effort to make numbers, we're pushing them through the math grinder.

In general, the teacher resistance to the strategic initiative centered on resistance towards the new Algebra 1 curriculum, increased accountability mandated by NCLB, and beliefs regarding the best interests of students, student ability, and mathematics content.

Summary

This chapter presents findings associated with the study. A mixed-methods approach, which utilized both quantitative and qualitative methods, was used in this historical case study to address the two research questions. Chapter 5 includes conclusions based upon the study's findings, recommendations for further study, and recommendations for practice.

Chapter 5: Conclusions and Recommendations

Overview

Since 2008, California has been on the forefront of the efforts to reform secondary mathematics by promoting early access to Algebra 1. In fact, in 1999 the California State Senate passed legislation penalizing schools for enrolling eighth grades in a pre-algebra or other general mathematics course. A study of the 222 school districts, involving data from 300,000 eighth graders, and comparing data from the 2003-2004 administration of the California High School Exit Exam (CAHSEE) with data from the administration in 2009-2010, found that efforts to enroll more middle school students in Algebra 1 had negative unintended consequences for student mathematics achievement. The study found that broad-based efforts to enroll more students in eighth-grade Algebra have negative effects on student achievement in large school districts and no benefits in small or medium districts (Domina, McEachin, Penner, & Penner, 2015). Additionally, studies have found that there are student achievement benefits to “enrolling relatively high-achieving students in eighth-grade Algebra courses” (Domina et al., 2015, p. 291). From a policy perspective, researchers suggested, “it is important to understand not just the effects of placing any given individual into Algebra ceteris paribus, but also the effects of implicating a broad-based Algebra-for-All policy” (Domina et al., 2015, p. 292) due to the fact that these policies may impact peer and teacher interactions.

This chapter summarizes the results that were garnered through the surveys, interviews, and review of historical documents related to the implementation of an algebra-for-all initiative in a large urban-suburban district. Specifically, this historical case study focused on the evolution of the strategic initiative between the 2002-2003 and

2013-2014 school years, and how secondary mathematics teachers and the larger district community responded to the initiative during those years. The chapter is divided into topics that include purpose of the study, statement of the problem, conclusions, and recommendations for further research.

Purpose of the study. The purpose of this mixed-methods case study was to conduct an investigation of the implementation of a strategic initiative requiring 100% of students to successfully complete Algebra 1 or a higher level mathematics course by the end of ninth grade. Specifically, the purpose of this research was to conduct a historical case study of one large and diverse school system's attempt to increase student achievement by implementing an algebra-for-all strategic initiative within a larger context of state and national standards, expectations, and accountability. The study focused on (a) how the strategic initiative evolved between the 2002-2003 and 2013-2014 school years, and (b) how the community and secondary mathematics teachers responded to the initiative between the 2002-2003 and 2013-2014 school years.

Statement of the problem. In secondary education, mathematics stands out from other content areas because it is considered to be more closely tied to international competitiveness, technological and economic growth, and the development of a highly skilled workforce. Due to its significance, and in response to national and international student achievement data, mathematics has become the focus of national, state, and local policy reform efforts for decades. But reform recommendations are seldom accepted and implemented as envisioned. They often face resistance from teachers, parents, and students who are comfortable with or emotionally attached to traditional goals and practices of mathematics education.

In secondary school mathematics, Algebra 1 stands out as a significant course because it can serve as an entry point or gatekeeper to higher levels of education in general and mathematics and science courses in particular. As a result, education policy reform recommendations have focused on increasing access and success in Algebra 1. The broad goal of this dissertation research was to provide an informative case study of challenges in school reform by documenting and analyzing experiences in one large, diverse school district that attempted an algebra-for-all initiative. It is one thing for school system leaders to declare their intent to reach an ambitious goal such as success for all in Algebra 1 but quite another to turn that ambition into reality. Implementation of reform in curriculum and teaching of critical school subjects is deeply affected by the factors upon which the reform efforts focus. In the case of the algebra-for-all initiative in the district under study, the implementation involved changes in teaching and assessment practices, revised Algebra 1 curriculum, and accelerated pathways for students in secondary mathematics. As a result, the District received pushback from a variety of stakeholders during the implementation process. Specifically, the researcher examined teacher resistance or acceptance of policy change by analyzing external and internal factors impacting their responses to the policy reform efforts.

How did the District's Algebra 1 strategic initiative evolve between the 2002-2003 and 2013-2014 school years?

Conclusion #1. Analysis of historical documents showed that during the period between 2002-2003 and 2013-2014 the school district discussed acceleration in mathematics, curriculum alignment with standards, student achievement, and the achievement gap. It appeared that the school system's implementation of the strategic initiative and expectations specific to secondary mathematics pathways and Algebra 1 achievement were partially in response to national trends and State expectations. In order to reach the NCLB mandate of 100% proficiency on the assessment (SAA) the district developed targets that incrementally increased and reached the goal of 100% proficiency in 2014.

Conclusion #2. Analysis of historical documents revealed a connection between Algebra 1 and many other school system initiatives between the 2002-2003 and 2013-2014 school years. Algebra 1 curriculum, instruction, achievement, and accountability touched on almost every other major school system initiative (professional development, algebra lead teachers, staff development teachers, grading and reporting, middle school reform, least restrictive environment, teacher evaluation system, achievement gap reduction initiatives, student acceleration/gifted and talented education, student achievement data on State-mandated assessments, system targets, and curriculum audits and revisions). These other reform topics represented other significant system changes that also had an impact on teachers. It appeared that the school system was tackling the challenges of educating a student population that grew in size and diversity through multiple reform efforts.

Conclusions Regarding the Evolution of the Strategic Initiative

The school system discussed the strategic initiative in the context of many other initiatives between the 2002-2003 and 2013-2014 school years. The initiative was linked with several other key initiatives and policies being implemented in the District during this time period. In addition, the school system's implementation of the initiative was influenced by accountability requirements from the State as a result of No Child Left Behind legislation. The researcher was surprised at this finding as it appeared that the initiative was more of a reaction to outside forces and expectations and may have lacked a clearly defined school system plan. The researcher was not able to find a written initiative that outlined a clearly defined purpose or implementation timeline. The initiative lived in the school system's response to national and state accountability, and acceleration targets and expectations. The documents related to this initiative were authored mostly by the superintendents and the Board of Education. There were very few documents that were written by the Office of Curriculum and Instructional Program or by the supervisor for the District's mathematics program.

It also appeared that the initial intentions of the school system to promote student achievement and access in Algebra 1 that were discussed in the late 1980s and early 1990s only came to fruition in a reaction to accountability requirements by the State. In response to the accountability mandates, the District depended on analysis of student data related to enrollment in Algebra 1, successful completion of the course, and on achievement on the State accountability assessment. It is possible that the heavy focus on monitoring these data points caused the system to over accelerate students in the secondary mathematics pathway.

How did secondary mathematics teachers and the larger school system community respond to the Algebra 1 strategic initiative between the 2002-2003 and 2013-2014 school years?

In 2009, when the researcher-developed survey was administered to high school mathematics teachers, the results indicated the following:

Conclusion #1. In terms of general support, teachers strongly disagreed/disagreed that the strategic initiative was necessary (54.4%), should be supported (52.8%), and was aligned with their beliefs about secondary pathways in mathematics. (68.82%); however, 74.4% strongly agreed/agreed that the initiative helped the system meet school system expectations. Therefore, the initiative was not generally supported by teachers and was seen as a mechanism of accountability.

Conclusion #2. In terms of student impact, teachers strongly disagreed/disagreed that the initiative impacted all students positively (74.8%), was a desirable strategy for ensuring student mathematical competence (72.9%), prepared students for the 21st century (65.3%), removed barriers to higher mathematics (72.1%), prepared students for higher mathematics (60.2%), increased the number of students enrolling in colleges and universities (68.6%), and promoted detracking of secondary mathematics (67.8%). In regards to the impact of the accountability on students, teachers strongly disagreed/disagreed that the initiative reduced the school's overall score on the SAA (55.1%). Teachers strongly agreed/agreed that the initiative enabled students to score *proficient* on the SAA (52.6%), and helped the school achieve adequate yearly progress (60.1%). As a result, teacher did not have a favorable view of the initiative or any benefits or positive impacts for students. The initiative was seen as tool in accomplishing accountability mandates without providing any positive outcomes for students.

Conclusion #3. In terms of teacher impact, respondents strongly disagreed/disagreed that the initiative enabled them to be effective in their work (74.8%), positively impacted their instructional practices (73.0%), and did not cause conflict related to their role as a teacher (67.1%). Teachers strongly agreed/agreed that the initiative had a negative impact with regard to their role as an Algebra 1 teacher (64.4%), and 53.9% of teachers felt that the initiative caused ambiguity related to their role as teachers. These teaches felt that the initiative negatively impacted their work and caused ambiguity in their role as teachers.

Conclusion #4. In terms of curriculum impact, teachers strongly agreed/agreed (71.3%) that the initiative negatively impacted their implementation of the curriculum. Teachers strongly disagreed/disagreed that the initiative allowed them to focus on the conceptual portions of the curriculum (73.1%), allowed them to focus on the computational portions of the curriculum (71.2%), gave them the opportunity to teach equal amounts of conceptual and computational mathematics (75.0%), or positively impacted their implementation of the curriculum (69.5%). Largely, teachers felt the initiative had a detrimental impact on their implementation of the curriculum. It is important to note that in 2003, the District had rolled out new curriculum for the Algebra 1 course that was aligned with NCTM standards and promoted a balance between conceptual and computational instruction. At the time of the survey, six years later, it appeared that teachers had a general dissatisfaction with curriculum implementation.

Conclusion #5. In terms of impact on planning, instruction, evaluation, and preparation of students, 93.5% strongly agreed/agreed that the initiative led to instructional time being spent in preparation for the SAA, and 93.5% strongly agreed/agreed that the initiative led to pressure on Algebra 1 teachers to raise scores on the SAA. Teachers strongly agreed/agreed that the initiative influenced the way they planned (91.6%), impacted their ability to cover the Algebra 1 curriculum (85.0%), influenced their selection of topics from the Algebra 1 curriculum (84.1%), influenced their use of instructional time (95.3%), influenced their use of instructional strategies during instruction (86.0%), and influenced the informal (75.1%) and formal (94.4%) assessments used to evaluate student learning. Teachers strongly disagreed/disagreed that the initiative caused them to teach topics not in the Algebra 1 curriculum (53.3%) and that it positively influenced the learning environment (73.9%). It appears that the teachers felt the strategic initiative impacted most of the significant components of teaching and learning. It is possible that teachers resented the instruction of the initiative in their classrooms and felt a loss of power due to expectations to comply with curriculum implementation and accountability mandates.

Conclusion #6. There was a statistically significant finding related to teacher impact by Algebra 1 teacher designation versus secondary teachers not teaching Algebra 1. There were no other statistically significant findings (by current teaching position, poverty rate of the school, participation in professional development, years teaching Algebra 1, or highest level of education). This researcher concluded that the only significant variable was whether the teacher was teaching Algebra 1 or not at the time the survey was completed. There had been some discussion gathered through phone interviews and reviews of postings on a district forum about students entering higher levels of mathematics unprepared due the accelerated mathematics pathway. Teachers stated that in Algebra 2 they needed to reteach basic algebraic principals due to a lack of foundational skills in students. However, the results of the survey show that the responses regarding teacher impact from teachers who were designated as Algebra 1 teachers at the time of the survey was statistically significant.

Conclusion #7. The qualitative data showed that the external impacts of accountability and curriculum had the most significant impact on teacher resistance to the initiative. In terms of curriculum impacts, teachers indicated that they felt pressure to get through the curriculum; they had concerns regarding over acceleration and developmental appropriateness of tasks for students and concerns regarding the content of the Algebra 1 course. Teachers shared concerns regarding accountability and State-mandated assessments that caused them to teach to the test to meet achievement targets.

Conclusion #8. The qualitative data showed that the internal impacts of beliefs about student ability, beliefs about what was best for students, and math content-specific considerations had the most significant influence on teacher resistance to the initiative. Teachers shared concerns regarding over acceleration of students, secondary mathematics pathways, supporting special education and ESOL students, and providing students with the foundation needed for future success.

Conclusions Regarding Teacher and School System Responses to the Strategic Initiative

In general, teachers in this study did not strongly support the initiative, and the strongest level of teacher resistance appeared during periods when the school system held schools accountable for meeting student achievement targets in response to State-mandated accountability. The initiative did not align with the beliefs of respondents who were teaching the Algebra 1 course. A number of this study's findings supported previous research conducted regarding teacher acceptance or resistance to reform efforts. As policies are implemented in local school settings, they are filtered through teachers. Teachers have a high degree of autonomy in how they implement curriculum, standards, or other policy expectations in their classrooms. In this manner, teachers are both the targets of a policy reform as well as the agents of change required to implement the reform. Conflict also plays a role in policy implementation. When there is an incompatibility of objectives or when some teachers see a policy as directly opposed to their interests, differences and disputes can arise regarding policy implementation, which is often thwarted as the actors are not able to reach any agreements. McLaughlin (1987, 2011) identified attitudes and beliefs as factors that impact teachers as they accept or resist policy efforts. Organizations do not innovate or implement change; individuals do. "The quality of individual-level responses determines the quality of policy implementation" (McLaughlin, 1987, p. 177). "The contemporary climate of high-stakes accountability can create disincentives for teachers to attend to more than standardized test scores" (McLaughlin, 2011, p. 67).

Increased accountability in reading and mathematics is a factor that impacts teachers' response to policy and reform efforts. "A deep-rooted disagreement exists in the United States as to what schools are for, what a good education includes, and what skills and content children need to know. Efforts to impose statewide agreement will inevitably offend some constituencies" (Hess et al., 2002, p. 74). Increased accountability challenges teachers' sense of duty and commitment to students; it mandates content and skills to be covered by assessments regardless of teacher preference. Standards allow for schools to provide all students with a common set of experiences and a basic level of knowledge; however, at times those standards may be at odds with teachers' sense of their personal philosophies and professional purpose, thereby causing them to feel a loss of control or power in their classrooms. Hess et al. wrote,

> American schools have been built on a premise of professional, autonomous teachers who operate out of a sense of duty and commitment. The premise of high-stakes testing challenges this culture by pressing teachers to teach the content and skills mandated by the state, regardless of their personal preferences. (Hess et al., 2002, p. 74)

There have been debates regarding mathematics curriculum, standards, and assessments for decades; what teachers believe about these topics also shapes their acceptance or resistance to mathematics policy and reform efforts. For new policies and reforms to be fully implemented as intended it is important to understand the barriers to change as experienced by teachers. Understanding the contexts and conditions that lead to teachers' acceptance or resistance to reform helps policy implementers to better support the implementation of reform efforts in schools with the ultimate goal of providing students with improved educational opportunities and outcomes.

Recommendations for Future Practice

The need to implement reform efforts aimed at increasing student achievement outcomes will continue to be at the forefront of national, state, and local educational systems. To promote successful implementation of policies and initiatives it is critical to understand factors that can promote acceptance or resistance to successful policy implementation. The findings from this study, led the researcher to making several recommendations related to promoting student achievement through reform efforts in secondary mathematics.

