Evaluation Study:
Preparing Students for Algebra 2

Office of Shared Accountability

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Executive Summary

The Office of Shared Accountability (OSA) conducted a multiyear evaluation of student preparation to take and succeed in Algebra 2 and higher mathematics courses in Montgomery County Public Schools (MCPS).

This study was requested to support the work of the Algebra 2 by Grade 11 M-Stat. The purpose of the evaluation is to examine the readiness of MCPS students to successfully complete Algebra 2 by Grade 11 with a C or higher (see Background). It is also intended to provide information of general interest regarding mathematics curriculum, instruction, and performance in MCPS.

The first year (2008–2009) explored instructional practices and supports believed by educators and students to be central to success in Algebra 2, including nontraditional candidates for the Algebra 2 course. Data collection activities included in-person interviews with the principal, mathematics resource teacher (RT), and two Algebra 2 teachers at 10 sampled schools; group interviews with Algebra 2 students at 8 high schools; analysis of MCPS mathematics documents and information on teachers, teacher certification, and mathematics professional development; and analysis of school system data on student enrollment and performance.

The second year (2009–2010) focused on critical instructional practices identified by MCPS and by findings from the first year of the evaluation. Data collection activities included observations of Algebra 2 classes as well as continued analysis of school system data.

This report contains findings from both years of the evaluation.

Key Findings

Key findings are reported by evaluation question.

Question 1: What instructional practices, course sequences, and student support provide the best preparation for Algebra 2 according to instructional staff and students in high schools?

Instructional Practices[1]

In their student discussion groups, students identified three common teacher practices that they found particularly helpful: going over mathematics problems that were assigned, providing examples and demonstrating how to solve problems, and simplifying or breaking down the steps needed to solve problems. Student groups also mentioned that

[1] In interviews, teachers and resource teachers were asked about what they have done to support a changing student body and how teachers and students are supported to help students be successful in Algebra 2. Findings based on their comments appear in several sections of the report.

opportunities for group work and discussions were helpful in learning Algebra 2 material, as well as providing review packets for tests and exams, and using Promethean boards during lessons.

Course Sequences

Instructional personnel at 8 of the 10 sampled high schools thought middle school preparation had a positive effect on preparation for and success in Algebra 2. However, instructional personnel at seven schools were concerned that the order in which students take higher-level math courses (e.g., Algebra 1, Geometry, Algebra 2) did not support student success. Personnel at eight schools were concerned about inconsistent criteria for placement into higher level courses or movement among classes. Some students also mentioned the need to consider an alternative course sequence.

Student Support

When asked what supports are available for Algebra 2 students, principals, resource teachers (RT), and teachers at most schools mentioned tutoring or extra help. Staff members at nearly all schools mentioned the new Bridge to Algebra 2 course, adding sections of Algebra 2, and other supports such as Promethean boards.

In addition to the instructional practices mentioned above, students indicated additional supportive practices including modification of the pace of the class, providing more or different ways of going over math problems, and being a more organized teacher.

Question 2: What instructional resources, materials, and professional development are available to support teachers in the delivery of Algebra 2 instruction?

Instructional Resources and Materials

Teachers regarded instructional materials for Algebra 2 to be very strong. They were almost unanimous in their positive assessment of the textbook for Algebra 2. Teachers also praised the county-provided worksheets and the county exam review packet.

Promethean classroom technology was new to MCPS high schools in 2008–2009 and has proved to be very popular for teaching and learning mathematics. Teachers praised the capabilities of Promethean technology to help them teach Algebra 2. Students in 16 of the 17 Algebra 2 discussion groups mentioned the Promethean boards as helpful to their learning.

Professional Development

MCPS last offered Tier 1 district professional development for Algebra 2 teachers in summer 2005. Among the 153 Algebra 2 teachers in 2008–2009, one fourth were trained at the 2005 summer training.

Question 3: What is the profile of current Algebra 2 teachers with regard to certification and experience?

At the start of the 2008–2009 school year, 153 teachers were assigned to teach one or more sections of Algebra 2. Nearly all Algebra 2 teachers in 2008–2009 were certified in mathematics, with Advanced Professional the most common certification type. Findings reveal that Algebra 2 teachers were experienced teachers. The average number of years of teaching experience in MCPS (mean) was 11.6 years. Moreover, almost one half of Algebra 2 teachers had been teaching in MCPS for more than 10 years.

Question 4: What is the profile of 2008–2009 Algebra 2 students, with regard to course taking patterns in mathematics, academic success, and demographic characteristics?

Among all Algebra 2 students enrolled in fall 2008, 86.6% completed and passed two semesters of Algebra 2 with a grade of D or higher. Of all Algebra 2 students enrolled in fall 2008, 71.4% met the Seven Keys performance standard (a grade of A, B, or C).

Among just those students who completed both semesters of Algebra 2, the proportion meeting the Seven Keys standard was 76.1%.

Of those enrolled in fall 2008 who completed and passed Algebra 2, 49.9% were White, 18.9% were African American, 17.8% were Asian American, and 13.1% were Hispanic. Moreover, 4.6% of students who completed and passed Algebra 2 received special education services, 14.2% were eligible for Free and Reduced-price Meals System (FARMS) services, and 2.6% were eligible for English for Speakers of Other Languages (ESOL) services.

Students who had completed Algebra 2 or Honors Algebra 2 in 2008–2009 were typically enrolled in Precalculus or Honors Precalculus during the 2009–2010 school year. Students taking Precalculus were about evenly split between those who took Geometry the year before Algebra 2 and those who took Honors Geometry the year before Algebra 2. A significant minority of students who completed Algebra 2 or Honors Algebra 2 in 2008–2009 took Statistics & Mathematical Modeling (SAMM) or Quantitative Literacy in 2009–2010.

Please see Appendix A for additional details.

Question 5: Are key instructional practices for Algebra 2 being implemented as intended?

To assess whether key instructional practices were being implemented in Algebra 2 classes as intended, OSA evaluators observed 49 Algebra 2 classes during November 2009. Observers looked for a wide variety of practices in the Algebra 2 classes, including choice of lesson components, teacher instructional practices, and use of formative assessment techniques.

Lesson Components

Extent of implementation was found to be high for warm-up and focus lesson components. Other components, including independent practice, use of small group or partner activities, and lesson closure were dependent on whether an observed class period was a single period or a block class.

Teacher Instructional Practices

The evidence of implementation of teacher instructional practices recommended in MCPS look-fors was high for teachers modeling the thinking process, using a variety of materials and modalities to teach the lesson, helping students connect to prior knowledge, demonstrating multiple strategies, and having students use multiple strategies to solve problems. Evidence of implementation was low for practices promoting differentiated learning such as having students work in small groups or pairs, facilitating student discussions, or providing differentiated activities for different groups of students.

Formative Assessment

Evidence of implementation of formative assessment techniques was high for asking questions to check for understanding, asking questions at a variety of levels (recall, comprehension, inference), and conducting walk-around checks of students' work. Evidence of implementation was low for using exit cards or summarizers, using written preassessments or quizzes, or listening to student discussions.

Additional Helpful Practices

In interviews during 2008–2009, Algebra 2 students identified practices they found helpful to learning Algebra 2. OSA observers looked for evidence of these practices during observed Algebra 2 classes. Only two such practices were observed in one half or more of observed Algebra 2 classes: teachers modeling study skills for students and teachers calling on a variety of students.

Key Recommendations

Question 6: Do current instructional practices, materials, and professional development support the needs indicated by the evaluation findings? What additional refinements are indicated?

Instructional Practices and Materials

- Reinforce the role of differentiation and the skills and environment needed to make it work in Algebra 2 classes.
- Reexamine the use of specific lesson components and the instructional time for those components specified for Algebra 2 classes in the instructional guide.

- Encourage formative assessment techniques that will allow rapid adjustments in instruction and delivery of continuous feedback.
- Continue to develop Promethean classroom technology skills for teaching Algebra 2.

Professional Development

- In addition to professional development needs suggested by the recommendations above, clarify expectations for "mandatory" training for secondary teachers.
- Strengthen opportunities for job-embedded professional development for Algebra 2.

Additional Refinements: Planning and Using Data to Support Instruction

- Explore creative ways to review and reinforce algebraic skills from Algebra 1 with rising Algebra 2 students.
- Encourage collaboration, data chats, and course-alike planning for Algebra 2 teachers.
- Develop county unit assessments for Algebra 2.

Additional Refinements: Preparation and Skill Prerequisites for Algebra 2

- Work with geometry teachers to make more explicit connections during the Geometry course between algebra skills and geometry.

Additional Refinements: Course Sequence

- Research the benefits of experimenting with different course sequences; consider piloting an alternative sequence (e.g., Algebra 1, Algebra 2, Geometry) in several clusters.