Recommendations for Districts Interested in Implementing Strategic Initiatives Tied to Algebra 1

1. School districts concerned with successful implementation of reform efforts in secondary mathematics should consider intentionally addressing teacher acceptance or resistance of reform efforts by addressing teacher beliefs regarding what is best for students and mathematics content.
2. School districts concerned with successful implementation of reform efforts in secondary mathematics should consider outlining a detailed vision for student achievement outside accountability and assessment mandates. This vision could include goal statements that go beyond data targets, there should be an implementation timeline that is monitored by curriculum specialists, and there should be a long-term plan for providing staff with professional development based on addressing beliefs regarding mathematics, curriculum, and student learning. Ideally, teachers would be involved in shaping the vision and would be asked for their feedback and participation. In addition, mathematics pathways should take into consideration student readiness as well as providing access and opportunity. Finally, the vision should clearly detail in writing the benefits for students. As a result, the possibility that more teachers will accept and actively promote implementation of the policy would be increased.
3. This study did not focus on the perspectives of parents, students, university faculty, or the larger community. School districts interested in implementing a successful algebra strategic initiative should gather the perspectives of these stakeholders.

Recommendations for the State Department of Education

1. State departments of education should continue to hold schools accountable for student achievement; however, it is important to note that a singular focus on accountability that is viewed as punitive toward students, teachers, or schools could have unintended consequences. When teachers see reform efforts as solely a means of compliance they are more likely to resist implementation efforts. Additionally, school districts trying to comply with accountability mandates may be tempted to put too heavy an emphasis on student enrollment and achievement data in absence of timelines that require a reasonable growth in student achievement.

Recommendations for the District

1. The school district under study should consider providing a clear vision for secondary student achievement and mathematics pathways that is not seen as solely connected to state accountability measures or targets. Accountability and standardized testing are important components of school reform and can positively impact student learning outcomes, however, it is important to provide a larger vision regarding student achievement and mathematics that addresses the belief systems of the larger school community.
2. The school district should consider how to provide a clear vision for secondary mathematics that takes into consideration the possibility that there will be overlap with the implementation of other school system initiatives. It would be beneficial to discuss the areas of where the expectations are the same and where they are different. Additionally, it would be beneficial to

identify how one initiative may positively or negatively impact the implementation of others.

3. The school district should consider how it can promote consistent implementation of reforms efforts under the leadership of different superintendents.
4. The school district should consider developing secondary mathematics pathways that are based on growth as opposed to mandated district targets. In large diverse school districts one target may not be a reasonable expectation for all schools. For example, instead of having a target of 80% successful completion for all students in all schools, a target could be determined for each school that would take into account the school's data and demographics, but would also hold the school accountable for reasonable incremental yearly growth in student achievement.
5. The District should determine if one secondary mathematics pathway can both ensure a basic level of mathematical competence for all students, and promote a rigorous and accelerated pathway designed to promote the advanced study of mathematics for highly capable students.
6. The District should consider changes in student demographics and determine if the expectations in the secondary mathematics pathway address the needs of the students in the district. The demographics for the District have changed in the past decade with increases in students who are learning English as a second language, and students from diverse racial/ethnic backgrounds.

7. The school district should consider providing meaningful and ongoing professional development experiences for secondary mathematics teachers aimed at addressing a vision for student learning.
8. The school district should consider reviewing the expenditure of resources related to the Algebra 1 strategic initiative over the past decade to determine if the initiative was successfully implemented in the District.

Recommendations for Future Studies

1. It is recommended that another study be conducted to assess the current level of support for the District's secondary pathways and acceleration in Algebra 1. This recommendation is being made because the data from teachers in this study was collected in 2009. The District is about to embark on a new system for accountability with a new assessment in Algebra 1. It is possible that once the new accountability system begins to impact students, teachers, and schools, the District again will face teacher resistance to reform efforts.
2. This study focused on one school district. The purpose of this research was to conduct a historical case study of this district's implementation of a specific Algebra 1 strategic initiative. There are insufficient data to make any causal claims. Further research to explore causality could assist in further developing additional knowledge in the field regarding teacher resistance or acceptance of secondary mathematics reforms in Algebra 1.

Appendix A: Exploratory Interviews Used for Survey Development or Improvement

Teacher 1 – CW
Interviewed on 5/31/2006 for 30 minutes
ESOL Algebra 1 teacher

Teacher 2 – EN
Interviewed on 5/31/2006 for 45 minutes
Math resource teacher and Algebra 1 teacher

Teacher 3 – JA
Interviewed on 5/26/2006 for 2 hours
Algebra 1 teacher

1. What are the characteristics of the students in your classes?
CW: Some are unmotivated and lazy

EN: Diverse, capable, lazy, some have skills and ability others don't, they have language needs, 5^{th}-grade to 10^{th}-grade math ability

JA: intelligent, no real knowledge of Algebra, eager to please, want to learn, lack discipline, lack critical thinking, don't study, don't ask for help, don't come to after-school help, don't ask questions when they don't understand, and don't know how to study together

2. **What instructional strategies do you use to help students learn Algebra 1 content? Which strategies work the best?**

CW:
- Review, remind, multiple examples
- Can't rely on oral directions or explanations—you need visuals, examples, going back to key or important facts
- Using different colored markers on the board to highlight important information—not using all black.
- Writing so your hand doesn't cover the words—projector
- Positioning in the room so you are not blocking the projector or board
- It is not a visual if all students can't see it
- Not worrying about every word in a problem—teaching kids to identify important numbers around the words and solve the problem

EN:
- Applications to real life—connect to them through background knowledge and contact

- Use algebra and related to preteach skills—use algebra and related so that you have a larger amount of time to build background. There is no curriculum for related—but it should be integrated with Algebra curriculum

JA:
- They need strategies that others don't need—note taking, test taking, summarizing their learning, using correct examples of problems to further their learning and comprehension
- Slowing down speech
- Students should be engaged—working at the board—cooperative learning.
- Teaching kids how to break down a questions—find out what it is asking
- How to eliminate choices
- Allowing students to solve a problem multiple ways—letting ESOL kids do things differently (Asian students particularly can do the math but differently)
- Preparing kids early with BCRs and calculator use
- With ESOL kids going beyond the model is more difficult
- Making sure that kids are scheduled for the entire year with the same teacher—not changing teachers for semester B
- Giving everyone an ART—algebra readiness test at the start of the class
- Taking kids to computer lab—www.math.com and using the lessons on solving two step equations—teaching via Web site—creating stations and kids moving from station to station—using board games

Which don't work at all?
CW: It doesn't work to teach something once and let it go; open-ended questions don't work—like "Does everyone understand?"

3. How do you support limited English proficient (LEP) students during instruction?

EN: The ESOL RT and ESOL transition specialists regularly communicate with the teachers about the students and best practices for meeting their needs. At this time, this school is the only HS in the county with a transition program.

JA:
- ESOL kids are with an ESOL math teacher
- When you have to give them accommodations you find out who is ESOL—formal testing. You can look up the information on File Maker Pro—data on all the kids—it is possible to record notes on the kids on File Maker Pro, but this system is not used by every teacher.

4. What are your thoughts regarding the strategic initiative? What works well? What are some concerns?

CW: It is an impossible policy—many kids will fail. The amount of time they have with the curriculum is not enough. It is hard enough to get through the curriculum but when you factor test-taking skills…

EN:
- There is pressure at the MS to push kids into Algebra in eighth grade. Kids who are below grade level in 7th grade are being put in algebra to reach 80% goal.
- 100% of kids should take algebra when they are ready. I understand the policy but it hurts kids who are not ready for Algebra 1. They should take it when they are developmentally ready (Piaget)
- 100% pass is not realistic—problem with NCLB
- Individual student accountability is good.

JA:
- In theory it should be able to be accomplished. Everybody is not ready—so kids need the right support. Setting kids up for failure without supports—doesn't get them ready for college and creates a cycle of failure (kids don't want to fail).
- Algebra 1 curriculum is watered down—they are really picking up Algebra 1 skills in Algebra 2.
- The sequence in MCPS should be Algebra 1, Algebra 2, and then Geometry, so kids don't lose their Algebra skills.
- Homogenous groups are not as good—it is better to have heterogeneous groups so that there can be a more positive classroom environment and a community of learners.
- Kids should be tested each quarter and moved up or down based on their performance in Algebra.

5. What are your thoughts on the SAA[27]?

CW:
- It is biased—word problems are a problem for kids who don't know enough English.
- It is going to impact the graduation rate for ESOL students.
- The accountability on the part of students is good.
- Mainstream teachers don't understand how to help ESOL kids—ESOL kids can read phonetically some of the problems, but there is no comprehension of the language.

EN:
- Algebra is more fundamental than geometry—it is more important for students to be successful.
- 45% of the SAA is data analysis, which is Unit 5 of the curriculum. The rest of the test is Unit 2 (functions) and Unit 4 (systems of linear equations).

JA:
- To get kids ready there should be mandatory supports—summer pre-Algebra for ninth graders and enrichment programs.

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[27] To protect the confidentiality of the District, the state assessment is being called the State Algebra Assessment (SAA).

- Pre-algebra doesn’t exist, but Math C would be a great pre-algebra.
- The county final is more difficult because it holds them accountable to all of the unit.
- The majority of the SAA is Units 2 and 5—too simplistic.
- The majority of the test is focused on equations, tables, and graphs—giving students one and asking them to match to another.
- There is a lot of language in it—at least geometry had more visuals, which helped to negate some of the language issues (plus ESOL kids took geometry later and had time to learn more English).

6. How has your instruction changed in order to prepare students for the SAA?

CW:
- Created SAA review packet—the MSDE HAS Algebra book was used to create additional sample problems.
- SAA covers 5 chapters of curriculum, and there are 7 chapters in MCPS curriculum—for students who needed the support we focused on Chapters 1-5.
- Chapters 6 and7 will be done in 2-3 weeks after school has ended, and the kids will then take the county final.
- Kids who needed this support were identified.

EN:
- There is pressure—good instruction can prepare students for the SAA—we’ve done practice items—students have seen lots of questions—model SAA type questions.
- It is a decent assessment—students show reasoning and process—those parts are subjective (grading written essays) —there will be an issue with kids not passing based on those scores and possible litigation at the state level.

JA:
- No—because it was integrated—every year I’ve looked at the public-release items—my quizzes are model SAAs.
- SAA prep—practice—during class, during lunch, after school.
- Algebra review packet three times—last week of class did two practice tests—now get ready for June final.

7. How did your school address the needs of students who failed the first semester for Algebra 1?

CW:
- They took 1A again.
- 1b in summer—SAA in Summer
- 1b—not available in the Fall
- After school Tuesday and TH from 2:15-3:30—teachers paid through a grant given to the school—17-18 ESOL (1 and 2) students came each time—most of them because they wanted to be with me.

EN:

- o They took 1A again—they will take 1B in the fall and take the January administration of the SAA—they will not take the 1B county final exam because 1st semester will be spent preparing them for SAA. Second semester of next year they will take PGA (principles of geometry and analysis) and the county final exam for 1B.
- o Having kids in 1A for second semester hasn't really worked—kids are still failing 1A—there are attendance and loss-of-credit issues.
- o Classes are homogenous—there are no model or star students to call on—it is hard to extend kids.

JA:

- o Took Algebra 1A for semester B—22 students
- o MVP—students who don't pass get 2 days of remediation—then they take another unit test and get a new grade. A few students take advantage of it—usually not the kids who failed.
- o If a kid has failed three or more tests—they get extra attention and help for the exam. We work on test-taking strategies and reading and writing skills.

8. Do you have any concerns regarding making adequate yearly progress (AYP)?

CW:

- o The school should improve each year – but I don't think we'll do well.

9. What can you tell me about the algebra program at your school?

CW:

- o Smart kids get single-period algebra.
- o Medium kids get double-period algebra.
- o Weak kids get extended year—finish Chapters 6 and 7 in summer
- o For ESOL kids there are several options:
    1. ESOL 1 and 2 kids are with Algebra 1 and ESOL co-teachers.
    2. double period for low-skills kids
    3. double period for regular-skills kids
    4. ESOL 3, 4, and 5 mixed in with general education kids
- o Every quarter we reevaluate the kids and their needs and change their classes if necessary.
- o Kids are reevaluated by class grades, test grades, class work, number of times it takes them to learn something new.
- o Low-level kids get ESOL algebra; more able kids are put into the mainstream—Charlie gives kids a short test (sometimes it is just one question) upon arrival to determine their placement.
- o My school has a block schedule

EN:

- o Single-period algebra for those who can handle it—double-period algebra for needy kids (special education concentration)

- ESOL section to be created for next year for ESOL 1-4 kids, which will be co-taught by algebra and ESOL teacher or ESOL para-educator
- Some ESOL kids may be in mainstream.
- We don't have a MAPS class—only ESOL METS kids are in anything other than algebra—when they go into algebra they are at 5th- or 6th-grade math level.
- We have room to grow and places where we need to improve. Our departmental focus next year will be on questioning. I will also have five new teachers.
- We need to figure out how to motivate kids—kids who care should do well.
- As a department we need to develop or refine our philosophy and prepare kids for the SAA.
- I have teachers who only want to teach algebra.
- We need to consider cultural and community solutions.
- I'm a better teacher here than in the [high-performing school] cluster—this is more challenging and it is hard to see that I'm a better teacher here when looking at student performance.

JA:
- Block—time is better used for re-teaching (algebra and related)
- The related section of the course involves games or activities that are integrated and hands-on learning.
- In a double period you see them every day.
- What level of accountability is there for teachers who have large numbers of kids failing?
- Algebra curriculum is not integrated—there is no single thread. So it is not easy to build new units on a single threat from old units—1st semester is patterns and linearity and 2nd semester is quadratics.

10. Are you impacted by students who took Algebra 1 in the eighth grade?

CW: No—we don't even see them because they go to mainstream.
EN:
- AYP is determined by first-time test takers—as more and more are pushed into eighth grade when they are not ready; they will fail and their score will impact our school.
- The kids who are currently passing in eighth grade should push up the scores for the school but they don't help us in the subgroups (ESOL and special education) where we need the help because those kids aren't taking it in the eighth grade.
- As more and more kids get pushed in at the middle school level the pass rate will lower.
- Students who took algebra in eighth grade and failed coming to high school algebra

11. Which staff development, if any, prepares you for the issues you confront?

EN: Not enough staff development—we need a plan for next year—the focus will be on questioning techniques. Since curriculum has already been rolled out, new teachers don't get training from the system.

JA: No staff development for teachers who are not successful

Appendix B: Pilot Study E-Mail

Dear eighth-grade Algebra 1 teachers,

I am a doctoral student at the University of Maryland in the Educational Policy and Leadership Department. If you are currently an eighth-grade Algebra 1 teacher, I would like to ask you to participate in a pilot of my study by responding to some questions regarding the ninth-grade Algebra 1 strategic initiative. Please do not forward this e-mail to current ninth-grade Algebra 1 teachers as they will receive the instrument in its final form next year. Your participation will help me to determine if my instrument is valid and reliable and will allow me to make needed changes to the instrument to improve my work. This instrument is not coded, and no individual or school can be identified. Your participation in this study is entirely voluntary.