Additional Refinements: Acceleration

- Review the effectiveness of district efforts to accelerate mathematics articulation and achievement, particularly with regard to algebra.

Additional Refinements: Support for Struggling and Failing Students

- Standardize policies regarding prerequisites and articulation pathways for struggling and failing students and for retaking of the (failed) Algebra 2 course.

Organization of the Report

This report begins with background information on Algebra 2 and mathematics instruction in MCPS and information about the evaluation study. Detailed findings and recommendations make up the main body of the report. Supplementary material, including detailed tables on student enrollment and performance in secondary mathematics courses, a review of literature on Algebra 2 and secondary mathematics, and copies of data collection materials, are appended to this report.

A follow-up memorandum with student performance information from the close of the 2009–2010 school year is planned for late 2010.

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The author would also like to thank the principals and school staff at the 10 participating high schools for welcoming us to conduct observations, interviews, and discussions. Special thanks are due to Algebra 2 students in eight high schools, who shared their mathematics experiences in group discussions in 2009.

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Background

Current Initiatives in MCPS Mathematics

MCPS Strategic Milestones and Seven Keys to College Readiness

Successful completion of Math 6 by the end of Grade 5 is a Goal 2 milestone of the Montgomery County Public Schools (MCPS) Strategic Plan, *Our Call to Action: Pursuit of Excellence* 2008–2013 (2008). A related target is that 80% of middle school students will successfully complete Algebra 1 (MCPS, July 2006). Algebra 1 is an area of focus in MCPS as a subject of the Maryland High School Assessments (HSA); as a requirement to graduate from high school; and as a prerequisite to taking more challenging mathematics courses in high school.

A logical extension of the initiative to increase middle school mathematics acceleration is the interest in Algebra 2. Completion of Algebra 2 is now being monitored among the MCPS milestones of academic success, known as the "Seven Keys to College Readiness" (MCPS, 2009).[2] The Algebra 2 curriculum also supports the content of the Scholastic Aptitude Test (SAT) and ACT (formerly American College Test). MCPS is interested in maximizing the accessibility of advanced mathematics courses that support college readiness, such as precalculus and calculus.

Districtwide Review

MCPS is currently engaged in a districtwide review of its mathematics program for prekindergarten through Grade 12. This review takes the form of several different activities including but not limited to those described below.

- M-Stat program: According to the MCPS strategic plan, "the M-Stat process provides a framework for the systematic and system monitoring of critical student achievement and performance data that enables the district and school leadership teams to drill down to root causes, focus on areas of need, develop action plans for improvement, and document best practices for recognition and dissemination throughout the system" (MCPS, 2008).

  The focus of two of the M-Stat teams is closely aligned with the goals of the Algebra 2 evaluation.

  Algebra 1 by Grade 8 M-Stat. An M-Stat team for Algebra 1 was formed in 2008 to develop processes and guidelines to support enrollment in and successful completion of Algebra 1 during middle school.

[2]The middle school Algebra 1 completion target was later included as one of the Seven Keys.

Algebra 2 by Grade 11 M-Stat. An M-Stat team for Algebra 2 was formed in 2009 to develop systemwide processes and guidelines supporting enrollment in and successful completion of Algebra 2. This team monitors student performance and completion of Algebra 2 by Grade 11 with a C or better for all subgroups and all schools.

- K–12 Mathematics Joint Work Group: The K–12 Mathematics Joint Work Group was established in 2009 to explore complex issues in teaching and learning mathematics in MCPS and to develop recommendations on ways to improve the student achievement in mathematics systemwide. The work group gathers input from staff, students, and parents; identifies issues and concerns; researches scientifically-based practices; benchmarks exemplary models; and analyzes data on the current state of mathematics in MCPS.

Additional mathematics-centered activities are taking place around the district. One example of an effort to better understand and improve mathematics performance is the Sherwood Cluster Mathematics Project. Together, all schools and all grade levels in the cluster established a unified approach to address the needs of students in mathematics. According to the academic intervention teacher directing this project, the cluster developed two main goals: 1) to improve mathematics instruction for successful completion of Algebra by the end of Grade 9 (80% by Grade 8 and 100% by Grade 9); and 2) to improve articulation, instruction, and relationships to increase student academic performance across all subgroups. In each focus area, an action plan was created for the cluster. As a result of the project's efforts, the goal of 80% of all Grade 8 students successfully completing Algebra was met. Strategies for closing the gap for subgroups continue to be a focus of the project.

Please see Appendix B for a review of literature pertaining to Algebra 1, Algebra 2, and mathematics in MCPS.

Algebra 2 Course

Algebra 2 is a secondary mathematics course in MCPS. According to the MCPS mathematics website, "Algebra 2 is the study of the complex number system and functions. Real-world problems are discussed, represented, and solved using advanced algebraic techniques, incorporating technology. The properties and algebra of functions, including polynomial, exponential, logarithmic, piece-wise, radical, and rational, are analyzed and applied, as well as conics, matrices, systems of equations, sequences, and series."

Taken following successful completion of both Algebra 1 and Geometry, Algebra 2 is the first course in a sequence of upper-level college preparatory mathematics courses. Content of the Algebra 2 course supports the content of assessment tests for prospective college students including the College Board Preliminary Scholastic Aptitude Test (PSAT), Scholastic Aptitude Tests (SAT 1, SAT 2), and Advanced Placement (AP) tests and the ACT (formerly American College Test).

While Algebra 2 is not currently mandated for graduation, MCPS seniors are required to graduate with at least four years of credits in mathematics (4.0 credits), including Algebra 1 and Geometry. Algebra 2 can be taken as an on-level course (Algebra 2), or as an Honors course (Honors Algebra 2, formerly known as Algebra 2 with Analysis). High school students receive .5 of a credit for each semester of the course they complete successfully, with a passing grade being a D or higher.

A small percentage of mathematics students take the Algebra 2 course in middle school. Middle school students successfully completing both semesters of Algebra 2 receive high school credit for the course (1.0 mathematics credit). In 2008–2009, 1.1% of students enrolled in Algebra 2 were in Grades 7 and 8.

Completion of Algebra 2 by the end of Grade 11 with a D or higher has been a strategic plan target for several years. However, the MCPS Seven Keys to College Readiness target is completion of Algebra 2 by the end of Grade 11 with a grade of C or higher.

The majority of MCPS students first take Algebra 2 in Grade 10 or before. In 2008–2009, 62.4% of students enrolled in Algebra 2 were in Grade 10 or below. See Appendix A for information on Algebra 2 students.

The Algebra 2 course in MCPS is supported by the following resources:

- High School Curriculum Framework for Algebra 2 and Precalculus (MCPS, 2005a),
- Curriculum Quick Reference, Mathematics, Algebra 2 (MCPS, 2005b), and
- Mathematics Instructional Guide, Algebra 2 (“Curriculum Guide”) (MCPS, 2005c).

The Findings section of this report provides more detail on professional development resources for Algebra 2 teachers, support resources for Algebra 2 students, and information about MCPS Algebra 2 teachers’ certification and professional development.

Evaluation Study

Scope of the Evaluation

The evaluation was initially requested by the Algebra 1 by Grade 8 M-Stat.[3] The purpose of this evaluation was to examine the readiness of MCPS students to successfully complete Algebra 2 in Grade 11 or earlier. The nature of the necessary information suggested a two-year approach to evaluation.

- The first year (2008–2009) explored instructional practices and supports believed by educators and students to be central to success in Algebra 2, including non-traditional candidates for the Algebra 2 course.
- The second year (2009–2010) focused on critical instructional practices identified by MCPS and by findings from the first year of the evaluation.

Evaluation Questions

The following major questions guided this evaluation:

Year One

Question 1: What instructional practices, course sequences, and student support provide the best preparation for Algebra 2 according to instructional staff and students in high schools?

Question 2: What instructional resources, materials, and professional development are available to support teachers in the delivery of Algebra 2 instruction?

Question 3: What is the profile of current Algebra 2 teachers with regard to certification and experience?

Question 4: What is the profile of 2008–2009 Algebra 2 students, with regard to course taking patterns in mathematics, academic success, and demographic characteristics?

Year Two

Question 5: Are key instructional practices for Algebra 2 being implemented as intended?

Question 6: Do current instructional practices, materials, and professional development support the needs indicated by the Year One findings? What additional refinements are indicated?

[3]The Algebra 2 by Grade 11 M-Stat team did not exist at the time this project began. Since the inception of the Algebra 2 by Grade 11 M-Stat team, this project has been an area of discussion and interest for the new team.

Evaluation Methodology

The study was a nonexperimental design that utilized multiple data collection methods to triangulate information from administrators, instructional staff, students, classroom observations, and school system data.