It has been estimated that it will take less than 15 minutes of your time to complete this survey. I would appreciate it if you could complete the survey on or before May 19, 2008. If you have any questions or concerns, please feel free to contact me directly at afiemirshah@aol.com. If you choose to complete the survey, you can do so by clicking on the link below.

Thank you for your time and contribution to my research.

Afie Mirshah-Nayar

Appendix C: Ninth-Grade Strategic Initiative Survey

Participation

You are being asked to participate in a survey about the ninth-grade Algebra 1 strategic initiative. Your participation will help to ensure a comprehensive and balanced view of this initiative. The study is being conducted as part of a doctoral dissertation. This instrument is not coded, and no individual or school will be identifiable. Your participation in this study is entirely voluntary. It has been estimated that it will take less than 15 minutes of your time to complete this survey. Thank you for your time.

Are you willing to participate in this study by completing the following survey?

☐ Yes

☐ No

In this section, you are asked to indicate your level of support for the ninth-grade strategic initiative. Indicate which of the following response options best fits for each statement.

General Support

	1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree
From the perspective of a secondary mathematics teacher, the ninth-grade Algebra 1 strategic initiative . . .				
1. is a necessary strategic initiative.	1	2	3	4
2. is an initiative that should be supported	1	2	3	4
3. is aligned with my beliefs about pathways in secondary mathematics.	1	2	3	4
4. helps the school system meet state requirements in mathematics.	1	2	3	4
5. other (please specify) ____________________.				

Student Impact

	1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree
From the perspective of a secondary mathematics teacher, the ninth-grade Algebra 1 strategic initiative . . .				
1. impacts all students positively.	1	2	3	4
2. is a desirable strategy for ensuring student mathematical competence.	1	2	3	4
3. prepares students for the 21st century.	1	2	3	4
4. removes barriers to higher mathematics.	1	2	3	4
5. prepares students for higher mathematics.	1	2	3	4
6. increases the number of students enrolling in colleges or universities.	1	2	3	4
7. promotes detracking of secondary mathematics.	1	2	3	4
8. enables more students to score proficient on the State Algebra Assessment.	1	2	3	4
9. reduces our school's overall score on the State Algebra Assessment.	4	3	2	1
10. has helped our school make Adequate Yearly Progress.	1	2	3	4
11. other (please specify) ____________________________.				

Teacher Impact

	1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree
From the perspective of a secondary mathematics teacher, the ninth-grade Algebra 1 strategic initiative . . .				
1. enables me to be effective in my work.	1	2	3	4
2 has a negative impact with regard to my role as an Algebra 1 teacher.	4	3	2	1
3 positively impacts my instructional practices.	1	2	3	4
4. causes ambiguity related to my role as a teacher.	4	3	2	1
5. does not cause conflict related to my role as a teacher.	1	2	3	4
6. other (please specify) ____________________________.				

Curriculum Impact

	1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree
From the perspective of a secondary mathematics teacher, the ninth-grade Algebra 1 strategic initiative . . .				
1. allows me to focus on the conceptual portions of the curriculum.	1	2	3	4
2 allows me to focus on the computational portions of the curriculum.	1	2	3	4
3. gives me the opportunity to teach equal amounts of computational and conceptual mathematics.	1	2	3	4
4. positively impacts my implementation of the curriculum.	1	2	3	4
5. other (please specify) ____________________________.				

In this section, you are asked to indicate the level of impact high-stakes assessment has had on your classroom. Indicate the level of impact that bests fits for each statement.

Impact on Planning, Instruction, Evaluation of Students, and Preparation of Students

	1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree
From the perspective of a secondary mathematics teacher, the ninth grade Algebra 1 strategic initiative . . .				
1. influences the way that I plan.	1	2	3	4
2. impacts my ability to cover the Algebra 1 curriculum.	1	2	3	4
3. influences my selection of topics from the Algebra 1 curriculum.	1	2	3	4
4. causes me to teach topics that are not in the Algebra 1 curriculum.	1	2	3	4
5. influences the use of instructional time.	1	2	3	4
6. influences the use of instructional strategies during instruction.	1	2	3	4
7. influences the learning environment.	1	2	3	4
8. influences the informal assessments used to evaluate student learning.	1	2	3	4
9. influences the formal assessments used to evaluate student learning.	1	2	3	4
10. leads to instructional time being spent in preparation for the assessment.	1	2	3	4
11. leads to pressure on Algebra 1 teachers at my school to raise scores on the assessment.	1	2	3	4
12. other (please specify) ______________________.				

Participation in Professional Development

Place a mark next to each professional development activity that you have completed.

- ☐ 2003-2004 Algebra 1 curriculum training
- ☐ Studying Skillful Teaching 1
- ☐ Studying Skillful Teaching 2
- ☐ Observing and Analyzing Teaching 1
- ☐ Observing and Analyzing Teaching 2
- ☐ Studying Skillful Teaching for Algebra 1 Teachers
- ☐ 2003-2004 Algebra 1 curriculum training
- ☐ 2003-2004 Algebra 1 curriculum training
- ☐ 2003-2004 Algebra 1 curriculum training

Demographic Information

Please answer each question.

1. Gender
   - ☐ Male
   - ☐ Female

2. Age group
   - ☐ 21-31
   - ☐ 32-42
   - ☐ 43-53
   - ☐ 53+

3. Number of years teaching
   - ☐ 0-5
   - ☐ 6-11
   - ☐ 11-16
   - ☐ 17-22
   - ☐ 23+

4. Number of years teaching Algebra 1

   ☐ 0-5

   ☐ 6-11

   ☐ 11-16

   ☐ 17-22

   ☐ 23+

5. How many Algebra 1 classes are you currently teaching?

   ☐ 0

   ☐ 1

   ☐ 2

   ☐ 3

   ☐ 4

   ☐ 5

6. How many Related Mathematics classes are you currently teaching?

   ☐ 0

   ☐ 1

   ☐ 2

   ☐ 3

   ☐ 4

   ☐ 5

7. Are you designated as *highly qualified* to teach Algebra 1?

   ☐ Yes

   ☐ No

   ☐ Don't know

8. Which of the following best describes your current position?

   ☐ Full-time teacher

   ☐ Part-time teacher

9. Is your current position a second career for you?

☐ Yes

☐ No

10. Are you currently considered a long-term substitute teacher?

☐ Yes

☐ No

11. What is your highest level of education?

☐ BA

☐ MA

☐ MA plus 30

☐ MA plus 60

☐ Doctorate

12. Which of the following certifications do you have?

☐ Not certified

☐ Professional Eligibility Certificate

☐ Standard Professional Certificate I

☐ Standard Professional Certificate II

☐ Advanced Professional Certificate

☐ Resident Teacher Certificate

☐ Conditional Certificate

13. Which of the following best describes your school?

☐ At least 40% of students are currently or at some point have participated in FARMS

☐ Less than 40% of students are currently participating or at some point have participated in FARMS

14. Which of the following best describes your current position?

☐ Algebra lead teacher

☐ Resource teacher

☐ Algebra 1 teacher

☐ Secondary mathematics teacher (not teaching any sections of Algebra 1)

This instrument is not coded, and no individual or school will be identifiable. If you are interested in participating in a semistructured interview related to the topic of this dissertation, please enter your full name on the line below. From the list of those interested in the semistructured interview, approximately 10 teachers will be randomly selected to participate in an interview. If you are not interested in participating in interviews, just click on the next button below.

Thank you

If you have any questions regarding this study and would like to contact me directly, please feel free to e-mail me at afiemirshah@aol.com

If you have any remarks specific to the content and organization of this survey, please feel free to share them below.

Appendix D: Qualitative Phone Interview Notes by Individuals

General Introduction and information given to everyone at the start of the phone interviews:

- Thanked each person for being willing to participate in the phone interview
- Shared that the notes would be transcribed and sent to them for review
- Shared that the phone interview was confidential; the teacher's name would not be used in any part of the dissertation. Information giving away the identity of the teacher wouldn't be shared in the dissertation.
- The interviews would last about 45 minutes to 1 hour each; there were four questions so we would spend about 15 minutes on each question.
- Clarification of terms used in survey:
    - SAA - State Algebra Assessment
    - Algebra 1 Strategic Initiative - the District expectation that all students successfully complete Algebra 1 by the end of 9th grade.

June 3, 2009 **7:30 PM start**	**Interview #1** **In the 2008-2009 school year teacher taught Algebra 1 sections A and B**
What are the benefits of the ninth-grade strategic initiative?	• Fact that we're getting every student to experience algebra and algebraic thinking early • Students learn to generalize thinking process. • Students learn to classify problems and groups of problems. • If they get it by the end of 9th grade they have 3 years to apply learning. • Many of them finish it by the end of 8th grade (we have pushed some kids).
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• Every child is different, some kids have difficulty getting abstract thinking. Not every child has been able to accomplish what is required. For example, ELLs who don't learn the way the teacher teaches. • For students who are not successful we need a better back up plan so that every kid gets it by the end of the course. • I focus more on my repeater kids (B kids are getting it). • There are students who are not motivated and have attendance problems in the A class. • I try to make the course different and don't repeat the same procedures for students who are taking it a second time. • I work on personal relationship building. • I find different instructional techniques and try to interest students by using technology. • It is a tight curriculum—so much to cover.

June 3, 2009 **7:30 PM start**	**Interview #1** **In the 2008-2009 school year teacher taught Algebra 1 sections A and B**
What are the challenges you face in implementing the ninth-grade strategic initiative?	• 19 years ago the curriculum focused on top kids and was a very rich curriculum. Now it is not the same curriculum. I don't want to use the term watered down—just not the same. • Students that have traditionally not been successful mathematically are now in the course. You can't build the second story without the first floor being there—the foundational understanding. • The double period course helps build foundation but due to the dynamics of scheduling kids may be in a single period whether they need a double period or not. The double period gives teachers time to reteach and reassess. **SAAs** • I'm really concerned about the testing being all selected response because it doesn't allow for partial credit. • Students can make a math error that leads them to pick one of the distracters. • Without a constructed response section the students will guess a lot more. • There are kids who can think and the selected response doesn't get at that. It moved away from the idea of critical thinking and problem solving. • One challenge is that we want every kid to complete Algebra 2. Without removing courses prior to Algebra 1 students will not graduate in four years. It is very difficult to double up on math without taking away alternative pathways. • We need to consider the business community views. • The high school diploma opens doors for kids—if they can't graduate because of this course we're closing doors for them that they could have taken. There are 12th grade students who as seniors did not graduate because of this course. It has changed the expectation of what a high school diploma is. • From my perspective as a resource teacher, I'm constantly concerned about whether students are prepared for the course. The kids don't know enough because of the way middle schools tend to operate. They move children to the next grade 6-7-on to 8th. The feeder middle school keeps putting kids in algebra. The students may be below grade level in 7th grade, not proficient on the MSAs, and being put into 8th grade Algebra 1.

<table>
<tr><th>June 3, 2009
7:30 PM start</th><th>Interview #1
In the 2008-2009 school year teacher taught Algebra 1 sections A and B</th></tr>
<tr><td></td><td>• High school is the first time they are told they don’t get to move up anymore. The high school course is a much different course because when you don’t have kids that can give you the answer it impacts the way you teach.
• Some students have poor study habits and a weak foundation in mathematics and my teachers are saying I can’t make up for the time they’ve lost.
• Because of the pressure who would want to teach Algebra 1?
• My school administration believes that our teachers are doing the best they can. We’re doing our best but feel we’re behind the 8 ball before we start.
• Due to the economic climate the Algebra lead teacher position will be gone next year.

• This isn’t just a school system issue—it’s a community issue as well. Schools can’t solve this problem alone. We serve kids who at 15 are working full time. The only way we’ll get good instruction is if everyone is on the same page. Undocumented parents will not come to school.

• When you’re raising standards and your goal is 100% you have to be aware of the growth of [in the] county and how it has become more diverse over the years.
• The issue is that you’re taking a philosophical belief and trying to fit it into a realistic structure. I believe in almost everything MCPS is trying to do. How much effort do we put into trying to get 100% of kids to pass the algebra course and SAA? Are we looking at kids individually or looking at kids as a number? When we group them into subgroups we don’t look at them as a kid (not the whole child).</td></tr>
<tr><td>How could the strategic initiative be improved?</td><td>• We need to redefine tracking in mathematics.
• Design the lessons differently.</td></tr>
</table>

June 7, 2009 3:30 PM start	**Interview #2**
What are the benefits of the ninth-grade strategic initiative?	• The biggest advantage is having more students have access to higher level mathematics. • It pushes kids faster. I don't think it gives gifted math students the opportunity to explore a lot of other math classes. It doesn't make it more challenging it just gives it earlier.
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• I need to focus heavily on refreshing algebra skills. Teaching it again because they don't have it down. They always need practice. **SAAs** • They [MCPS] are not as concerned about students passing the SAA. They are focused on getting a lot of kids into algebra early. They are also not as concerned with college success. That's past us—they'll get to college and will get pushed on.
What are the challenges you face in implementing the ninth-grade strategic initiative?	• The biggest population of kids who populate the lower level classes in the 9th grade are ESOL students. Most other kids have already taken it in earlier grades. • Students come to precalculus and calculus without solid grounding in factoring, solving quadratics, (building blocks). They are very calculator dependent. Half of the advanced placement test is non-calculator. • Students are not as good at solving word problems as they were in the past.
How could the strategic initiative be improved?	• They [MCPS] need to offer honors level algebra that is heavy into problem solving. For on-level students they need to make it a 2 year process across 8th and 9th grades. • It is an arbitrary goal that all students must take it by the end of 8th grade. • If they rush to get students into calculus as juniors they don't have a math course to take as seniors. The only option as the next class is multivariable at [the local community] College. I had a student who was excellent in math he took advanced placement calculus as a 10th grader, advanced placement statistics as a 11th grader and no math as a senior due to scheduling. • This causes the lower end kids to be scared of math and wary of taking any math in college. There are kids who are late bloomers and are not ready for abstract level of thought. Students end up memorizing theorems and proofs. • Students who fail algebra A should take it again for second semester.

June 7, 2009 **3:30 PM start**	**Interview #2**
	• Having algebra 1 and related math for 9^{th} graders seems to be enough to help get kids through. • Geometry should be offered as a double period with a support class. For some kids it'll be the last math they'll ever take. • We should provide a bridge program. • Having multiple levels of Algebra 1 is very good.
General remarks…	• In my school people teach what they like to teach. I don't like teaching kids with interrupted learning and behavior problems. It is very difficult and should be done by teachers who like the challenge. • For very, very low levels there is such a rush to get to algebra concepts that they are not spiraling them through concepts. • In 3^{rd} grade there is a short time spent on basic math/multiplication.