Sample of Schools

A two-step cluster sampling method was used to draw a stratified random sample of 10 high schools. Characteristics used to sample MCPS high schools included school enrollment, number of students at school enrolled in Algebra 2 in fall 2008, proportion of all MCPS Algebra 2 students in (this) school taking Algebra 2, and proportion of feeder Grade 8 students (to the school) who completed Algebra 1 prior to high school. In high schools with shared feeder middle schools, a raw average of Algebra 1 completion experience among all feeder middle schools was used. Math-science magnet students at Montgomery Blair High School and Poolesville High School were not included in school enrollment counts.

Schools with fewer students who entered high school with Algebra 1 credit were an oversampled stratum for the study. This was because there is more work to do in making Algebra 2 accessible in those schools where fewer students are ready for the course early in their high school career.

Data Collection

Data collection activities during Year One of the evaluation included the following:

Interviews. In-person interviews with the principal, mathematics resource teacher (RT), and two Algebra 2 teachers at each of the sampled schools took place in winter 2009. All interviewed teachers taught multiple sections of Algebra 2 during 2008–2009. Teachers of honors students and teachers of on-level students were included at each school.

Group interviews with Algebra 2 students. Eight of the schools agreed to student group interviews in spring 2009. Both Honors Algebra 2 students and regular (on-level) Algebra 2 students participated at each school. Altogether, 168 students participated in 17 different group discussions. Eight groups were with Honors Algebra 2 students and nine with on-level Algebra 2 students. The average number of participants per discussion was 10, with similar numbers of male students and female students participating. The grade level of students in the discussion corresponded with enrollment patterns in Algebra 2, with the majority of participants coming from Grades 9 and 10.

Appendix C contains copies of individual and group interview questions.

Document review. This focused on MCPS mathematics documents and information on teachers, teacher certification, and mathematics professional development.

Analysis of school system data. This included enrollment files and report card results for students taking Algebra 2 and other mathematics courses.

Data collection activities during Year Two of the evaluation included the following:

Observations of Algebra 2 classes. Algebra 2 teachers in the sampled schools who taught at least two sections of Algebra 2 were observed for one full class period. Most classes were single-period classes lasting about 45 minutes; two schools in the study used longer ("block") periods of about 90 minutes. At the 10 high schools sampled for the evaluation, OSA observed every teacher assigned to teach two or more sections of Algebra 2 (49 teachers).

Pre- and post-observation questions. All observed teachers were asked to provide responses to a small set of pre- and post-observation questions about the observed class and some of their teaching practices. This helped observers to focus the observation most effectively. Nearly all observed teachers provided information.

Analysis of school system data continued during Year Two.

Detail on Observations of Algebra 2 Classes

Observations took place at the beginning of the second marking period (November, 2009). The number of completed observations, based on schedules for Semester A, ranged from a low of three classes at two schools to a high of eight classes at one school. Table 1 displays the number of class sections taught by MCPS Algebra 2 teachers during Semester A (160 teachers).

OSA observed 49 teachers with two or more sections of Algebra 2, or 42.9 % of all such teachers in fall 2009. The 49 observed classes included 25 honors classes and 24 on-level classes. OSA observed 30.6 % of all current Algebra 2 teachers (regardless of the number of sections they teach).

Table 1
Algebra 2 Class Assignments, Fall 2009

Number of class sections taught	All Algebra 2 teachers (N = 160)	
	#	%
1	46	28.7
2	58	36.2
3	38	23.7
4	13	8.1
5	5	3.1

Observed classes were generally working on Unit 3 of the instructional guide. Most Honors classes were four or five lessons into the unit; on-level classes were working on the first or second lesson of the unit. A few on-level classes were still completing Unit 2.

OSA observers requested class handouts, prepared notes, quizzes, exit cards, and assignments from each teacher for the day before, day of, and day following the observation. These handouts provided additional information on class content, scope, and assessment during the observation field period. Mathematics program staff reviewed these materials to determine whether teachers were teaching content that was fully within the scope of the Algebra 2 course.

Observation Protocol

An observation protocol was designed in conjunction with mathematics program staff. MCPS look-fors, the MCPS Algebra 2 instructional guide, and identified practices from Year One evaluation results were used in designing indicators of key instructional practices for Algebra 2.

Several steps were taken to ensure a relevant, high-quality instrument:

- The protocol was first pretested in Algebra 2 classes that were not part of the study sample.
- Following the pretest, the protocol was reviewed by a panel of high school and middle school mathematics resource teachers, plus representatives of Department of Curriculum and Instruction (DCI) and Office of Organizational Development (OOD), before a final joint review by OSA with the mathematics program staff.[4]
- The mathematics program staff prepared observers for what they could expect to see during observed classes.

A copy of the observation protocol is in Appendix C.

Strengths and Limitations Associated with the Study

A number of steps were taken to safeguard a strong methodology and produce reliable results.

1. The use of a stratified random sample of high schools based on characteristics relevant to the study allows findings to be generalized to all MCPS high schools and ensures the external validity of evaluation results.

2. The use of multiple data sources provides a more complete view of implementation and the current status of Algebra 2.

[4]Among other suggestions, mathematics resource teachers consulting on the evaluation recommended that teachers be asked about the background of the students in their Algebra 2 classes, such as whether any students were repeating Algebra 2, or whether any took Bridge to Algebra 2 last year. This information was believed important to teachers' planning for differentiation during lessons. See Table 12 for findings.

3. A high rate of participation by members of stakeholder groups provides additional confidence that findings in the sampled high schools could expect to be replicated elsewhere. In this study, individual interviews were conducted with mathematics resource teachers, selected Algebra 2 teachers, and principals at each school in the sample, with 100% participation by invitees. Group interviews were conducted with Algebra 2 students at eight of the sampled schools. Moreover, a large proportion of Algebra 2 teachers was observed (43% of all MCPS teachers assigned to teach multiple sections of Algebra 2).

4. Each data collection activity was conducted within very brief periods of time (for example, 49 lesson observations within just three weeks), strengthening the ability to assess the Algebra 2 environment at a specific point in time.

5. School system data on student enrollment, completion, and performance in Algebra 2 courses and other mathematics courses helped to profile current program status and illuminate qualitative findings.

6. OSA utilizes a model of stakeholder input for evaluations. The M-Stat team for Algebra 1 by Grade 8 provided input into this evaluation. In Year Two, the new M-Stat team for Algebra 2 by Grade 11 assumed the advisory role and provided input for the evaluation. Additionally, advice on classroom instruction was provided by a panel of high school and middle school resource teachers.

The following limitations pertain to this study.

1. MCPS evaluations have not focused on secondary courses. In fact, this is the first evaluation of a nonmandatory high school course undertaken by OSA. Therefore, comparisons to methodology and results of relevant MCPS studies are not available.

2. Since Algebra 2 students do not all take identical assessments, the utility of student performance information for the purpose of comparisons is limited. For example, students in different high schools or different class sections within the same school may not be assessed using identical questions.

Findings

This section reports the findings from each data collection activity. Findings are organized by evaluation question. Multiple data collection methods were used to answer each question.

Question 1: What instructional practices, course sequences, and student support provide the best preparation for Algebra 2 (both entry and success) according to instructional staff and students in high schools?

Instructional Practices

In interviews, teachers and resource teachers were asked about what they have done to support a changing student body and how teachers and students are supported to help students be successful in Algebra 2. Findings based on their comments appear in several sections of the report.

Students in 17 group discussions were asked about the things their teacher did that they found most helpful for learning Algebra 2 course material (Table 2).

Students in 16 of the 17 groups mentioned Promethean boards as helpful to instruction in Algebra 2. More than one half of the student groups identified three common teacher practices that they found helpful: going over mathematics problems that were assigned (58.8%), providing examples and demonstrating how to solve problems (58.8%), and simplifying or breaking down the steps needed to solve problems (52.9%). Close to one half of the groups also mentioned that opportunities for group work and discussions were helpful in learning Algebra 2 material (47.0%).

Other practices identified as helpful by a majority of student groups included providing review sheets or review packets for tests and exams (70.5%) and using Promethean boards during lessons (94.1%). (Table 2)

Table 2
Current Teacher Practices Identified by Students as Helpful for Learning Algebra 2

Helpful teacher practices	Student groups interviewed (N = 17) # of groups mentioning *n*	% of groups mentioning *%*
General practices		
Goes over homework/problems	10	58.8
Provides examples/demonstrations	10	58.8
Explains/simplifies/breaks down steps	9	52.9
Provides opportunities for group work/class discussions/teacher involves students	8	47.0
Offers repetition/practice	6	35.2
Provides tips to remember/strategies	4	23.5
Makes sure you understand	4	23.5
Test review and test preparation		
Provides review sheet/packet	12	70.5
Schedules a review day	6	35.2
Other helpful test preparation practices	4	23.5
Teacher characteristics		
Teacher's personality (helpful)	7	41.1
Teacher is available for help	6	35.2
Teacher has planned for class/teacher is well organized	4	23.5
Helpful instructional materials		
Promethean boards	16	94.1
Notes or notes packets provided by teacher	7	41.1
Books/worksheets	5	29.4

Note. Open-ended responses. Comments were grouped into the categories listed above. A comment was included if any member(s) of a group mentioned it.