June 8, 2009 **7:30 PM start**	**Interview #3** **2008-2009 school year served as Algebra Lead Teacher**
What are the benefits of the ninth-grade strategic initiative?	• I guess the main benefit is it gives more options for students to take higher level classes after algebra. It helps with certain majors in college and puts kids on an advanced math track. It is a pretty strict progression of math courses (four main ones). Some majors assume you've had some calculus (doctor, engineer). • Students who take Algebra 1 in the 8^{th} grade can take calculus. • For students not ready for precalculus they can take Bridge to Algebra 2 between Geometry and Algebra 2.
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• This impacts instruction for ESOL 1s that come straight into Algebra 1 from their country. They fail because they don't have enough language. They need a year in MAPS to learn English and math words. ESOL 1 kids who have MAPS are passing algebra, but those without MAPS are not passing. • It used to be that math was not filled with a lot of words—that's not true anymore. Algebra 1 now is very wordy and involves realistic situations, which is supposed to make it more interesting, but hurts ESOL kids. • For special education kids there is a MAPS course for special ed. It is a sheltered course with a special education aide and math teacher. These students have a hard time if they move too quickly.

June 8, 2009 **7:30 PM start**	**Interview #3** **2008-2009 school year served as Algebra Lead Teacher**
	• There is a double period class but for some students there wasn't room left in double period. • For ESOL students if they have several years in the country they are ready for 9th-grade Algebra 1. • Algebra 1 moves fast for the ESOL and special education populations.
What are the challenges you face in implementing the ninth-grade strategic initiative?	• The curriculum assumes that you have and are comfortable using a graphic calculator. There are people who can't afford the calculator. The curriculum is calculator dependent. Some kids have had them for 3 years and have games on them and are faster than the teacher. Others are not comfortable with the menus, screen, or minicourse. • Getting the kids—it is a real struggle getting the kids to come in after school for help. There are a variety of reasons some of them need to baby sit younger siblings or work. • We have one very long lunch. The kids eat lunch for 30 minutes and see teachers for 20 minutes, but it's hard to get them to see teachers. • When you need to call parents the most you can't get the parents. Contacting parents is hard. • For 9th graders it's a hard transition from middle school—middle school kids are babied. In 9th grade kids still expect a party on the last day of school. They are constantly losing papers and not have a pencil—they are disorganized and doing HW is a problem. • Math has a bad rap—a lot of people think it's OK to be bad at math. When people learn that I'm a math teacher the first thing people say is I was never any good at math. It's ok to not be good at math. Most parents can help their kids with reading and writing. Even if a parent is good at math they can't help their kids with it. Even if they are good at math. **SAAs** • We're teaching to the test—especially the last couple of weeks. I know you aren't supposed to teach that way. • Not having BCRs is a challenge. Without BCRs there's now a bigger chance that the kids are guessing and we don't know what they know. 25% is like a zero—they can get it by guessing on a multiple choice test—it's a bad information thing. With BCRs/ECRs they had to think. With the SRs (selected response) they don't even work the problem. They pick the distracters. I understand why they did it—because they needed a faster turnaround on test results.

June 8, 2009 **7:30 PM start**	**Interview #3** **2008-2009 school year served as Algebra Lead Teacher**
	• There are seniors who needed to pass to graduate—we didn't have their scores back in time to determine if they need to do bridge projects. The result of the May test wouldn't come back till October.
How could the strategic initiative be improved?	• ESOL 1 and 2 students need a double period of ESOL Algebra 1 so you could go slower with more practice and vocabulary. • Everyone in special education who should get a double period would get a double period (this is a scheduling problem—it is not possible to be in double period algebra courses if they overlapped each other). • It should no longer be allowed to charge rent/fees for calculators. In algebra 1 it is required that they have a calculator and we have to loan every kid a calculator. We can collect deposits but will give it back when the kids return the calculators. • We had eight Algebra 1 teachers and most had one or two classes. One person taught three sections. We should have small teams so you can plan and stay together. • One thing I'm willing to try and do is planning with other subject areas. I'd like to plan with Matter and Energy 9th-grade teacher. Planning between courses on how formulas and practical problems in Matter and Energy connect directly to Algebra 1. • Making connections and making things meaningful to children with real examples and application.

June 11, 2009 **8:00 PM start**	**Interview #4** **In the 2008-2009 school year teacher taught 2 sections of Algebra 1 (a double period and a section for 10th-, 11th-, and 12th,grade repeaters)**
What are the benefits of the ninth-grade strategic initiative?	• Number 1 is high expectations for all students. Having high expectations for all is a good thing. • Having Algebra 1 by 9th grade sets up Geometry, Algebra 2, precalculus. It provides the opportunity to get up to a pretty high math. The longer you put off Algebra 1 the fewer math courses you get to. • MAPS is the lowest math and is taught by math teacher to ESOL level 1 and 2 students.

June 11, 2009 **8:00 PM start**	**Interview #4** **In the 2008-2009 school year teacher taught 2 sections of Algebra 1 (a double period and a section for 10th-, 11th-, and 12th,grade repeaters)**
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• It's tough to answer these questions. The 10-12 class is a weird class. Students who did not pass due to attendance, behavior, lack of academic focus, math skills, and a few ESOL level 3+ students. Some are very good math kids and some are not. I go through the curriculum at the same rate as the county assessments/formatives/end of unit. It's basic stuff, most of them have seen it before. In my ESOL class there are some freshman but they are not all freshmen. • Hypothetically, I think it would impact instruction. I'm not always convinced that every student is ready for Algebra 1 in the 9th grade. You have to have something extra for those students. • There are some really sharp kids that can help struggling kids. • Freshmen year there are on-level to lower level students in the same class. • There is a window of time for assessments. Probably no consequence if you don't make it—consequence comes when you hit the end of semester and are in trouble for the county final. • The ESOL class is a double period class and it allows me to hit the targets. They need more time depending on their educational background.
What are the challenges you face in implementing the ninth-grade strategic initiative?	• No matter what happens in middle school they take Algebra 1 in 9th grade. If you barely survive math C you'll be in Algebra 1. Those students struggle in Algebra 1. • It's a challenge to work with that population—most likely they are struggling in other classes and coming to high school, which is a new environment. It sets a path that is so hard for them to get off. They struggle, learn to not enjoy math and it's a bad precedent. **SAAs** • SAAs impact students because they are a graduation requirement. I don't know where that's gonna go because almost every student did a bridge project and passed it. If they simply cannot pass they will get through. It's a totally different assessment. The bridge plans is closely guided and facilitated by a teacher. I had one special education student who didn't take the SAA. I was mad at her for blowing it off—she was supposed to be taking the modified SAA. She said I'll just do the bridge—I'm just gonna do the project thing. They can do

June 11, 2009 8:00 PM start	Interview #4 In the 2008-2009 school year teacher taught 2 sections of Algebra 1 (a double period and a section for 10th-, 11th-, and 12th,grade repeaters)
	the project and everyone seems to get through. With my ESOL kids I can still convince them that this is important and they will buy-in. They understand what it's about and I can't wait to see the results. They worked pretty hard. The ESOL kids don't know about bridge. The 10-12 class is more savvy and know how to work the system.
How could the strategic initiative be improved?	• There has to be a way. I want to find a way to support the struggling students more. They are thrown into an academic math course for the first time. • Kids that have been fine in math will be fine in 9th-grade Algebra. We do have related math for some students. • I'm not necessarily opposed to it. I just want there to be a recognition that not every student can do this. It's not realistic—it's realistic for a lot of students but not all. • I tell my students it's ok for you to struggle in math—some of you have played around before. I don't want students to feel pressure or stupid or horrible. • One student in the 10-12 class taking the class for the 2nd time—her skills are so low that it's stunning. I did a lot to try and fill gaps. The MAP-R scores are amazingly low—she can't read. She is struggling to get through and will most likely not get through this year. She's nowhere near able to pass in 9th grade. • Our principal came from BCC and was shocked at how many Algebra 1 sections we have. It's getting better we are decreasing the number of Algebra 1 sections.
General remarks…	• The concept is not necessarily a bad concept. You want students to have an option to go to college. They will hit math courses they need to get to college. • If they take algebra later they will take consumer math in their senior year. If you take it in 9th grade you are more likely to get courses you need and get through Algebra 2 and have options. • I'd like to get recognition that you're not gonna get 100% and let's not demoralize the kids that can't do it. • 80% of students taking Algebra 1 in middle school is outrageous. Takes what we're talking about and changes it and not in a good way. 8th grade is ridiculous. Where does the 80% come from? Strikes me as arbitrary. There's a lot of kids that aren't ready for it in 8th grade.

June 16, 2009 **7:00 PM start**	**Interview #5** **In the 2008-2009 school year teacher taught two sections of Algebra 1—single period all 9th graders**
What are the benefits of the ninth-grade strategic initiative?	• It pushes kids mathematically. Challenging themselves and there's no falling through the crack. Because all students are taking Algebra 1 before they get to high school. When I was in high school there might have been one—now it's the norm versus exception.
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• A lot of kids aren't ready for it. They are diverse in mathematical skills. Some kids are ready and for other kids it's way over their head. The conceptual understanding is challenging to teach in the course. • The SAAs are 40% data analysis and probability so kids get short changed and are lacking in basic algebra skills. • A lot of kids don't know how to add, subtract, multiply, and divide and don't know what it means. When you're trying to solve linear equations, they don't understand the order of operations. Some kids don't have a concept of what negative numbers are. Other kids can multiply in their heads. Other kids are so lost. Some kids do and some don't have an understanding of how numbers work. • Because the curriculum is so packed I don't have time to teach them addition, subtraction, multiplication, and division. I taught them to use the calculator and sometimes they would still get the wrong answer because they typed incorrectly into the calculator. When you're graphing it makes a difference.
What are the challenges you face in implementing the ninth-grade strategic initiative?	• Keeping kids motivated. Trying to get all kids to pass the SAA. Going slower than some kids need and they get de-motivated. Kids who have difficulty also get de-motivated. • The curriculum is directly aligned with the SAA, which is 40% analysis and probability. None of these topics are in a traditional algebra course and all the statistics and probability takes time. In MCPS we teach factoring in 2 or 3 days and not giving the kids the time to internalize concepts. **SAAs** • The impact of the SAAs for graduation is that 9th graders don't get it—to them it wasn't even real. To the seniors who thought Oh wow—I'm not going to graduate.
How could the strategic initiative be improved?	• Well, first if they want to test algebra they should just test algebra. Teach just a year of just algebra. • The ESOL kids are at a disadvantage—everything is a word problem—some should just be a math problem. • They should split the curriculum—one semester statistics, data analysis, and probability course.

June 16, 2009 **7:00 PM start**	**Interview #5** **In the 2008-2009 school year teacher taught two sections of Algebra 1—single period all 9th graders**
	• Some kids' brains have not matured to the point where they can conceptualize. Pushing kids but not past the point where they are ready. • It's hard for me to teach precalculus when they can't solve a linear equation. The kids are getting worse and worse. The longer they've been in MCPS they are getting worse. They lack basic problem solving and solving equations. • Some of my honors kids can't add fractions. • Students have seen algebraic problems since elementary school—they've seen it but don't know it. • Half my class can't factor a quadratic equation and don't recognize number patterns. They had a rushed algebra experience.
General remarks…	• What sets it up is kids in elementary schools use calculators. Nobody forces them to memorize. So they don't understand how numbers work and they get a feeling of I don't like math early on. • I don't like the math curriculum in MCPS all the way down. That affects kids negatively. • Elementary school teachers might be a little afraid of math. They may lack understanding of concept of math. They need better math training and really need to understand how math works. • We don't force kids to memorize basic math. Math should make sense. There's too much they have to memorize. It really takes time for anybody to learn something new to re-express it and make real-life applications. Word problems aren't the same thing as creating a project that lets kids discover and construct their own knowledge. • There are too many topics in the MCPS curriculum. Kids are exposed to a lot but they don't understand a lot. • Teaching a 9th grade course—a lot of kids come in feeling like loser and have a negative feeling about it. There are kids who didn't take Algebra 1 in middle school, kids who take it and fail, and they know we're the losers. It used to be taking it in 9th grade was a normal thing to do. Kids feel embarrassed or ashamed about themselves.

June 18, 2009 7:00 PM start	**Interview #6**
What are the benefits of the ninth-grade strategic initiative?	• I don't see many. I don't think setting a goal—erroneously set—Algebra by the end of 8th grade. Algebra is the cause—not a natural projection of kids who are on a certain track or bright anyway. • It could open up possibilities for some kids. • Teachers should put kids where they belong versus putting a certain number in a course. Not everybody can do it.
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• X number of kids must have algebra by a certain grade. It weakens the algebra curriculum. Not everybody can do algebra at an early age. • It has the reverse effect in high school with more and more kids ending up in a math progression and pushed along. Traditionally Algebra 1 was taught in 9th grade and 8th grade for really exceptional students. Now kids are taking Algebra 1 in 7th grade, Geometry in 8th grade and are not taught by high school teachers but by middle school teachers. They then take Algebra 2 in 9th grade, 10th precalculus, 11th calculus, and 12th multivariable. Many schools want Algebra 2 in middle school. • The 9th-grade students are coming in without the background they need. We're finding that we have to do remedial algebra 1 work like fractions, number sense, properties, negative numbers, division, manipulation of fractions, and order of operation things. • We try to teach honors Algebra 2 with a lot of work with regular algebra topics. • MCPS has padded the algebra curriculum with statistics, which doesn't belong in an algebra class. Calculus-bound students don't need statistics at all. • I have kids being tutored getting Cs and Ds. Kids don't feel successful in math and thinking I don't know why I'm in this math. • We are making demands on them and they drop out of honors and can't handle precalculus. • A statistics and math modeling course used to be for seniors that weren't ready for calculus is now growing in enrollment. In 10th and 11th grade students are taking statistics and math modeling and consumer math. They can't do calculus and precalculus so they are scrounging for another math class. • Kids good at math will be OK—they will get help filling wholes. A lot kids that would have been OK if they hadn't been passed through are the ones really hurting. • The weaker students are always weak.

June 18, 2009 7:00 PM start	**Interview #6**
	• Impact on my instructional practice as included 1:1 tutoring at lunch.
What are the challenges you face in implementing the ninth-grade strategic initiative?	• The seven keys to success—our administration looked at Algebra 2 grades. We weren't giving enough Cs or higher and wanted to find out why kids weren't getting Cs or higher. We have to fight administration by changing instruction, changing what should be taught in the course. • You have to be creative in how you push kids but you can't push too hard because you lose them. They might get their first C. • Nobody has ever said why we are doing this. I wonder if they took calculus at all—the administrators who make these rules. Why should everybody have to take this course? It is a bad misuse of statistics. The only reason is to make the superintendent look good. • There's an article from a teacher at Blair High School last summer. It is about what Blair had to do. The best and brightest kids in the county are in the magnet there and they have high-level math courses at that school. They had to create an Algebra 2 class for magnet kids that aren't fine. They blasted the initiative. • The Algebra 1 test from 12 years ago—my Algebra 2 kids would be hard pressed to do it. • The parents' egos get involved. If some other kids do it then my kids should do it. They don't listen to their teachers. • County exam scores are falling. The overall drop tells them that there's a problem.
How could the strategic initiative be improved?	• We should use math teacher recommendations for course placement. Trust the math teacher. • You shouldn't say X number of kids will do this. • This was supposed to fight tracking—I really don't think it's done this. Consumer math is full of Hispanic and African American kids. I don't think it's opened up any opportunity that wasn't already there. It's put upper middle class kids in class that they shouldn't be in. • Math tracking isn't a bad thing. The students should try harder or go to a different level. Kids who are struggling are not getting the instruction they need.
General remarks…	• Some data came out about kids who had algebra in middle school did better is the reason this initiative came out in a discipline that hasn't changed for years. • Why they want all kids in this class—putting them there doesn't make them more college bound.