Course Sequence, Placement Decisions, Curriculum, Pacing

During interviews, principals, RTs, and teachers identified both positive and negative issues associated with course sequence, curriculum issues, and the pacing of instruction related to Algebra 2 (Table 3).

Personnel at eight of the high schools commented that middle school preparation was having a positive effect on preparation for and success in Algebra 2, with students getting an earlier start on high school mathematics content, teachers collaborating for success in high school, and so forth.

Personnel at seven schools were concerned that the order in which students take higher level math courses (e.g., Algebra 1, Geometry, Algebra 2) did not support student success. One teacher said, "We've been talking for the last 2 years about the need to change the way courses are set up: Year 1 = Algebra 2; Year 2 = Geometry and Bridge to Algebra 2. We lose a lot of time going back to reteach, because students miss a year of work and teachers expect them to remember, and it doesn't work but for about ten percent of students. [This order] needs to change or we are only going to have moderate to low success in the course." Another commented, "The Geometry course 'gap year' falling between Algebra 1 and 2 causes a

disruption in skills learned and used. I use warm-ups to review Algebra skills that may have been forgotten while in Geometry."

Exit card comments from Algebra 2 students also addressed course sequencing (see Table 6). A typical comment was as follows: "Algebra 2 should be taken the year immediately following Algebra 1 because we have a tendency to forget with a year in between."

Personnel at eight schools were concerned about inconsistent criteria for placement into higher level courses or movement among classes. For example, one teacher said, "Students should not be allowed to advance through Algebra 1 without making a grade of A, B, or "C." Students taking Honors Geometry who scored D in Algebra 1 do not understand Algebra well. Need a stronger foundation." Another teacher pointed out there is "no screening into Honors. Students take what they and their parents want."

Table 3
Course Sequence, Curriculum, and Pacing Issues Identified by School Staff

	Number of schools or persons responding[a]			
Issues	Schools[b] (*N* = 10)	Principals (*N* = 10)	Resource teachers (*N* = 10)	Teachers (*N* = 21)
Course sequence				
Positive preparation (e.g., middle school providing an early start on algebra skills, collaboration of high school teachers with middle school teachers, good middle school preparation)	8	4	7	2
Inconsistent criteria used for course placement	8	2	3	7
Order of higher level math courses taught: Algebra, Geometry, Algebra 2 (course order may not support success in Algebra 2)	7	1	3	8
Increase in number of students in Algebra 2 classes (middle school acceleration, rigor policy) (negative)	6	5	3	2
Curriculum				
Curriculum issues (less demanding content than in past, Algebra 2 teachers have to review Algebra 1 topics)	7	1	5	6
Effects of High School Assessment (HSA) needs on curriculum[5] and skills learned	6	1	4	2
Pacing				
Packed curriculum in Algebra 2	5	0	0	7
Pace of Algebra 2 is too fast	4	0	2	2

Note. Open-ended responses. Comments were grouped into the categories listed above.
[a]A response was counted if it took place anytime during an interview regardless of the question or prompt.
[b]A response was counted for a school if it was mentioned by at least one person at that school.

[5] Beginning with the 2006–2007 school year, high school teachers agreed to change the order of delivery of Algebra 1 units in an effort to better prepare students for the topics on standardized tests.

In their interviews, mathematics RTs were asked about the process for placement decisions of students in mathematics classes. For example, one RT said: "We meet with 8th grade teachers two or three times per year. Students being successful in Honors Geometry will start in Honors Algebra 2. In February we share the first semester grades with the middle school teachers so they can look at their students and see how they are doing in the 9th grade. We also do this in the 10th grade." Another commented, "Our counselors discuss articulation with middle schools. I get the grades—I go behind the counselor [school counselor] and verify placement. I look at teachers' recommendations and make a final determination."

Another RT, who was getting ready to start the articulation process at school, said: "Yes, middle and high [school] articulation starts next week [February 2009] . . . If the student got a C in a regular geometry and Algebra 1 then would place in [regular] Algebra 2. Would only consider for Honors [Algebra 2] if the student got an A or B in the course . . . Some have been successful in the Honors track when [they] weren't originally there, but most have not . . . The first year as RT, I did Algebra 1 articulation that involved observations (middle came to high and high went to middle schools) and discussions of how to recommend students from high school courses."

Support for Students

School staff. At each school in the sample, the principal, mathematics RT and selected Algebra 2 teachers were interviewed. Principals, RTs, and teachers at most schools identified existing support for Algebra 2 students (Table 4). Staff at all schools mentioned tutoring by students or extra help offered by teachers during lunch period or after school. Staff at nearly all schools mentioned the new Bridge to Algebra 2 course, adding sections of Algebra 2, other supports such as Promethean boards, and review of mathematics skills. In the context of preparing for Algebra 2, some school staff mentioned a summer practice packet (seven schools) and a summer class in mathematics offered at school (five schools).

Table 4
Support for Algebra 2 Students

Types of support	Number of schools or persons responding[a] Schools[b] (*N* = 10)	Principals (*N* = 10)	Resource teachers (*N* = 10)	Teachers (*N* = 21)
Supports provided				
Tutoring/extra help	10	4	9	19
Created new course (Bridge) or added class sections	9	3	8	11
Other supports (instructional materials, Promethean board, instructional guides, worksheets, notes, etc.)	9	3	7	17
Review of math skills and math practice (both in class and out of class)	8	0	2	7
Adjusting pacing or coverage of curriculum	7	1	2	7
Summer support				
Summer practice packet	7	0	2	10
Summer program offered (at school)	5	0	3	5

Note. Open-ended responses were coded into the comment categories listed above.
[a]A response was counted if it took place anytime during an interview, regardless of the question or prompt.
[b]A response was counted for a school if it was mentioned by at least one person at that school.

Students. In addition to talking about teachers' helpful practices, students were asked what else teachers could do to help them succeed in Algebra 2 (Table 5). Mentioned most often were modification (slowing down) of the pace of the class (9 out of 17 groups), providing more or different ways of going over math problems (6 out of 17 groups), and being a more organized teacher (6 out of 17 groups).

Table 5
Additional Helpful Teacher Practices Identified by Algebra 2 Students

Additional helpful practices	Student group interviews (*N* = 17) Number mentioning *n*	Percent mentioning *%*
General practices		
Modify pace of class/slow down	9	52.9
More/different ways to go over homework/problems	6	35.2
More/different ways to explain or teach concepts	5	29.4
Modify amount/type of homework	5	29.4
Make class more fun/interesting	5	29.4
Provide extra help	5	29.4
Test review and test preparation		
Allow more retakes of tests/quizzes	5	29.4
Better test preparation	5	29.4
Other test suggestions	5	29.4
Teacher characteristics		
Be organized/plan well/stay on topic	6	35.2
Helpful instructional materials		
More notes provided by teacher/easy to read notes	5	29.4

Note. Open-ended responses by at least five groups. Comments were grouped into the categories listed above.

Each student answered an exit card question, as follows: "If you could tell your principal *one really important thing* about Algebra 2, what would it be?" (Table 6) Students gave a wide range of responses; no single response was given by more than one in five students. The most frequent comments echoed those already mentioned above, including that the course moves too fast (19.1%), that teachers need to be able to explain and use a variety of strategies (16.1%), and that test reviews are important (6.5%).

Some students' comments were typical of those received. On the ability of teachers to pace the course and explain the content, one student said: "For some of the harder topics we cover, we need more time to learn it before we have to be tested on it. We need more time to learn and figure it out ourselves. Slow it down a little." Another student commented, "Algebra 2 is easier when the teacher actually explains and teaches what we have to learn. First semester, I had a teacher who was too overwhelmed with teaching Algebra 1 and geometry and did not care for her Algebra 2 class. But now I have a better teacher who cares and does explain what we need to know, which makes it way easier." A third student said, "The teacher really makes the course. Some of the teachers go too fast, and are impatient, but some really understand. A good teacher makes math easier and more enjoyable."

Table 6
Most Frequent Comments From Student Exit Cards in Algebra 2

	All students (N = 167)	
Comments and issues	*n*	*%*
Instructional practices, course sequences, student support		
Course moves too fast for material to be learned	32	19.1
Teachers need to be involved with students, able to explain, able to use different strategies, supportive, organized	27	16.1
Reviews (for tests) are important	11	6.5
Course order: Algebra 2 should follow Algebra 1 instead of geometry	7	4.1
Need fewer quizzes, longer time to complete tests	7	4.1
Negative and general comments		
Hard/challenging/difficult course	17	10.1
Course is boring/needs more student involvement	8	4.7
Student describes teacher ability or methods as not good/poor	7	4.1
Positive and general comments		
Student describes teacher ability or methods as excellent/good	14	8.3
Easy course/easy work	13	7.7
Other positive course comments, e.g., "good class"	19	11.3

Note. Most common responses given. Multiple responses possible. One student did not complete a card.