June 18, 2009 7:00 PM start	Interview #6
	• There are big problems and it has to be fixed. They are losing experienced good teachers. • The SAA is a very flawed test. It is not really an algebra test. It is heavily based in word problems, which is a problem for ESOL kids. • Another side of this is that more pre-algebra type things haven't been taught. The concept of division, time table, ratios, multiplication. Students use calculators to find an average. Something has to go and that is usually exercises that give them a fundamental understanding. This impacts middle level kids and lower level kids. • Any good math teacher recognizes talent, ability, desire (this is not considered because 80% of kids don't desire to be good), focus, and caring that you get the right answer (if you don't care there are so many places to go wrong). Math people don't let go of a problem they really care and won't let it go until they figure it out.

June 19, 2009 6:00 PM start	Interview #7
What are the benefits of the ninth-grade strategic initiative?	• Hard time finding any. • I do like that it gives every kid the opportunity to be on an even playing field. • There's no more tracking supposedly. If you were in a tracked area it would be hard to rise above that. There's no honors algebra. • Sets a lot of kids up for failure.
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• We have an Algebra Lead Teacher that does all the planning and says this is what you have to do. There's not a lot of planning other than that. The only autonomy I have is how I deliver the info. • I never saw the curriculum for Algebra 1. We meet once per week and whatever unit we were doing we would get the packet. It was step-by-step with notes for kids. We can use the packet as a guide and can do our own thing if we want, but I worried if I don't do it my kids will not be as prepared. • There is room for small difference. Our own activities, game, different ways to do it/present it. Not always in a worksheet format. Be creative—write on construction paper instead of worksheet.
What are the challenges you	• Students come in with mathematical ability not up to par. They skipped parts of math in middle school like fractions,

June 19, 2009 6:00 PM start	**Interview #7**
face in implementing the ninth-grade strategic initiative?	percentages, and they can't comprehend the mathematics you're doing. • I would like to see pre-algebra available—they have it for special education but it would benefit others. • In middle school students skip levels. 6th graders with high math ability skip to next level Math C and skip Math B. Honors Algebra 2 kids have skipped levels. They put them in higher level without regard to what they're missing. When you miss out on something you don't know how to do it. When students are missing math concepts you need to spend time teaching them what they need. • The curriculum is jam packed—which do you do? • There is Algebra 1 double period for ESOL kids and special ed kids with a co-teacher. • Algebra 1 is calculator driven—all calculator based—missing mathematics behind it. You show them how to find the greatest common denominator with a couple of key strokes. • The message is everybody's going to college. • Geometry is algebra driven—you don't write proofs anymore. Area that you're trying to solve because it's still an equation. • Algebra 2 curriculum is jam packed—there's no time to teach—don't have much choice. • Students coming from Math A straight to Algebra 1 have missed Math B and C. You have to catch them up on the math they've missed. There are 10th, 11th, and 12th graders in Algebra 2. • In 9th and 10th grade honors Algebra 2 there were students who couldn't tell me the square root of 4 without a calculator. **SAAs** Motivation to pass and to graduate on time. We can take it as many times as we want—no serious pressure and very little motivation. These are the lower math children who haven't had much mathematics success in life. Their minds cannot grasp long-range goals. Adolescent behavior and lack of motivation—their inability to understand cause and effect at 14 or 15 years old whether or not the SAA is required.
How could the strategic initiative be improved?	• Forcing higher math on kids not capable is not ideal. Intellectual pursuits begin at their capacity. • No set prerequisite for courses and honoring that. • There are very few exceptional math kids. You have conversations with them and they just get it. They understand numbers and ask inquisitive questions. They bring up things they see and how everything ties in together.

June 19, 2009 6:00 PM start	**Interview #7**
General remarks…	• My philosophy is the goal is to be productive, logical thinking, and have problem solving skills. Does that have to be done through Algebra 1 course? • For those who've failed Algebra 1—I don't know if there's a right way to address. We kept pulling along one student—had every algebra teacher—so far failing him (this year is his 3rd time taking and failing algebra). He's 17 with a poor home life. We're telling him to suck it up—that's what we're doing. Students like him are not ready for an Algebra 1 class. Try to love them as much as you can—this is the hoop you have to jump through in order to graduate.

Jun 21, 2009 7:00 PM start	**Interview #8**
What are the benefits of the ninth-grade strategic initiative?	• Puts students in a position—path to college. • Gets everybody (focusing on the word everybody) focused on it. My Consulting Teacher during a formal post observation meeting asked: Do you believe that everybody can get at least a C in algebra? I don't know, I have kids who failed three times. They are in the 12th grade and taking their fourth bite at the apple. The data shows that it's hard. • The kids can't do simple math things—we have to provide them with a calculator. They do multiplication of 5 X 4 in a calculator. Are we doing them any harm skipping over stuff they need? Drilling them on what they're gonna get on the SAA. Skipping certain stuff in the curriculum. • For kids who have not passed it two or three times I'm not sure we're helping them. • As a student teacher I hadn't taught Algebra 1. In MCPS we like to have kids pass in 8th grade. In 9th most of them have failed once in middle school. 50% will fail a second time. • In my previous career I was an engineer—the data suggest that there's something wrong. Something needs to be revisited. Kids are still failing. • There is a benefit for many, yes, but there's a subgroup that doesn't benefit.
In what ways has the ninth-grade strategic initiative impacted your instructional practices?	• These are in no particular order. There's pushback from kids—why are we doing this—because they don't want to do it because they've failed once and keep doing the same thing. They think this is a form of craziness. I'm not good at math—I can't do it and it leads to behavior issues, they are bored and frustrated.

Jun 21, 2009 7:00 PM start	Interview #8
	• They are de-motivated—they've failed it before. They can't tell time on a clock, have low math skills, can't do multiplication tables, and don't have number sense (negative and positive numbers). • There are retention issues—they are memorizing things to do. We're learning X then Y; if on a test they see Y then X, suddenly there's an issue. Memorizing things—that doesn't last very long. Revisit something 2 weeks later and it's not there for them. • Kids who took Algebra 1 in middle school and don't pass the final retake in high school—I don't quite understand. • The calculator fee issue. There's a new policy—now [the District] has to provide class sets of calculators. They can't function without these calculators. Kids steal them so 30-40% were gone by the end of the year. Kids need them for basic multiplication so we keep buying them throughout the year. During instruction, the mental processes stop—deviate to using calculator. Enough time's gone by when they get back to equation that they have to think what am I doing again. You don't have to stop every time—it slows down the whole learning process. Frustration leads to behavior issues and reduces the amount of time for the instruction. **SAAs** • This is the first year you actually had to pass the test. Freshmen in their mind have 4 years to pass it. • Those at risk get pulled out of elective classes, which is a hassle for them. • For some reason they've gotten the idea that they can't succeed—then everything else reinforces it. • The reviewing and pressure they don't have to deal with anymore when they pass it. They were happy to do bridge projects to graduate—another hurdle. 4th graders have heard about the bridge stuff. • There is 4-5 weeks of SAA prep out of second semester. The final exam included things that neither I nor other algebra teachers could get to (factoring, quadratic equations). • Because of the jam-packed curriculum there isn't much time for reteaching. There's a new topic every day. Topics don't string together very well. • The data analysis they weren't bad at—we're teaching it because it's on the SAA. Why do we have so much on it? Data analysis—conceptually it's a whole different thing from Algebra 1.

Jun 21, 2009 7:00 PM start	**Interview #8**
	• There are new topics on a regular basis. We are marching them through it. I have a daily warm up, classwork (which I collect—if you don't collect, they wouldn't do it), and assign HW. You've got to threaten them every step of the way in order to keep them on task. It was a pressure cooker for them as well as for me. First-year teacher issues on my part.
What are the challenges you face in implementing the ninth-grade strategic initiative?	• The book was not useful. The math book didn't follow the curriculum at all. Didn't have data analysis in it so we used worksheet and notes. Kids didn't have an aid at home to look at. We don't use the book. I know that when I went to school I could depend on the books I had. I can't depend on this book. • NCTM has identified data analysis as one of key six indicators. I understand why it would be in a high school curriculum but not in an algebra SAA.
How could the strategic initiative be improved?	• The initial premise (based on talk that goes on in the lunchroom). • More experienced teachers are teaching honors-calculus. • Do you believe that every student should go to college? (global competitors—it's not an issue of qualification.) Businesses don't want to spend more money than they have to. One track, one program of learning reduces costs. • In [the District] we have this position—highlighted in the county—nobody wants to reteach so we put blinders on. They teach remedial algebra at [the local community] College—real algebra without data analysis. Not so sure why we're doing this. If the foundation is wrong (wrong soil) we can't build anymore; we have to go back and address the foundation. These kids are becoming victims. • In engineering you get what you measure and that's all you're going to get. We are not measuring number sense, multiplication times table, or reading a clock. They pass algebra and can't do anything with it like working with square roots or basic skills. • Kids that are having difficulty (50% of the population) might be successful if they had the proper preparation. Kids shouldn't be getting to us without prerequisite skills. If they do get to us without them we should be giving it to them. Kids should be brought into a room with a computer-aided instruction at their own pace—almost like a charter school. • It's not working with a subset of kids. For those kids who pass in middle school this thing is great for them. Those who didn't make it in middle school and are having difficulty making it in high schools as well—we should see their behavior as raising a

Jun 21, 2009 7:00 PM start	**Interview #8**
	red flag at this problem. But in an effort to make numbers we're pushing them through the math grinder.
General remarks…	• From my perspective as a career changer, I was fighting to keep their attention, keep their heads off desks. I had one or two success stories, but I got the feeling that I was offering a product to customers that weren't interested in it. I probably would have opted not to return to it if I had to teach the same thing again. I'm dealing with kids that didn't pass in middle school. • There's a problem and someone needs to understand what the problem is. We haven't cracked the code on those kids. • One thing I did forget—the kids in the 50% who are failing—word problems are a big part of that. Standard [District] exams are big on word problems. ESOL level 2, 3, and even 4 just shutting them down. Kids are struggling to get the answer, some don't even try. We all recognize that this is an issue. ESOL kids really have the hardest time.

Appendix E: Qualitative Phone Interview Notes By Questions

Responses from phone interviews from different teachers have been combined from all interviews by each question below:

1. What are the benefits of the ninth-grade strategic initiative?

- Fact that we're getting every student to experience algebra and algebraic thinking early
- Students learn to generalize thinking process.
- Students learn to classify problems and groups of problems.
- If they get it by the end of 9th grade they have 3 years to apply learning.
- Many of them finish it by the end of 8th grade (we have pushed some kids).
- The biggest advantage is having more students have access to higher level mathematics.
- It pushes kids faster. I don't think it gives gifted math students the opportunity to explore a lot of other math classes. It doesn't make it more challenging it just gives it earlier.
- I guess the main benefit is it gives more options for students to take higher level classes after algebra. It helps with certain majors in college and puts kids on an advanced math track. It is a pretty strict progression of math courses (four main ones). Some majors assume you've had some calculus (doctor, engineer).
- Students who take algebra 1 in the 8th grade can take calculus.
- For students not ready for precalculus they can take Bridge to Algebra 2 between Geometry and Algebra 2.
- Number 1 is high expectations for all students. Having high expectations for all is a good thing.
- Having Algebra 1 by 9th grade sets up Geometry, Algebra 2, precalculus. It provides the opportunity to get up to a pretty high math. The longer you put off Algebra 1 the fewer math courses you get to.
- MAPS if the lowest math and is taught by math teacher to ESOL level 1 and 2 students.
- It pushes kids mathematically. Challenging themselves and there's no falling through the crack. Because all students are taking Algebra 1 before they get to high school. When I was in high school there might have been one—now it's the norm versus exception.
- I don't see many. I don't think setting a goal—erroneously set—Algebra by the end of 8th grade. Algebra is the cause not a natural projection of kids who are on a certain track or bright anyway.
- It could open up possibilities for some kids.
- Teachers should put kids where they belong versus putting a certain number in a course. Not everybody can do it.
- Hard time finding any.
- I do like that it gives every kid the opportunity to be on an even playing field.

- There's no more tracking supposedly. If you were in a tracked area it would be hard to rise above that. There's no honors algebra.
- Sets a lot of kids up for failure.
- Puts students in a position—path to college.
- Gets everybody (focusing on the word everybody) focused on it. My Consulting Teacher during a formal post observation meeting asked: Do you believe that everybody can get at least a C in algebra? I don't know; I have kids who failed three times. They are in the 12th grade and taking their fourth bite at the apple. The data shows that it's hard.
- The kids can't do simple math things—we have to provide them with a calculator. They do multiplication of 5 X 4 in a calculator. Are we doing them any harm skipping over stuff they need? Drilling them on what they're going to get on the SAA. Skipping certain stuff in the curriculum.
- For kids who have not passed it two or three times I'm not sure we're helping them.
- As a student teacher I hadn't taught Algebra 1. In MCPS we like to have kids pass in 8th grade. In 9th most of them have failed once in middle school. 50% will fail a second time.
- In my previous career I was an engineer—the data suggest that there's something wrong. Something needs to be revisited. Kids are still failing.
- There is a benefit for many, yes, but there's a subgroup that doesn't benefit.

2. In what ways has the ninth-grade strategic initiative impacted your instructional practices?

- Every child is different, some kids have difficulty getting abstract thinking. Not every child has been able to accomplish what is required. For example, ELLs who don't learn the way the teacher teaches.
- For students who are not successful we need a better back up plan so that every kid gets it by the end of the course.
- I focus more on my repeater kids (B kids are getting it).
- There are students who are not motivated and have attendance problems in the A class.
- I try to make the course different and don't repeat the same procedures for students who are taking it a second time.
- I work on personal relationship building.
- I find different instructional techniques and try to interest students by using technology.
- It is a tight curriculum—so much to cover.
- I need to focus heavily on refreshing algebra skills. Teaching it again because they don't have it down. They always need practice.
- They [MCPS] are not as concerned about students passing the SAA. They are focused on getting a lot of kids into algebra early. They are also not as concerned with college success. That's past us—they'll get to college and will get pushed on.

- This impacts instruction for ESOL 1s that come straight into Algebra 1 from their country. They fail because they don't have enough language. They need a year in MAPS to learn English and math words. ESOL 1 kids who have MAPS are passing algebra, but those without MAPS are not passing.
- It used to be that math was not filled with a lot of words—that's not true anymore. Algebra 1 now is very wordy and involves realistic situations, which is supposed to make it more interesting ,but hurts ESOL kids.
- For special education kids there is a MAPS course for special ed. It is a sheltered course with a special education aide and math teacher. These students have a hard time if they move too quickly.
- There is a double period class but for some students there wasn't room left in double period.
- For ESOL students if they have several years in the country they are ready for 9th grade Algebra 1.
- Algebra 1 moves fast for the ESOL and special education populations.
- It's tough to answer these questions. The 10-12 class is a weird class. Students who did not pass due to attendance, behavior, lack of academic focus, math skills, and a few ESOL level 3+ students. Some are very good math kids and some are not. I go through the curriculum at the same rate as the county assessments/formatives/end of unit. It's basic stuff; most of them have seen it before. In my ESOL class there are some freshmen but they are not all freshmen.
- Hypothetically, I think it would impact instruction. I'm not always convinced that every student is ready for Algebra 1 in the 9th grade. You have to have something extra for those students.
- There are some really sharp kids that can help struggling kids.
- Freshmen year there are on-level to lower level students in the same class.
- There is a window of time for assessments. Probably no consequence if you don't make it—consequence comes when you hit the end of semester and are in trouble for the county final.
- The ESOL class is a double period class and it allows me to hit the targets. They need more time depending on their educational background.
- X number of kids must have algebra by a certain grade. It weakens the algebra curriculum. Not everybody can do algebra at an early age.
- It has the reverse effect in high school with more and more kids ending up in a math progression and pushed along. Traditionally Algebra 1 was taught in 9th grade and 8th grade for really exceptional students. Now kids are taking Algebra 1 in 7th grade, Geometry in 8th grade and are not taught by high school teachers but by middle school teachers. They then take Algebra 2 in 9th grade, 10th precalculus, 11th calculus, and 12th multivariable. Many schools want Algebra 2 in middle school.
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- MCPS has padded the algebra curriculum with statistics, which doesn't belong in an algebra class. Calculus bound students don't need statistics at all.
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- The weaker students are always weak.
- Impact on my instructional practice as included 1:1 tutoring at lunch.
- We have an Algebra Lead Teacher that does all the planning and says this is what you have to do. There's not a lot of planning other than that. The only autonomy I have is how I deliver the info.
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- There is room for small difference. Our own activities, game, different ways to do it/present it. Not always in a worksheet format. Be creative; write on construction paper instead of worksheet.
- These are in no particular order. There's pushback from kids—why are we doing this—because they don't want to do it because they've failed once and keep doing the same thing. They think this is a form of craziness. I'm not good at math—I can't do it and it leads to behavior issues; they are bored and frustrated.
- They are de-motivated—they've failed it before. They can't tell time on a clock, have low math skills, can't do multiplication tables, and don't have number sense (negative and positive numbers).
- There are retention issues—they are memorizing things to do. We're learning X then Y; if on a test they see Y then X, suddenly there's an issue. Memorizing things—that doesn't last very long. Revisit something 2 weeks later and it's not there for them.
- Kids who took Algebra 1 in middle school and don't pass the final retake in high school—I don't quite understand.
- The calculator fee issue. There's a new policy—now [the District] has to provide class sets of calculators. They can't function without these calculators. Kids steal them so 30-40% were gone by the end of the year. Kids need them for basic multiplication so we keep buying them throughout the year. During instruction, the mental processes stop—deviate to using calculator. Enough time's gone by when they get back to equation that they have to think what am I doing again. You don't have to stop every time; it slows down the whole learning process.

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- This is the first year you actually had to pass the test. Freshmen, in their mind, have 4 years to pass it.
- Those at risk get pulled out of elective classes, which is a hassle for them.
- For some reason they've gotten the idea that they can't succeed—then everything else reinforces it.
- The reviewing and pressure they don't have to deal with anymore when they pass it. They were happy to do bridge projects to graduate—another hurdle. 4th graders have heard about the bridge stuff.
- There is 4-5 weeks of SAA prep out of second semester. The final exam included things that neither I nor other algebra teachers could get to (factoring, quadratic equations).
- Because of the jam-packed curriculum there isn't much time for reteaching. There's a new topic every day. Topics don't string together very well.
- The data analysis they weren't bad at—we're teaching it because it's on the SAA. Why do we have so much on it? Data analysis—conceptually it's a whole different thing from Algebra 1.
- There are new topics on a regular basis. We are marching them through it. I have a daily warm up, classwork (which I collect—if you don't collect, they wouldn't do it), and assign HW. You've got to threaten them every step of the way in order to keep them on task. It was a pressure cooker for them as well as for me. First-year teacher issues on my part.

3. What are the challenges you face in implementing the ninth-grade strategic initiative?

- I'm really concerned about the testing being all selected response because it doesn't allow for partial credit.
- Students can make a math error that leads them to pick one of the distracters.
- Without a constructed response section the students will guess a lot more.
- There are kids who can think and the selected response doesn't get at that. It moved away from the idea of critical thinking and problem solving.
- One challenge is that we want every kid to complete Algebra 2. Without removing courses prior to Algebra 1 students will not graduate in 4 years. It is very difficult to double up on math without taking away alternative pathways.
- We need to consider the business community views.
- The high school diploma opens doors for kids—if they can't graduate because of this course we're closing doors for them that they could have taken. There are 12th-grade students who as seniors did not graduate because of this course. It has changed the expectation of what a high school diploma is.
- From my perspective as a resource teacher, I'm constantly concerned about whether students are prepared for the course. The kids don't know enough because of the way middle schools tend to operate. They move children to the next grade 6-7—on to 8th. The feeder middle school keeps putting kids in algebra.

The students may be below grade level in 7th grade, not proficient on the MSAs, and being put into 8th-grade Algebra 1.

- High school is the first time they are told they don't get to move up anymore. The high school course is a much different course because when you don't have kids that can give you the answer it impacts the way you teach.
- Some students have poor study habits and a weak foundation in mathematics and my teachers are saying I can't make up for the time they've lost.
- Because of the pressure who would want to teach Algebra 1?
- My school administration believes that our teachers are doing the best they can. We're doing our best but feel we're behind the 8 ball before we start.
- Due to the economic climate the Algebra lead teacher position will be gone next year.
- This isn't just a school system issue—it's a community issue as well. Schools can't solve this problem alone. We serve kids who at 15 are working full time. The only way we'll get good instruction is if everyone is on the same page. Undocumented parents will not come to school.
- When you're raising standards and your goal is 100% you have to be aware of the growth [in the District] and how it has become more diverse over the years.
- The issue is that you're taking a philosophical belief and trying to fit it into a realistic structure. I believe in almost everything MCPS is trying to do. How much effort do we put into trying to get 100% of kids to pass the algebra course and SAA? Are we looking at kids individually or looking at kids as a number? When we group them into subgroups we don't look at them as a kid (not the whole child).
- The biggest population of kids who populate the lower level classes in the 9th grade are ESOL students. Most other kids have already taken it in earlier grades.
- Students come to precalculus and calculus without solid grounding in factoring, solving quadratics, (building blocks). They are very calculator dependent. Half of the advanced placement test is noncalculator.
- Students are not as good at solving word problems as they were in the past.
- The curriculum assumes that you have and are comfortable using a graphic calculator. There are people who can't afford the calculator. The curriculum is calculator dependent. Some kids have had them for 3 years and have games on them and are faster than the teacher. Others are not comfortable with the menus, screen, or minicourse.
- Getting the kids—it is a real struggle getting the kids to come in after school for help. There are a variety of reasons—some of them need to babysit younger siblings or work.
- We have one very long lunch. The kids eat lunch for 30 minutes and see teachers for 20 minutes, but it's hard to get them to see teachers.
- When you need to call parents the most you can't get the parents. Contacting parents is hard.
- For 9th graders it's a hard transition from middle school—middle school kids are babied. In 9th grade kids still expect a party on the last day of school. They are

constantly losing papers and not have a pencil—they are disorganized and doing HW is a problem.

- Math has a bad rap—a lot of people think it's OK to be bad at math. When people learn that I'm a math teacher the first thing people say is I was never any good at math. It's ok to not be good at math. Most parents can help their kids with reading and writing. Even if a parent is good at math they can't help their kids with it. Even if they are good at math.
- We're teaching to the test—especially the last couple of weeks. I know you aren't supposed to teach that way.
- Not having BCRs is a challenge. Without BCRs there's now a bigger chance that the kids are guessing and we don't know what they know. 25% is like a zero—they can get it by guessing on a multiple choice test—it's a bad information thing. With BCRs/ECRs they had to think. With the SRs (selected response) they don't even work the problem. They pick the distracters. I understand why they did it—because they needed a faster turnaround on test results.
- There are seniors who needed to pass to graduate—we didn't have their scores back in time to determine if they need to do bridge projects. The result of the May test wouldn't come back till October.
- No matter what happens in middle school they take Algebra 1 in 9^{th} grade. If you barely survive math C you'll be in Algebra 1. Those students struggle in Algebra 1.
- It's a challenge to work with that population—most likely they are struggling in other classes and coming to high school, which is a new environment. It sets a path that is so hard for them to get off. They struggle, learn to not enjoy math and it's a bad precedent.
- SAAs impact students because they are a graduation requirement. I don't know where that's gonna go because almost every student did a bridge project and passed it. If they simply cannot pass they will get through. It's a totally different assessment. The bridge plans is closely guided and facilitated by a teacher. I had one special education student who didn't take the SAA. I was mad at her for blowing it off—she was supposed to be taking the modified SAA. She said I'll just do the bridge—I'm just gonna do the project thing. They can do the project and everyone seems to get through. With my ESOL kids I can still convince them that this is important and they will buy-in. They understand what it's about and I can't wait to see the results. They worked pretty hard. The ESOL kids don't know about bridge. The 10-12 class is more savvy and know how to work the system.
- A lot of kids aren't ready for it. They are diverse in mathematical skills. Some kids are ready and for other kids it's way over their head. The conceptual understanding is challenging to teach in the course.
- The SAAs are 40% data analysis and probability so kids get shortchanged and are lacking in basic algebra skills.
- A lot of kids don't know how to add, subtract, multiply, and divide and don't know what it means. When you're trying to solve linear equations, they don't understand the order of operations. Some kids don't have a concept of what negative numbers are. Other kids can multiply in their heads. Other kids are so lost. Some kids do and some don't have an understanding of how numbers work.

- Because the curriculum is so packed I don’t have time to teach them addition, subtraction, multiplication, and division. I taught them to use the calculator and sometimes they would still get the wrong answer because they typed incorrectly into the calculator. When you’re graphing it makes a difference.
- Keeping kids motivated. Trying to get all kids to pass the SAA. Going slower than some kids need and they get de-motivated. Kids who have difficulty also get de-motivated.
- The curriculum is directly aligned with the SAA, which is 40% analysis and probability. None of these topics are in a traditional algebra course and all the statistics and probability takes time. In MCPS we teach factoring in 2 or 3 days and not giving the kids the time to internalize concepts.
- The impact of the SAAs for graduation is that 9th graders don’t get it—to them it wasn’t even real. To the seniors who thought Oh wow—I’m not going to graduate.
- The seven keys to success—our administration looked at Algebra 2 grades. We weren’t giving enough Cs or higher and wanted to find out why kids weren’t getting Cs or higher. We have to fight administration by changing instruction, changing what should be taught in the course.
- You have to be creative in how you push kids but you can’t push too hard because you lose them. They might get their first C.
- Nobody has ever said why we are doing this. I wonder if they took calculus at all the administrators who make these rules. Why should everybody have to take this course? It is a bad misuse of statistics. The only reason is to make the superintendent look good.
- There’s an article from a teacher at Blair High School last summer. It is about what Blair had to do. The best and brightest kids in the county are in the magnet there and they have high level math courses at that school. They had to create an Algebra 2 class for magnet kids that aren’t fine. They blasted the initiative.
- The Algebra 1 test from 12 years ago—my Algebra 2 kids would be hard pressed to do it.
- The parents’ egos get involved. If some other kids do it, then my kids should do it. They don’t listen to their teachers.
- County exam scores are falling. The overall drop tells them that there’s a problem.
- Students come in with mathematical ability not up to par. They skipped parts of math in middle school like fractions, percentages, and they can’t comprehend the mathematics you’re doing.
- I would like to see pre-algebra available—they have it for special education but it would benefit others.
- In middle school students skip levels. 6th graders with high math ability skip to next level Math C and skip Math B. Honors Algebra 2 kids have skipped levels. They put them in higher level without regard to what they’re missing. When you miss out on something you don’t know how to do it. When students are missing math concepts you need to spend time teaching them what they need.
- The curriculum is jam packed—which do you do?

- There is Algebra 1 double period for ESOL kids and special ed kids with a co-teacher.
- Algebra 1 is calculator driven—all calculator based—missing mathematics behind it. You show them how to find the greatest common denominator with a couple of key strokes.
- The message is everybody's going to college.
- Geometry is algebra driven—you don't write proofs anymore. Area that you're trying to solve because it's still an equation.
- Algebra 2 curriculum is jam packed there's no time to teach—don't have much choice.
- Students coming from Math A straight to Algebra 1 have missed Math B and C. You have to catch them up on the math they've missed. There are 10th, 11th, and 12th graders in Algebra 2.
- In 9th and 10th grade honors Algebra 2 there were students who couldn't tell me the square root of 4 without a calculator.
- Motivation to pass and to graduate on time. We can take it as many times as we want—no serious pressure and very little motivation. These are the lower math children who haven't had much mathematics success in life. Their minds cannot grasp long-range goals. Adolescent behavior and lack of motivation—their inability to understand cause and effect at 14 or 15 years old whether or not the SAA is required.
- The book was not useful. The math book didn't follow the curriculum at all. Didn't have data analysis in it so we used worksheet and notes. Kids didn't have an aide at home to look at. We don't use the book. I know that when I went to school I could depend on the books I had. I can't depend on this book.
- NCTM has identified data analysis as one of key six indicators. I understand why it would be in a high school curriculum but not in an algebra SAA.

4. How could the strategic initiative be improved?

- We need to redefine tracking in mathematics.
- Design the lessons differently.
- They [MCPS] need to offer honors-level algebra that is heavy into problem solving. For on-level students they need to make it a 2-year process across 8th and 9th grades.
- It is an arbitrary goal that all students must take it by the end of 8th grade.
- If they rush to get students into calculus as juniors they don't have a math course to take as seniors. The only option as the next class is multivariable at [the local community] College. I had a student who was excellent in math; he took advanced placement calculus as a 10th grader, advanced placement statistics as a 11th grader, and no math as a senior due to scheduling.
- This causes the lower end kids to be scared of math and wary of taking any math in college. There are kids who are late bloomers and are not ready for abstract level of thought. Students end up memorizing theorems and proofs.
- Students who fail Algebra A should take it again for second semester.