Summary

Students identified three teacher practices—going over mathematics problems that were assigned, providing examples and demonstrating how to solve problems, and simplifying or breaking down the steps needed to solve problems—as particularly helpful to instruction. Students also mentioned that group work and discussions, review packets for tests and exams, and Promethean boards were helpful.

Instructional personnel at seven high schools were concerned that the order in which students take higher level math courses (e.g., Algebra 1, Geometry, Algebra 2) did not support student success. Personnel at eight schools were concerned about inconsistent criteria for placement into higher level courses or movement among classes.

Principals, resource teachers, and Algebra 2 teachers mentioned tutoring or extra help as being available to support students. Students mentioned additional practices that would support them, including modification of the pace of the class, providing more or different ways of going over math problems, and the Algebra 2 teacher being more organized.

Question 2: What instructional resources, materials, and professional development are available to support teachers in the delivery of Algebra 2 instruction?

Instructional Resources and Materials

Texts, worksheets, county exam packets. In interviews, teachers regarded instructional resources for Algebra 2 to be very strong. They were almost unanimous in their positive assessment of the textbook for Algebra 2 (as one teacher described it, "one of the best high school math texts in MCPS"). They found it helpful that the textbook comes on a disk for the teacher to use as well.

Teachers also praised the county-provided worksheets and the county exam review packet. One teacher said, "A good resource for me to guide me as to what to teach is the MCPS exam review. I really use it to go over questions and how they're going to be asked." Another teacher summed it up as follows: "The exam review packet from the county is one of the best reviews we have."

Promethean classroom technology. Promethean technology came to a limited number of high school classrooms for the first time in fall 2008, with expansion to many more high school classrooms in fall 2009. Most of the Algebra 2 classes observed by OSA in fall 2009 (43 out of 49 classes) were in Promethean-equipped classrooms. Students in 16 of the 17 Algebra 2 discussion groups mentioned the Promethean boards as helpful to their learning.

In their interviews during their first year using Promethean technology, teachers praised the capabilities of Promethean technology to help them teach Algebra 2. One teacher said, "Usually I write on the Promethean board, but sometimes I have the students come up to the board and write the problems. They love this – they find it fun." Another teacher said, "It's nice with the Promethean board because we can use anything from interest [on the Internet] directly in classroom." And another teacher commented, "The Promethean board is helpful for illustrating word problems. I present a 'grab bag' of stuff we know, and move things around. I flip between problems."

Instructional staff members found Promethean capabilities to be beneficial in planning Algebra 2 lessons. For example, one teacher noted: "Promethean board has been most useful. There are skeleton Promethean board lessons that present a variety of topics from instructional guide lessons." Another teacher said, "Our Algebra 2 textbook is on a disk. I can use the disk to write lesson plans, pull problems using the camera feature, and put them into my Promethean display." An RT said, "Promethean Planet [the Promethean resource website] has lesson plans. It fits well

with the MCPS content." Another RT commented, "Every week I search Promethean Planet. In our joint planning, we have every unit laid out. For the curriculum guide we have five Promethean lessons and other resources to supplement for areas that kids need more support, such as radicals."

The formative assessment capabilities of Promethean (ActiVote), allowing teachers to adjust instruction quickly, were seen by Algebra 2 teachers as a strength of this new classroom technology. As one teacher said, "I use Activote. Hard-to-engage students are more involved now. I use ActiVote data to see if kids need extra help. ActiVote makes kids feel more accountable." Another said, "Promethean is for quick checks. Students say whether they think they know something. Promethean is very beneficial for me . . . I know exactly where I need to go." An RT said, "Promethean ActiVote data. Teachers do quizzes on the spot, plus we can download to an excel file and look at data. Students also look at their own data at the Promethean board."

Instructional staff members reported that they were eager to see the availability of Promethean equipment, and Promethean capabilities, expanded at school. As one resource teacher said, "Every room should have a Promethean board. We would like to have Promethean board-friendly information like what's provided for the Bridge to Algebra 2 class." Another RT commented, "It would be helpful to have more Promethean board flip charts, more review games and activities; more time to adapt to [Promethean board]."

Other materials. Other materials teachers found particularly helpful in teaching Algebra 2 included worksheets (both commercial and teacher-made) and the projectable calculator for use with the Promethean board or with overhead projectors. The display calculator is a popular feature with teachers. In one teacher's words: "The TI Smart View—I think every school should get one. It shows three views of a calculator, the keys that were pressed, functions that you entered." Comments from some teachers without one indicate that they would like to get it.

The Internet offers additional resources. One teacher who has discovered some of these noted: "I use Algebra2.com and the McDougal website and software to generate tests and worksheets. These are pretty good. They have self-check quizzes that I use with the students that are good."

A note about calculators. The interviews did not feature direct questions about calculators. On a spontaneous basis, personnel at nine schools expressed concerns about how calculators are used, including a principal, six resource teachers, and nine Algebra 2 teachers. The primary concern was that students use calculators because they lack needed mathematics skills. A related concern was a lack of clarity about when calculator use is appropriate and when it is expected in MCPS courses.

Professional Development

MCPS offered Tier 1 ("mandatory") district professional development for Algebra 2 teachers in summer 2005, as part of a rollout of the updated Algebra 2 curriculum guide. However, district training has not been offered since.

According to report card records in 2005–2006, 146 teachers were assigned to teach Algebra 2. The Office of Organizational Development reported that 58.9% of those teachers attended the 2005 Tier 1 summer training.[6] One fourth (26.8%) of the 153 current Algebra 2 teachers (2008–2009) were trained at the 2005 Tier 1 summer training.[7] (Table 7)

In interviews, teachers and RTs were asked about professional development available to support teachers in teaching Algebra 2. Among those interviewed, 11 out of 21 teachers and 6 out of 10 RTs said they were not aware of professional development opportunities offered to Algebra 2 teachers. Four teachers and two RTs mentioned the 2005 curriculum training as a professional development opportunity for Algebra 2 teachers.

Table 7
Teacher Participation in Algebra 2 Tier 1 Training, Summer 2005

	Algebra 2 teachers, MP1 2005–2006 (*N* = 146)		Algebra 2 teachers, MP1 2008–2009 (*N* = 153)	
Participation	*n*	*%*	*n*	*%*
Attended training	86	58.9	41	26.8
Registered, did not attend training	7	4.7	0	0
Did not register, did not attend training	53	36.3	112	73.2

Source of teacher assignment data: MCPS enrollment and report card files. Source of registration data: MCPS Office of Organizational Development.

Summary

Teachers regarded instructional materials for Algebra 2 to be strong. Teachers praised the Algebra 2 textbook, the county-provided worksheets, and the county exam review packet. Teachers and students praised the capabilities of Promethean technology.

Professional development for Algebra 2 has been very limited. Only one fourth of 2008–2009 Algebra 2 teachers were trained at 2005 summer training, the last time district Tier 1 training was offered. Algebra 2 topics during job-embedded professional development at school must compete for time among all mathematics topics.

Question 3: What is the profile of current Algebra 2 teachers with regard to certification and experience?

Certification

At the start of the 2008–2009 school year, 153 teachers were assigned to teach one or more sections of Algebra 2. Certification information was not available for eight of those teachers.

[6] Informal follow-up on why some teachers do not attend district professional development does not provide full clarity. A typical reason offered is that teachers do not have teaching assignments in time to register for training; it is not known to what extent this is an issue in secondary schools.

[7] District professional development for Algebra 2 has not been offered since 2005.

Most Algebra 2 teachers in 2008–2009 were certified in mathematics (143 teachers). One was certified in special education mathematics and one in special education.

The most common certification type among Algebra 2 teachers was Advanced Professional (98 teachers, or 64%), followed by Standard I (30 teachers, 19.6%) and Standard II (14 teachers, 9.0%). (Table 8)

Table 8
Teacher Certification Type Algebra 2 Teachers, MP1 2008–2009

	Algebra 2 teachers, MP1 2008–2009	
	N = 153	
Certification Type	*n*	*%*
Advanced Professional	98	64.0
Standard Professional I	30	19.6
Standard Professional II/Extended Standard	14	9.0
Conditional	3	1.9
Information not available	8	5.2

Source of certification data: MCPS Office of Human Resources.

Experience

As a group, Algebra 2 teachers were experienced teachers. The average number of years of teaching experience in MCPS was 11.6 years. Almost one half of Algebra 2 teachers had been teaching in MCPS for more than 10 years (47.6%). (Table 9)

Table 9
Teacher Experience Algebra 2 Teachers, MP1 2008–2009

	Algebra 2 teachers, MP1 2008–2009	
Experience teaching in MCPS	*N* = 151	
Mean (average) years teaching experience *(standard deviation)*	11.6 years *(10.59)*	
	n	*%*
One year or less	33	21.8
More than one year, up to five years	21	13.9
More than five years, up to 10 years	25	16.5
More than 10 years, up to 15 years	30	19.8
More than 15 years	42	27.8
Minimum experience	New teacher	
Maximum experience	40 years	

Note. Teaching experience prior to MCPS is not shown. Two teachers did not have information available and are not shown in the table.
Source of certification data: MCPS Office of Human Resources.

Summary

Algebra 2 teachers in 2008–2009 were certified in mathematics. The most common certification type among Algebra 2 teachers was Advanced Professional. Algebra 2 teachers were experienced teachers. The average number of years of teaching experience in MCPS (mean) was 11.6 years. Almost one half of Algebra 2 teachers had been teaching in MCPS for more than 10 years.

Question 4: What is the profile of 2008–2009 Algebra 2 students with regard to course taking patterns in mathematics, academic success, and demographic characteristics?

Please see Appendix A for tables A-1 through A-12 referenced in this section.

Among students enrolled in Algebra 2 in fall 2008, 86.6% completed and passed two semesters of Algebra 2. (Table A-1) However, not all students who were enrolled at the beginning of the school year finished the course. More than 9 out of 10 students who completed two semesters of Algebra 2 passed the course (92.4%). (Table A-2)

Among students enrolled in Algebra 2 in fall 2008, 1.1% were middle school students (Grades 7 and 8), 18.7% were in Grade 9, 42.5% were in Grade 10, 29.0% were in Grade 11, and 8.5% were in Grade 12.

Of those students who completed and passed Algebra 2, 49.9% were White, 18.9% were African American, 17.8% were Asian American, and 13.1% were Hispanic. Of those students who completed and passed Algebra 2, about one out of 20 (4.6%) received special education services, 14.2% were eligible for FARMS services, and 2.6% were receiving ESOL services during the year they took Algebra 2. When compared with the proportions of all MCPS high school students, male students, African American students, Hispanic students, students receiving special education services, students eligible for FARMS services, and students receiving ESOL services were slightly underrepresented in Algebra 2 enrollment. (Table A-3a)

Among all Algebra 2 students enrolled in fall 2008, 86.6% completed and passed two semesters of Algebra 2 with a grade of D or higher. Of all Algebra 2 students enrolled in fall 2008, 71.4% met the Seven Keys performance standard (a grade of A, B, or C). Among just those students who completed both semesters of Algebra 2, the proportion meeting the Seven Keys standard was 76.1%. (Table A-4)

Students who completed Algebra 2 or Honors Algebra 2 in 2008–2009 were generally enrolled in Precalculus or Honors Precalculus for the 2009–2010 school year. Students taking Precalculus were about evenly split between those who took Geometry the year before Algebra 2 and those who took Honors Geometry the year before Algebra 2. Those taking Honors Precalculus the year after Algebra 2 were mostly former Honors Geometry students. Among students who completed Algebra 2 or Honors Algebra 2 in 2008–2009, 14% took Statistics & Mathematical Modeling (SAMM) or Quantitative Literacy in 2009–2010. Two thirds of these students had been (on-level) geometry students the year prior to taking Algebra 2. (Table A-7)

Summary

Among students enrolled in Algebra 2 in fall 2008, 86.6% completed and passed two semesters of Algebra 2. Of those students enrolled in fall 2008 who completed and passed Algebra 2, 49.9% were White, 18.9% were African American, 17.8% were Asian American, and 13.1% were Hispanic. During the 2008–2009 school year, 71.4% of students enrolled in Algebra 2 in fall 2008 met the Seven Keys performance standard (a grade of A, B, or C). Among students completing two semesters of Algebra 2, the proportion meeting the Seven Keys standard was 76.1%.

Students who had completed Algebra 2 or Honors Algebra 2 in 2008–2009 were typically enrolled in Precalculus or Honors Precalculus during the 2009–2010 school year.

Question 5: Are key instructional practices for Algebra 2 being implemented as intended?

Two key sources of information were used to determine intended practices for Algebra 2. The first source was information provided to schools and teachers by MCPS including instructional guides and curriculum look-fors (MCPS 2005b, 2005c). The second source was information identified from Year 1 interviews with principals, resource teachers, teachers, and students about what works best for Algebra 2.

Observed Classes

To assess whether key instructional practices were being implemented in Algebra 2 classes as intended, OSA evaluators observed 49 Algebra 2 classes during November 2009. Teachers with two or more sections of Algebra 2 at the 10 sampled high schools were observed for one full class period.

On the day of the observation, there were 16 to 32 students in each observed class, for an average (mean) of 26 students per class.

Classes were split between Honors Algebra 2 (25 classes) and on-level Algebra 2 (24 classes). Most observed classes were for single periods (42 classes), while two of the sampled high schools used block periods (7 observed classes). (Table 10)

Table 10
Background Information on Observed Classes

Background information	All Algebra 2 classes (N = 49) *n*	Additional information
Level of class:		
Honors Algebra 2	25	
On-Level Algebra 2	24	
Length of class period:		
Single period classes (Range 43–53 minutes)	42	Mean 46.52 minutes *(SD 2.167)*
Block period classes (Range 86–90 minutes)	7	Mean 88.57 minutes *(SD 1.902)*
Grade level of students in observed class (multiple grade levels in each class):		
Grade 8[a]	2	
Grade 9	28	
Grade 10	41	
Grade 11	32	
Grade 12	22	
Student characteristics (supplied by teacher; multiple responses possible):		
Class includes English Language Learners (ELL)	12	
Class includes students with IEP	18	
Class includes Algebra 2 repeaters[b]	10	
Class includes students who took Bridge to Algebra 2 last year[c]	9	
Teacher did not supply information	20	
Classroom is equipped with Promethean classroom technology:		
Yes	43	
No	6	

Note. SD = standard deviation.
[a]Grade 8 students are taking this course at a high school.
[b]Teachers of five additional classes said they do not know.
[c]Teachers of seven additional classes said they do not know.

Observers looked for evidence that teachers communicated the day's agenda, objectives, essential question, or similar information about the lesson. This was done most commonly using a blackboard or whiteboard (25 classes). Most observed classes were in Promethean-equipped classrooms (43 classes), and in 14 classes teachers used the Promethean board to communicate this type of information. In 15 classes, the teacher referred to the day's information orally.

Use of Instructional Time

The MCPS instructional guide for Algebra 2 specifies the recommended components of an instructional block and the amount of time devoted to each. Figure 1 displays these components.

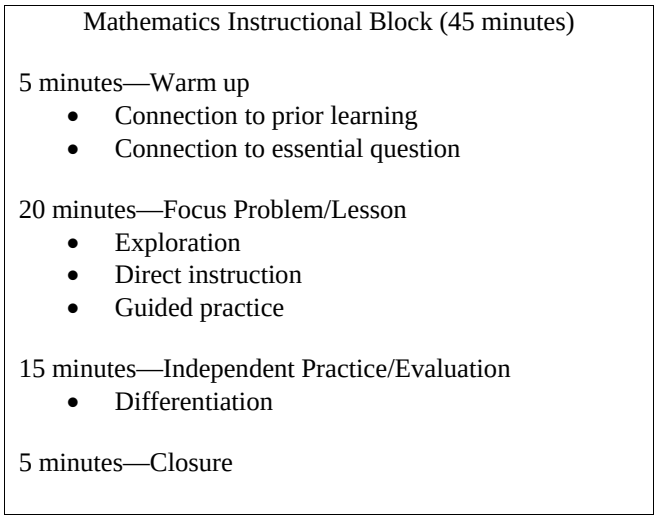

Figure 1. Components of the mathematics instructional block.

Observers looked to see which lesson components were included in observed lessons and the amount of class time devoted to each component. While not every teacher was expected to use every lesson component, teachers used various combinations of lesson components for each lesson. Table 11 displays the information about observed lesson components, segmented by single period and block period classes.

Not surprisingly, the most commonly observed component was the focus lesson. Of the 49 classes observed, 40 single-period classes and all 7 of the block-period classes included a focus lesson. The first focus lesson lasted an average of about 19 minutes in single-period classes and about 30 minutes in block-period classes; these lengths were in line with the 20-minute expected length according to the Algebra 2 instructional guide. A second, shorter focus lesson was observed in 15 of the single-period classes (about 9 minutes) and three of the block-period classes (about 17 minutes).

The next most commonly observed component was a warm-up activity (which needed to be related to the day's lesson to qualify as a warm-up). About 7 out of 10 of the single-period classes (35 out of 42) and 6 out of 7 block-period classes included this component. The warm-up lasted an average of over 12 minutes in single-period classes and about 16 minutes in block-period classes (in both cases longer than the instructional guide recommendations).