- Having Algebra 1 and related math for 9^{th} graders seems to be enough to help get kids through.
- Geometry should be offered as a double period with a support class. For some kids it'll be the last math they'll ever take.
- We should provide a bridge program.
- Having multiple levels of Algebra 1 is very good.
- It should no longer be allowed to charge rent/fees for calculators. In Algebra 1 it is required that they have a calculator and we have to loan every kid a calculator. We can collect deposits but will give it back when the kids return the calculators.
- We had 8 Algebra 1 teachers and most had one or two classes. One person taught three sections. We should have small teams so you can plan and stay together.
- One thing I'm willing to try and do is planning with other subject areas. I'd like to plan with Matter and Energy 9^{th}-grade teacher. Planning between courses on how formulas and practical problems in Matter and Energy connect directly to Algebra 1.
- Making connections and making things meaningful to children with real examples and application.
- There has to be a way. I want to find a way to support the struggling students more. They are thrown into an academic math course for the first time.
- Kids that have been fine in math will be fine in 9^{th}-grade Algebra. We do have related math for some students.
- I'm not necessarily opposed to it. I just want there to be a recognition that not every student can do this. It's not realistic—it's realistic for a lot of students but not all.
- I tell my students it's ok for you to struggle in math—some of you have played around before. I don't want students to feel pressure or stupid or horrible.
- One student in the 10-12 class taking the class for the second time—her skills are so low that it's stunning. I did a lot to try and fill gaps. The MAP-R scores are amazingly low—she can't read. She is struggling to get through and will most likely not get through this year. She's nowhere near able to pass in 9^{th} grade.
- Our principal came from BCC and was shocked at how many Algebra 1 sections we have. It's getting better; we are decreasing the number of Algebra 1 sections.
- Well, first if they want to test algebra they should just test algebra. Teach just a year of just algebra.
- The ESOL kids are at a disadvantage; everything is a word problem—some should just be a math problem.
- They should split the curriculum—one semester statistics, data analysis, and probability course.
- Some kids' brains have not matured to the point where they can conceptualize. Pushing kids but not past the point where they are ready.
- It's hard for me to teach precalculus when they can't solve a linear equation. The kids are getting worse and worse. The longer they've been in MCPS they are getting worse. They lack basic problem solving and solving equations.
- Some of my honors kids can't add fractions.

- Students have seen algebraic problems since elementary school; they've seen it but don't know it.
- Half my class can't factor a quadratic equation and don't recognize number patterns. They had a rushed algebra experience.
- We should use math teacher recommendations for course placement. Trust the math teacher.
- You shouldn't say X number of kids will do this.
- This was supposed to fight tracking—I really don't think it's done this. Consumer math is full of Hispanic and African American kids. I don't think it's opened up any opportunity that wasn't already there. It's put upper middle class kids in class that they shouldn't be in.
- Math tracking isn't a bad thing. The students should try harder or go to a different level. Kids who are struggling are not getting the instruction they need.
- Forcing higher math on kids not capable is not ideal. Intellectual pursuits begin at their capacity.
- No set prerequisite for courses and honoring that.
- There are very few exceptional math kids. You have conversations with them and they just get it. They understand numbers and ask inquisitive questions. They bring up things they see and how everything ties in together.
- The initial premise (based on talk that goes on in the lunchroom).
- More experienced teachers are teaching honors calculus.
- Do you believe that every student should go to college? (global competitors—it's not an issue of qualification. Businesses don't want to spend more money than they have to. One track, one program of learning reduces costs.
- In [the District] we have this position—highlighted in the county—nobody wants to reteach so we put blinders on. They teach remedial algebra at [the local community] College—real algebra without data analysis. Not so sure why we're doing this. If the foundation is wrong (wrong soil), we can't build anymore; we have to go back and address the foundation. These kids are becoming victims.
- In engineering you get what you measure and that's all you're gonna get. We are not measuring number sense, multiplication times table, or reading a clock. They pass algebra and can't do anything with it like working with square roots or basic skills.
- Kids that are having difficulty (50% of the population) might be successful if they had the proper preparation. Kids shouldn't be getting to us without prerequisite skills. If they do get to us without them we should be giving it to them. Kids should be brought into a room with a computer-aided instruction at their own pace—almost like a charter school.
- It's not working with a subset of kids. For those kids who pass in middle school, this thing is great for them. Those who didn't make it in middle school and are having difficulty making it in high schools as well—we should see their behavior as raising a red flag at this problem. But in an effort to make numbers we're pushing them through the math grinder.

5. **General Remarks:**

- In my school people teach what they like to teach. I don't like teaching kids with interrupted learning and behavior problems. It is very difficult and should be done by teachers who like the challenge.
- For very, very low levels there is such a rush to get to algebra concepts that they are not spiraling them through concepts.
- In 3rd grade there is a short time spent on basic math/multiplication.
- The concept is not necessarily a bad concept. You want students to have an option to go to college. They will hit math courses they need to get to college.
- If they take algebra later they will take consumer math in their senior year. If you take it in 9th grade you are more likely to get courses you need and get through Algebra 2 and have options.
- I'd like to get recognition that you're not gonna get 100% and let's not demoralize the kids that can't do it.
- 80% of students taking Algebra 1 in middle school is outrageous. Takes what we're talking about and changes it and not in a good way. 8th grade is ridiculous. Where does the 80% come from? Strikes me as arbitrary. There's a lot of kids that aren't ready for it in 8th grade.
- What sets it up is kids in elementary schools use calculators. Nobody forces them to memorize. So they don't understand how numbers work and they get a feeling of I don't like math early on.
- I don't like the math curriculum in MCPS all the way down. That affects kids negatively.
- Elementary school teachers might be a little afraid of math. They may lack understanding of concept of math. They need better math training and really need to understand how math works.
- We don't force kids to memorize basic math. Math should make sense. There's too much they have to memorize. It really takes time for anybody to learn something new to re-express it and make real-life applications. Word problems aren't the same thing as creating a project that lets kids discover and construct their own knowledge.
- There are too many topics in the MCPS curriculum. Kids are exposed to a lot but they don't understand a lot.
- Teaching a 9th grade course—a lot of kids come in feeling like loser and have a negative feeling about it. There are kids who didn't take Algebra 1 in middle school, kids who take it and fail, and they know we're the losers. It used to be taking it in 9th grade was a normal thing to do. Kids feel embarrassed or ashamed about themselves.
- Some data came out about kids who had algebra in middle school did better is the reason this initiative came out in a discipline that hasn't changed for years.
- Why they want all kids in this class—putting them there doesn't make them more college bound.
- There are big problems and it has to be fixed. They are losing experienced good teachers.

- The SAA is a very flawed test. It is not really an algebra test. It is heavily based in word problems, which is a problem for ESOL kids.
- Another side of this is that more pre-algebra type things haven't been taught. The concept of division, time table, ratios, multiplication. Students use calculators to find an average. Something has to go and that is usually exercises that give them a fundamental understanding. This impacts middle level kids and lower level kids.
- Any good math teacher recognizes talent, ability, desire (this is not considered because 80% of kids don't desire to be good), focus, and caring that you get the right answer (if you don't care, there are so many places to go wrong). Math people don't let go of a problem they really care and won't let it go until they figure it out.
- My philosophy is the goal is to be productive, logical thinking, and have problem-solving skills. Does that have to be done through Algebra 1 course?
- For those who've failed Algebra 1—I don't know if there's a right way to address. We kept pulling along one student—had every algebra teacher—so far failing him (this year is his third time taking and failing algebra). He's 17 with a poor home life. We're telling him to suck it up—that's what we're doing. Students like him are not ready for an Algebra 1 class. Try to love them as much as you can—this is the hoop you have to jump through in order to graduate.
- From my perspective as a career changer, I was fighting to keep their attention, keep their heads off desks. I had one or two success stories but I got the feeling that I was offering a product to customers that weren't interested in it. I probably would have opted not to return to it if I had to teach the same thing again. I'm dealing with kids that didn't pass in middle school.
- There's a problem and someone needs to understand what the problem is. We haven't cracked the code on those kids.
- One thing I did forget—the kids in the 50% who are failing—word problems are a big part of that. Standard [District] exams are big on word problems. ESOL level 2, 3, and even 4 just shutting them down. Kids are struggling to get the answer, some don't even try. We all recognize that this is an issue. ESOL kids really have the hardest time.

Appendix F: Historical Document Analysis

Year	External impacts	Internal impacts
1988	0	0
1990	0	0
1993	0	0
1994	0	0
1995	0	0
1998	0	0
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	4	6
2007	16	18
2008	7	16
2009	30	51
2010	0	0
2011	0	0
2012	0	0
2013	5	4
2014	1	14
2015	0	0

Year	External impacts	Intangible factors	Levels of collaboration	School culture
1988	0	0	0	0
1990	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	4	0	0	0
2007	16	10	10	2
2008	7	0	0	0
2009	30	2	1	2
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	5	0	0	0
2014	1	0	0	0
2015	0	0	0	0

	External impacts	Tangible factors	Accountability	Curriculum	Resources	Support structures	Time
1988	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	4	4	1	2	0	1	0
2007	16	8	3	2	1	4	1
2008	7	7	3	4	1	0	1
2009	30	29	10	16	0	3	3
2010	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0
2013	5	5	3	1	1	1	0
2014	1	1	0	1	0	0	0
2015	0	0	0	0	0	0	0

	Internal impacts	Individual disposition	Level of engagement	Motivation	Stress	Teacher vitality	Understanding of teacher's role	Autonomy	Feelings of loss
1988	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0
2006	6	0	0	0	0	0	0	0	0
2007	18	4	3	2	2	2	1	1	0
2008	16	5	0	0	0	0	5	4	3
2009	51	20	11	7	7	4	11	3	10
2010	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0
2013	4	1	0	0	0	0	1	1	1
2014	14	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0

	Internal impacts	Math content specific consideration	Beliefs about student ability	Beliefs about what is best for students	Teacher identity
1988	0	0	0	0	0
1990	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	0	0
1995	0	0	0	0	0
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
2006	6	6	3	4	0
2007	18	13	6	9	2
2008	16	11	0	9	2
2009	51	33	28	24	1
2010	0	0	0	0	0
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	4	3	3	3	0
2014	14	9	8	8	0
2015	0	0	0	0	0

	Internal Impacts	Understanding of Goals	Amount of change required	Beliefs about change required	Pace of change
1988	0	0	0	0	0
1990	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	0	0
1995	0	0	0	0	0
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
2006	6	1	0	1	0
2007	18	4	1	3	1
2008	16	5	0	5	0
2009	51	16	0	15	0
2010	0	0	0	0	0
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	4	0	0	0	0
2014	14	7	0	7	1
2015	0	0	0	0	0

Appendix G: Implementation Timeline

School year	School system action
2002-2003	• **October 2002:** Memorandum from the superintendent provided a summary of key areas of progress in secondary schools. This documents specifically highlighted Algebra 1 or higher completion rates by students in the school system.
2003-2004	• **September 2003:** The school system conducted an internal report on successful completion of Algebra 1 or higher level math and enrollment in Honors or Advanced Placement courses for the 2002-2003 school year. • **May 2004:** The school system conducted an internal report on the passing rates on end-of-semester final exams in Algebra, Geometry, Honors Geometry, Biology, English, and Government. • **Summer 2004:** In conjunction with the rollout of a new Algebra 1 curriculum, all teachers teaching Algebra 1 were required to attend mandatory training. This was the first summer in which teachers were expected to attend mandatory training in the summer tied to new curriculum rollout. Only 50% of the teachers teaching Algebra 1 in the 2004-2005 school year attend the required training.
2004-2005	• **October 2004:** The superintendent shared an internal report with the BOE with results tied to the State's accountability high-stakes testing in Algebra, English, and Government for the 2003-2004 school year. • **October 2004:** The school system conducted an internal report on successful completion of Algebra 1 or higher level math and enrollment in Honors or Advanced Placement courses for the 2003-2004 school year. • **June 2005:** The 2003-2008 strategic planning document for the school system identified the percentage of middle school students successfully completing algebra and geometry as a measure of a high-quality and rigorous education for all students.
2005-2006	• **October 2005:** The superintendent provided an update to the BOE on successful completion of Algebra 1 or higher level mathematics for the 2004-2005 school year. • **October 2005:** The school system conducted an internal report on the passing rates on end-of-semester final exams in Algebra, Geometry, Honors Geometry, Biology, English, and Government. • **January 2006:** The superintendent shared data on student performance on the SAT and AP assessments. The data on successful completion of Algebra 1 in Grade 8 or earlier were shared in the memorandum.
2006-2007	• **August 2006:** The superintendent shared an internal report with the BOE with results tied to the State's accountability high-stakes testing in Algebra, English, and Government for the 2005-2006 school year.

School year	School system action
	• **October 2006:** The superintendent provided an update to the BOE on successful completion of Algebra 1 or higher level mathematics for the 2005-2006 school year. • **February 2007:** Internal research study was conducted on the impact of professional development on students' Algebra achievement.
2008-2009	• **January 2009:** The K-12 Mathematics Work Group was formed to consider mathematics instruction in the school District.
2009-2010	NA – The researcher does not have any documents from this school year.
2010-2011	• **November 2010:** The K-12 Mathematics Work Group final report and recommendations were shared with the BOE.
2011-2012	• **June 2012:** The superintendent shared an update with the BOE on progress made in implementing the recommendations of the K-12 Mathematics Work Group.
2012-2013	• **January 2013:** The superintendent shared an update on the implementation of the CCSS in mathematics. • **April 2013:** The Algebra 1 curriculum was revised to be aligned with the CCSS. Teachers were informed that they were expected to attend mandatory summer training in July 2013. • **July 2013:** The superintendent formed Mathematics Semester Examination Work Group to review high failure rates as discussed by parents or the media.
2013-2014	• **March 2014:** The superintendent provided an update to the BOE on adoption of CCSS and high-stakes testing conducted by the State. • **June 2014:** The superintendent provided an update to the BOE on the work of the Math Semester Exam Work Group.