Other lesson components were more conditional. Independent practice took place in more than one half of single-period classes (25 out of 42 classes) but in only one of the block-period classes. Both class lengths used fewer minutes of independent practice than was recommended in the guide (on average 8 minutes in single-period classes, 13 minutes in the one block-period class).

While block-period classes featured activities with small groups or partners (5 out of 7 classes), and devoted about one third of total class time to this work (average of 32 minutes), there was very little use of small groupings in single-period classes. Only 8 of the 42 single-period classes utilized small groups, which lasted on average nine minutes.

Lesson closure was not common in single-period classes, with just 8 out of 42 classes including lesson closure. One half of block-period classes (4 out of 7 classes) included closure. Single-period classes devoted over four minutes to this activity, on average, in line with the instructional guide. Block-period classes used 5 ½ minutes, on average, for closure.

Additional time was used for activities not among the guide-directed lesson components. A majority of single-period classes (29 out of 42) used an average of 9 minutes on activities that did not appear to fit with any of the instructional guide components, such as reviewing unrelated past work or handing back papers. Two of the block-period classes did this also, using an average of 22 minutes. (Table 11)

Table 11
Algebra 2 Lesson Components by Length of Class Period

	Single-period Algebra 2 classes 43–53 minutes (*N* = 42 classes)				Block-period Algebra 2 classes 86–90 minutes (*N* = 7 classes)			
	Number of classes		Range of minutes	Average length in minutes *(SD)*	Number of classes		Range of minutes	Average length in minutes *(SD)*
Lesson component	*n*	*(%)*			*n*	(%)		
Pre-lesson: Homework review, handing back student papers, etc.	29	59.2	1–38	9.34 *(8.364)*	2	28.5	18–26	22.00 *(5.657)*
Warm up (related to day's lesson)	35	71.4	4–28	12.23 *(5.610)*	6	85.7	5–28	15.67 *(9.092)*
Guide recommended time				*5.00*				*Est. 10.00*
Focus lesson 1	40	81.6	5–45	19.25 *(8.276)*	7	100.0	13–57	30.14 *(15.334)*
Focus lesson 2	15	30.6	2 –20	8.53 *(4.719)*	3	42.8	4–26	16.67 *(11.372)*
Guide recommended time				*20.00*				*Est. 40.00*
Small groups or partners	8	16.3	2–30	9.13 *(8.951)*	5	71.4	7–49	32.00 *(16.093)*
Independent practice	25	51.0	3–29	8.20 *(6.151)*	1	14.2	13	not applicable
Guide recommended time				*15.00*				*Est. 30.00*
Lesson closure	8	16.3	2–7	4.38 *(2.066)*	4	57.1	3– 8	5.50 *(2.082)*
Guide recommended time				*5.00*				*Est. 10.00*

Note. Multiple components possible during each observed lesson. Average (mean) length of lesson component is calculated only for classes including that component. SD = standard deviation.

Instructional Practices of Algebra 2 Teachers

Observers looked for a number of key instructional practices, most taken directly from the curriculum look-fors (MCPS, 2005b), during observed Algebra 2 classes. For each instructional practice, observers noted whether the teacher used the practice throughout the lesson, once or twice during the lesson, or not at all (Table 12).

Five instructional practices were observed in at least 6 out of 10 classes, indicating a high level of implementation:

- In all 49 classes, teachers were observed using a variety of materials and modalities for teaching the lesson (throughout the lesson in 15 classes, plus once or twice in the remainder of the classes).
- In 47 classes, the teacher was observed modeling the thinking process for developing strategies and discovering relationships—a practice at the heart of the Algebra 2 course (throughout the lesson in 30 classes, plus once or twice in an additional 17 classes).
- In 41 classes, the teacher was observed helping students make connections to prior knowledge (throughout 16 classes, plus once or twice in an additional 25 classes).
- In 38 classes, the teacher was observed presenting or demonstrating multiple strategies to solve problems (throughout 14 classes, plus once or twice in an additional 24 classes).
- A closely related instructional practice—the teacher having students solve problems using multiple strategies—was observed in 29 classes (throughout 10 classes, plus once or twice in an additional 19 classes).

Three instructional practices were observed in about 4 out of 10 classes, indicating a moderate level of implementation:

- In 22 classes, the teacher had students use calculators to solve problems (throughout 8 of the observed classes, plus once or twice in an additional 14 classes).
- In 20 classes, the teacher reinforced students' use of the language of mathematics, through speaking or writing (throughout 6 classes, plus once or twice in an additional 14 classes).
- In 18 classes, the teacher described or demonstrated the use of technology to solve problems such as on the calculator (throughout 10 classes, plus once or twice in an additional 8 classes).

The remaining instructional practices were observed in one fourth of classes or fewer, indicating a low level of implementation:

- In 13 classes, the teacher had students work in small groups or pairs (two of these were throughout).
- In 10 classes, the teacher used "real world" applications of mathematical concepts (two of these were throughout). According to the MCPS Mathematics website, in Algebra 2 "real-world problems are discussed, represented, and solved using advanced algebraic techniques."
- In eight classes, the teacher facilitated student discussions about mathematical concepts and processes ("nuts and bolts") (seven of these were throughout).
- In eight classes, the teacher had students discuss problem-solving strategies and reasoning (seven of these were throughout).
- In just one class, the teacher provided differentiated activities, formats, or outcomes for different groups of students.

The MCPS curriculum framework for Algebra 2 specifies the need to differentiate instruction for students.

> "Differentiated instruction addresses student strengths, interests, and learning styles and should be paced to make the curriculum accessible to everyone. Flexible and varied grouping practices enhance the opportunity to receive expanded, intensive, enriched, and accelerated curriculum at all instructional levels as warranted by students' needs. A balance needs to be achieved so that all students have the opportunity to work in homogenous and heterogeneous groups." (MCPS, 2005a, p. 3).

It is notable that most of the instructional practices with the lowest amount of evidence of implementation are practices that support differentiated instruction. (Table 12)

Table 12
Evidence of Instructional Practices in Observed Algebra 2 Classes

	Extent of evidence (N = 49)					
	Throughout		Once or twice		Not observed	
Instructional practices	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*
Teacher models thinking process for developing strategies and discovering relationships.	30	61.2	17	34.7	2	4.1
Teacher uses a variety of materials and modalities to teach the lesson (manipulatives, drawings, paper-and-pencil, computers, books, discussion).	15	30.6	34	69.4	0	0.0
Teacher helps students make connections to prior knowledge.	16	32.7	25	51.0	8	16.3
Teacher presents or demonstrates multiple strategies to students.	14	28.6	24	49.0	11	22.4
Teacher has students solve problems using multiple strategies.	10	20.4	19	38.8	20	40.8
Teacher has students use calculators to solve problems.	8	16.3	14	28.6	27	55.1
Teacher reinforces students' use of the language of mathematics (through speaking and writing).	6	12.2	14	28.6	29	59.2
Teacher describes or demonstrates use of technology (e.g., graphing calculator, computer) to solve problems.	10	20.4	8	16.3	31	63.3
Teacher has students work in small groups or pairs	2	4.1	11	22.4	36	73.5
Teacher uses "real world" applications of mathematical concepts.	2	4.1	8	16.3	39	79.6
Teacher facilitates interactive student discussions about mathematical concepts and processes.	7	14.3	1	2.0	41	83.7
Teacher has students engage in class discussions that focus on problem solving strategies and reasoning.	7	14.3	1	2.0	41	83.7
Teacher provides differentiated activities, such as different activities, formats, or outcomes, for different groups of students.	0	0.0	1	2.0	48	98.0

Formative Assessment

Observers looked for evidence of formative assessment in the Algebra 2 classes (Table 13). Three formative assessment practices were observed in at least two thirds of the 49 observed classes, indicating a high level of implementation:

- In 46 classes, teachers asked questions to check for understanding (throughout 25 classes, plus once or twice in an additional 21 classes).
- In 34 classes, teachers asked questions at a variety of levels (recall, comprehension, inference) (throughout 23 classes, plus once or twice in 11 additional classes).
- In 33 classes, teachers walked around to check work at students' desks (throughout 10 classes, plus once or twice in 23 other classes).

Three additional formative assessment practices were observed in one third to one half of classes, a moderate level of implementation:

- In 25 classes, teachers asked students to clarify or justify their thinking out loud (throughout 10 classes, plus once or twice in 15 other classes).
- In 20 classes, teachers called a student up to solve a problem (throughout 5 classes, plus once or twice in 15 others).
- In 18 classes, teachers used dipsticking or thumbs up to assess understanding (throughout 4 classes, plus once or twice in 14 additional classes).