Appendix H: Historical Policy Themes by Year

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
1988	1	10	• Board of Education discussion of number of students taking algebra in the seventh grade (70 students) • Discussion of secondary math pathways • Student readiness
1990	1	3	• Board of Education discussion of algebra curriculum and the significance of algebraic skills
1993	1	7	• Board of Education discussion of mathematics pathways • Increasing enrollment in Algebra 1 by ninth grade • Curriculum revisions • Access to higher math and science courses • Providing supports for students • Inclusion of African American and Hispanic students to accelerated pathways
1994	1	6	• Board of Education discussion of number of ninth-grade students successfully completing Algebra 1 • State-mandated accountability testing in mathematics • Connections to SAT, PSAT, and college selection
1995	1	3	• Board of Education discussion of the number of students taking and successfully completing Algebra 1 in middle school
1998	1	1	• Board of Education resolved to include algebra readiness for eighth graders in future scheduled discussions.
1999	2	8	• Board of Education discussion of student achievement on the District final examinations in Algebra 1 • Student approach and attitude toward the final exam • Connection to the SAA • Restructuring of the Algebra 1 initiative and providing enrichment and recovery in algebra as items to be considered in the broadening concept of literacy
2000	4	51	• Board of Education discussion of the failure rate (64%) on the Algebra 1 exams

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			• Discussion of statistics that showed a third of the ninth-grade population was taking courses above Algebra 1 (largely White and Asian) • Ninth-grade students enrolled in courses below Algebra 1 were predominantly African American and Hispanic (66%) and impacted by poverty (69%). • Discussion of supports for students and initiatives to strengthen the content of mathematics instruction through a new teacher evaluation system and professional development • Discussion of content and instruction in mathematics, tracking, and mathematics curriculum • Review of audit by outside organization, which found unequal access and achievement for students of color in Algebra 1, widely varying curriculum implementation across schools with little system congruity, lack of policies providing long-range direction for alignment of the written, taught, and tested curriculum in Algebra 1, inadequate direction and support to focus instruction, and lack of clearly articulated District program for K-12 mathematics
2001	2	2	• Board of Education resolved to purchase nearly 4,000 graphing calculators (based on number of students enrolled in Algebra 1). • Discussion of the SAA and how the State would be phasing in the accountability tests
2002	8	22	• Board of Education discussion and approval of new curriculum frameworks to be developed and implemented by January 2003 for content areas tested by the State (including Algebra 1) • Board of Education member requested discussion with District staff about mathematics curriculum, and it was decided that a broader discussion of math curriculum would be placed on a future agenda. • Discussion of students taking algebra in seventh grade and the achievement gap • Discussion of the goal of all children completing Algebra 1 by eighth grade, noting that the District had not clearly articulated the goal although the curriculum was designed for students to successfully complete algebra by end of eighth grade

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			• Discussion related to the percentage of students enrolled in Algebra 1 as ninth graders who passed the District's exam (59.6%) • Data shared regarding the acceleration of students in mathematics in sixth, seventh, and eighth grades. During the 2001-2002 school year the District had the highest percentage of students successfully completing Algebra 1 or a higher level mathematics course by the end of eighth grade (48.8%) and by the end of ninth grade (74.9%). • Data shared regarding increases for African American and Hispanic students successfully completing Algebra 1 (eighth-grade completion for African American students [25.7%] and Hispanic students [21%]; increase in ninth-grade completion for African American students [8 percentage points] and Hispanic students [4.6 percentage points])
2003	6	33	• Board of Education discussed review of the system's curriculum by an outside organization. The review was conducted to verify the rigor of the curriculum and ensure alignment with the SAA. The report noted items in the second semester final exam for Algebra 1 that extended beyond the expectations of the State. It was noted that the District's framework was more rigorous than the State's. • Discussion related to professional development for teachers and ongoing training to build staff capacity • Discussion related to the goal of having students complete Algebra 1 by eighth grade • Board of Education approval of new curriculum in Algebra 1 • Board of Education discussion of the State's accountability program, No Child Left Behind, and the SAA; discussion regarding the year that passing the State's accountability tests would become a graduation requirement (2009) • Budget items included increased staffing so that class sizes could be reduced in Algebra 1.
2004	13	99	• Board of Education discussion of Algebra 1 semester exam passing rates for eighth- and ninth-grade students (72%). There was a statistically significant difference of more than 40 percentage

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			points in passing rates between middle (92%) and high school students (50%). • Of the 13,007 students enrolled in Algebra 1 in 2004, there were 6,481 middle school students. • Discussions around the achievement gap and lower achievement of African American and Hispanic students with regard to passing Algebra 1 and passing the District's final exam in Algebra 1; discussion regarding the achievement of ESOL students or those receiving FARMS services (the passing rate for those students was 40 to 60 percentage points higher in middle school than high school) • Discussion related to student achievement on the SAA in 2002 and 2003 • The District began an evaluation study to determine if the implementation of the new Algebra 1 curriculum was achieving the desired goals of mastery of course content, success on District's final exam, and success on the SAA. • Discussion of interventions offered by high schools to incoming ninth-grade students • The District stated in strategic planning documents that all students would successfully complete algebra by the end of Grade 9 and geometry by the end of Grade 10. • The District stated in strategic planning documents that success in Algebra 1 was necessary to gain access to higher level mathematics and science courses, as well as to prepare for the mathematics portion of the SAT. • Budget items included increased staffing so that class sizes could be reduced in Algebra 1. • Allocation of funds for training high school algebra teachers in 2005 • Discussion of the mandatory summer 2004 training for Algebra 1 teachers • Discussion of an online course for students who failed the Algebra 1 SAA (continued)
2005	8	34	• Data shared regarding the success of students with disabilities on the SAA • Annual system targets set with the 2004 data as the baseline data and a goal of 100% success on the

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			SAA for the 2009-2010 school year (in response to State and NCLB accountability) • Data shared regarding the number of students successfully completing Algebra 1 in eighth grade • The Board of Education discussed the acceleration of students in mathematics starting in Grade 5. In the 2005-2006 school year, 37% of fifth-grade students (*n* = 3,800) were on an accelerated mathematics pathway. Of the 3,800 students, 500 were African American and 380 were Hispanic. Five years prior only 196 students were accelerated in Grade 5 mathematics and only a handful were African American and Hispanic students. • Board of Education discussion of the correlation between taking higher level mathematics and achieving competitive scores on the SAT • The school system set a goal of 80% successful completion of Algebra 1 by the end of Grade 8. • Board of Education discussion of the Middle School Program Review conducted by an outside organization. The audit found a high percentage of Grade 8 students enrolled in and passing Algebra 1 and Honors Geometry.
2006	9	44	• Discussion regarding the NCLB mandates and State accountability system. Students starting high school as ninth graders in 2006 needed to pass the SAA as well as other State high-stakes tests to graduate. The SAA also would be used to hold schools accountable. • Discussion of supports for students who did not pass the SAA or needed additional supports and interventions • Discussion of institutional barriers that impeded the success of African American and Hispanic students • Data shared system wide highlighting the work of schools that had significant percentages of students successfully completing Algebra 1 in eighth grade • Report from an advisory committee published on Gifted and Talented (GT) Education in the District. Report noted success in making accelerated mathematics accessible to African American and Hispanic students, but also noted that these students were underserved in GT programs.

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			• Continued discussions of Algebra 1 successful completion in Grades 6, 7, 8, and 9. Data showed increases for African American and Hispanic students but reflected a continuing achievement gap. Target of 80% successful completion in Grade 8 not met and noted in District research report. • Discussion of the role of Algebra lead teachers at high schools to support student achievement • Professional development sessions provided to high school leadership teams (three half days over the course of the school year)
2007	9	54	• Successful completion of Algebra 1 in eighth grade was noted as a key data point in the District's strategic planning documents. • Discussion of data related to the achievement of students on the SAA with a focus on the achievement of African American and Hispanic students at multiple times and in multiple formats during the course of the year • District targets developed for the next 5 years and tied to successful completion of Algebra by eighth grade • The importance of mathematics, specifically Algebra 1, was noted in school system documents as a means of preparing students for higher level courses, the 21st century, and the mathematics portion of the SAT. • District targets were set for middle and high schools with expectations for the percentage of schools meeting the District targets in Algebra 1 (for example, 19 of 38 middle schools met the target of 54.6% of students successfully completing Algebra 1 before the end of eighth grade). The data were reviewed by race/ethnicity as well for each school. • Data on the school system's acceleration of students showed that 48% of fifth graders were on an accelerated pathway in comparison with 2% in 2001; additionally, 68% of eighth graders were taking algebra in comparison with 36% in 1999 and 49% in 2006. • Discussion related to closing secondary learning centers (issues with least restrictive environment); considerations on how to best meet the needs of students with disabilities; information about schools'

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			being able to co-teach in content classes such as Algebra 1 to meet the needs of all students • District focus on equity and access through a race initiative focus; district discussions on institutional barriers to the academic achievement of African American and Hispanic students; discussion of data points, best practices, and access in relation to the SAA, Grade 5 advanced mathematics, and Grade 8 successful completion of Algebra 1 • District research brief on the implementation of the new Algebra 1 curriculum that was implemented in the 2003-2004 school year
2008	10	42	• Public reports and pushback on the District's acceleration of too many students in mathematics at the expense of the curriculum; discussion related to gaps in the mathematical knowledge of students in higher levels of mathematics due to being over-accelerated; discussion of the value of calculators in supporting student achievement • Discussion of the impact of the SAA on the District's Algebra 1 curriculum (lost time on curriculum due to focus on SAA preparation) • Discussion of District's goal of having 80% of students completing Algebra 1 before the end of eighth grade by 2010 • Continued sharing of District student achievement data and school system expectations for acceleration in Algebra 1 • BOE discussion related to system targets and question regarding their reasonableness
2009	6	36	• Continued emphasis of the District's expectation that all students successfully (C or higher) complete Algebra 1 by the end of eighth grade (continued) • Discussion related to the SAA and the requirement for students who started high school in 2009 to pass those assessments to graduate • Discussion related to the accountability models that hold individual schools accountable based on student performance on the SAA • Data shared regarding the continued growth in the number of students successfully completing Algebra 1 in the eighth grade; data shared regarding the increases for diverse student populations (for

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			example, in 2006 21.2% of African American students successfully completed Algebra 1 in eighth grade, but in 2009 that number more than doubled to 46.6%) • Continued discussion regarding addressing institutional barriers and the BOE's commitment to equity; discussion regarding closing the racial/ethnic achievement gap. • Data showing that 4,962 students took advanced math in 2008 in comparison to 196 students 7 years prior
2010	9	51	• Continued district communication of expectation of successful course completion in Algebra 1 by the end of Grade 8; BOE discussion of definition of successful completion; BOE discussion of data showing decreases in achievement of White and Asian students in Grade 8 Algebra 1; BOE discussion of how students who had difficulty with basic mathematics could be successful in Algebra 1 • District staff outlining supports available to students who struggled in Algebra 1 • BOE discussion of acceleration of students in mathematics in fifth grade; discussion regarding the target for algebra completion in eighth grade; BOE member's questioning if it was a realistic target; discussion regarding the impact of acceleration on placement of students at the high school level; discussion of tracking students by ability in mathematics • Review of upcoming Common Core expectations; District communication regarding the goals of conceptual and procedural fluency • Discussion regarding economic conditions in the District and mention of commitment to maintaining programs, systems, and processes without adding new initiatives • Discussion of achievement gap and setting realistic targets for 2010 • Discussion of efforts to reform middle school teaching and learning • Review of work conducted by a Mathematics Work Group. Report suggested that although institutional barriers and tracking mechanisms were effectively removed, some students were placed in courses for

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			which they did not have adequate preparation. Some administrators shared that the District's performance targets had forced them to focus on the number of students enrolled in a course and may have had the unintended consequence of students' skipping grade-level material. • District's pulling back on acceleration and skipping grades or units of mathematics at the elementary school level
2011	4	13	• Discussion of successful (C or better) completion of Algebra 1 in eighth grade and question about the final exam grade for eighth graders • District data showed that in 2011, 63% of students in eighth grade were completing Algebra 1 with a C or higher. • Discussion of the SAA and the likelihood of students receiving special services (ESOL or Special Education) passing the assessment
2012	4	20	• Discussion of completion of Algebra 2 by Grade 11 (49.0% in 2008 compared to 62.6% in 2012) • Discussion related to achievement gap, specifically in middle school • Creation of a Mathematics Implementation Team that worked to support teachers, participate in school-based planning, model classroom instruction, and provide system-level professional development • Review of data in relation to the racial/ethnic achievement gap • Review of the recommendations of the K–12 Mathematics Work Group Report • Discussion regarding alignment with Common Core expectations; development of a focused, coherent, and rigorous curriculum to promote mathematical proficiency, mathematical practices, and deep conceptual understanding • Review of system targets and acceleration in mathematics pathways • Development of a model of acceleration and enrichment based on learning progressions • Implementation of Curriculum 2.0 content and mathematical practices requiring that teachers instruct students in ways that move beyond the techniques they experienced in their own education

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			and perhaps beyond what they currently use in their classroom practice • Building the capacity of teachers to develop conceptual understanding in their students across all five areas of mathematical proficiency • Communicating with stakeholders, including parents, the reason for this significant shift in mathematics teaching and learning and its benefits for students • Since the baseline year of 2001, Grade 9 algebra or higher level mathematics completion rates had climbed 10 percentage points from 71.5% to 81.5%. The achievement gap was narrowing, with gains of 23.5 percentage points for both African American and Hispanic students.
2013	19	116	• Discussion of student failure rate on the Algebra 1 exam • School system development of plans at each high school to address student achievement in Algebra 1 • Discussion regarding alignment of curriculum with Common Core State Standards • A review of student achievement data in Algebra 1 and Algebra 2 in recent years suggested that the 2001 mathematics curriculum—coupled with a procedure-based instructional approach and the practice of skipping grade-level mathematics content—does not prepare all students for the 21^{st}-century expectations for mathematics learning. • Although the previous mathematics program resulted in improved performance district wide and across all subgroups, less than two thirds of the 2012 graduating class successfully completed Algebra 2. Similarly, 62% of students in 2012 successfully completed Algebra 1 by Grade 8 and only 68% by Grade 9. Discussion by the BOE that students needed deeper understanding to be successful on PARCC • Continued discussion related to acceleration and mathematics pathways • Two days of training provided for Secondary Core Teams specific to Algebra 1 and Common Core State Standards • As the comparison between CCSS and the 2001 mathematics curriculum was conducted, it became

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
2014	11	50	clear that many of the standards in CCSS were more complex and challenging. In addition, content in CCSS was introduced in earlier grades than was the case in the 2001 mathematics curriculum. CCSS, like standards in many successful nations around the world, placed a greater emphasis on depth of understanding. Both CCSS and the 2001 mathematics curriculum contained a high level of rigor and coherence, but CCSS had a greater emphasis on deep mathematical understanding, defined as an appropriate balance among conceptual understanding, procedural skill, and problem solving with an emphasis on application and modeling. • Significant number of discussions related to getting students ready for CCSS and PARCC • Discussion related to trends in failure rates on the Algebra 1 final exams. Although the recent failure rates alarmed parents and members of the school board, the problem went back a long way. In 2000, the Board of Education discussed Algebra 1 exam failure rates of 64%. In 2004, a report showed that about half of high school students were failing Algebra 1 final exams. In 2006, a report found that 54% had failing Algebra 1 final exams in high school. • It was noted that the school system had not given high school math teachers professional development for 5 or 6 years, due to a lack of funding. (continued) • Connection between Algebra 1 and new PARCC assessments noted in BOE discussion • Discussion of student achievement data: A total of 56% of Grade 8 students successfully completed Algebra 1 with a C or higher in 2013. • Significant discussions related to possible causes for high failure rate for students on school system final exams. For final exams in June, about 70% of high school students failed in Algebra 1 and geometry. Several possible causes included course articulation practices, student preparation, system grading practices, and the need for additional professional development. The greatest concern highlighted by the work group was a consistent pattern of low grades by students who accounted for the majority of the exam failures; 80% to 90% of students who

Year	Number of sources	Number of remarks	Policy themes found in sources and remarks
			earned a grade of D or E in either marking period failed the semester exam. In many instances, students earning a grade of C fared better but failed the exams at a rate of more than 50%. These students were disproportionately Black/African American, Hispanic/Latino, or recipients of special services. • Discussion of professional development provided to secondary mathematics teachers for Algebra 1 during the summer in 2013; discussion of collaborative planning time for Algebra 1 teachers • Failure rates for June 2014 were so high (82% for high school students) that the school district recalculated grades. The middle school failure rate was 23%.
2015	1	9	• Continued discussion of high failure rate for students on school system final exams. In January 2015, 65% of high school students failed the final exam.

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