Finally, three formative assessment practices were observed in less than one fourth of classes, a low level of implementation:

- Eleven classes included an exit card or summarizer.
- Teachers were observed listening to student discussions in pairs or groups throughout just one class, plus once or twice in seven additional classes. (See Table 11. Only 13 classes included any kind of small group or partner work.)
- A written preassessment or quiz was used in just four classes (OSA did not observe test periods).

Table 13
Evidence of Formative Assessment in Observed Algebra 2 Classes

	Extent of evidence (*N* = 49 classes)					
	Throughout		Once or twice		Not observed	
Formative assessment	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*
Asking questions to check for understanding/listening to students' responses	25	51.0	21	42.9	3	6.1
Asking questions at a variety of levels (recall, comprehension, inference)	23	46.9	11	22.4	15	30.6
Visual walk-around and check of homework or work at students' desks (checking for understanding)	10	20.4	23	46.9	16	32.7
Asking student to clarify thinking or justify response aloud (critical thinking)	10	20.4	15	30.6	24	49.0
Calls students to front of class to solve a problem	5	10.2	15	30.6	29	59.2
Every pupil responds, dipsticking, thumbs up	4	8.2	14	28.6	31	63.3
Exit card/Summarizer	n/a	n/a	11	22.4	38	77.6
Listens to students discussing in pairs or groups	1	2.0	7	14.3	41	83.7
Written pre-assessment or assessment	n/a	n/a	4	8.2	45	91.8

Lesson Topics, Vocabulary, and Handouts

To ensure that the content being taught in observed classes was within the scope of the Algebra 2 course, DCI reviewed the lesson content and vocabulary and lesson-related handouts from observed lessons.

Lesson topics. Teachers and students in observed classes were generally working on Unit 3 of the instructional guide. Most honors classes were four or five lessons into the unit; on-level classes were working on the first or second lesson of the unit. A few on-level classes were still completing Unit 2.

Those lesson topics introduced in writing or verbally by teachers were noted by the observers. Many of the topics were the same, but teachers used slightly different descriptions. Lesson topics were reviewed by DCI instructional specialists in order to be grouped correctly.

Solving quadratic equations was the lesson topic in 25 of the 49 observed classes. Quadratic functions was the topic in 16 additional classes. Matrices was the lesson topic in seven classes. One class was working on performing operations with complex numbers. (Table 14)

Table 14
Topics of Algebra 2 Observed Lessons

Lesson topics	All classes (N = 49) n
Methods of solving quadratic equations (n=25)	
Solve quadratic equations using radicals	5
Factoring quadratic equations	4
Solve equation using quadratic formula	4
Completing the square	3
Factoring/solving quadratic equations by factoring	3
Factoring	3
Discriminants	2
Quadratic formula	1
Perform operations with complex numbers (n = 1)	
Quadratic functions (n = 16)	
Quadratic function graphing and properties	7
Graphing quadratic equations from standard, vertex and intercept form	5
Identifying parts and properties	3
Graphing quadratic equations	1
Matrices (n = 7)	
Inverse matrices/systems of equations with matrices	6
Use matrices to find area of a triangle	1

Note. Teachers used different words to describe the topic of the lesson to students. Lesson topics were grouped into the categories above.

Focus vocabulary. Vocabulary words given particular emphasis by teachers were noted during observed lessons. Many of the vocabulary words and terms on which teachers focused during observed lessons had been introduced to students in Geometry, Algebra 1, or before Algebra 1; only a limited number of terms were new in Algebra 2. (Table 15)

Many other words were used during lessons, and a focus word in one class was not necessarily a focus word in another. The focus vocabulary words were reviewed by DCI in order to be sure they were grouped correctly.

Table 15
Focus Vocabulary Words for Algebra 2 Observed Lessons

Vocabulary used prior to Algebra 1 (10 examples)	Vocabulary first used in Algebra 1/ Geometry, expanded in Algebra 2 (83 examples)
Additive inverse Inequality Order of operations/ PEMDAS Ordered pair Origin Reciprocal Simplify Variable	Absolute value Axis of symmetry Domain Increase/Decrease definitions Intercepts (X intercept, Y intercept) Monomial Parabola Polynomial Quadratic Range Real number Scientific notation Trinomial Vertex Vertex form
Vocabulary first used in Algebra 1/ Geometry, reviewed in Algebra 2 (35 examples)	**Vocabulary new in Algebra 2 (35 examples)**
Binomial Coefficient Commutative Constant Difference of squares Discriminant Distributive property Greatest common factor Horizontal translation Matrices Perfect square Quotient property Radical Rationalizing Root Standard form Vertical stretch	Conjugate (Complex) Complex numbers Complex plane Column matrix Determinant Imaginary numbers Intercept form Inverse (matrix) Magnitude Vector

Note. 49 observed Algebra 2 lessons. Multiple words were possible for focus in a lesson. Words were used in lessons that were not focus vocabulary words.

Handouts. Handouts were collected for the lesson prior to the day of observation, the day of the observation, and the lesson following the day of observation. Handouts included class notes, homework pages, in-class worksheets, quizzes, exit cards, and reproductions of Promethean flipcharts used in class. DCI reviewed the handouts provided by Algebra 2 teachers to confirm that they were aligned with the Algebra 2 course.

Based on this review, all teachers appeared to be giving students material that is part of the Algebra 2/Honors Algebra 2 curriculum. A few teachers taught review skills such as factoring or simplifying square roots; these skills are needed to solve problems found in the Algebra 2 curriculum.

Additional Helpful Practices for Students

In interviews during the first year of evaluation (2008–2009), Algebra 2 students identified a number of practices they found helpful to learning Algebra 2. In fall 2009, observers looked for evidence of these practices during observed Algebra 2 classes (Table 16). Only two such practices were observed in one half or more of observed Algebra 2 classes: teachers modeling study skills for students (29 classes) and teachers calling on a variety of students (25 classes).

In about 4 out of 10 classes, teachers announced available help sessions (21 classes). In 20 classes, teachers indicated that they had posted relevant material on EdLine, the electronic classroom support program used in MCPS.

Table 16
Evidence of Additional Helpful Practices
in Observed Algebra 2 Classes

	All Algebra 2 classes (N = 49)	
Practice	*n*	*(%)*
Teacher models study skills (note taking, outlining, creating graphic organizer, having students prepare a review packet), includes verbal modeling "Be sure you are noting the formula/ definition"	29	59.2
Teacher uses random/equitable methods for calling on students, calls on a variety of students	25	51.0
Teacher announces tutoring or teacher help sessions after class or after school	21	42.9
Teacher posts notes, outlines, day's material, homework, information on EdLine (written or verbal notice to students that it is available)	20	40.8
Strategies (e.g. problem solving steps, graphic organizers, charts) are displayed in the classroom	14	28.6
Teacher distributes review packet/outline/test or quiz review information	12	24.5
Teacher distributes notes related to today's lesson	6	12.2

Exemplary Lessons

Findings in this report focus on aggregating evidence of instructional practices across many lessons. Another way to answer the evaluation question, "Are key instructional practices for Algebra 2 being implemented as intended?" is to examine whether and how practices are being combined to create strong lessons.

Teacher identifiers in this section have been changed for confidentiality.

All types of data from the observations (use of time, choice of lesson components, instructional practices, formative assessment, and helpful practices) plus additional observer notes were used to construct the narratives found below, describing lessons that were successful in combining

many of the instructional practices indicated by the instructional guide for Algebra 2, plus using ongoing formative assessment and keeping students engaged.

In the Algebra 2 lessons described in this section, these and other desired instructional practices were included:

- Mr. H.'s on-level Algebra 2 class: modeling the thought process; demonstrating multiple strategies for solving problems; engaging students in discussion; formative assessment using multiple levels of questioning

- Ms. T.'s on-level Algebra 2 class: having students work with a partner to solve problems; using manipulatives to engage students; demonstrating multiple ways to solve problems; having students use multiple problem-solving strategies; formative assessment

- Mr. C.'s honors Algebra 2 class: having students work with a partner to solve problems; modeling the thinking process; offering memory tips to students (an example of the type of practice students identify as particularly helpful); formative assessment including asking questions and dipsticking to check for understanding

Here are descriptions of the three exemplary lessons.

Mr. H.'s On-Level Algebra 2 class. One single-period class of on-level Algebra 2 with students in grades 10, 11, and 12 learned about the functions of quadratic properties with Mr. H. On this observation day at the beginning of the second marking period, 24 students were present. Mr. H. had written on a blackboard "Students will be able to graph quadratic functions and list characteristics." The classroom featured posted displays of definitions and composition of functions.

The teacher modeled the thought process throughout the lesson, and talked about how he thinks and visualizes multiple strategies for solving a problem. One problem from the focus lesson was:

$$\mathbf{F(x)=2x^2+12x+13}$$

Mr. H. demonstrated how to solve this problem both with and without a calculator. He had students use their calculators as he talked, alternating between the calculator demonstration and drawing the problem while engaging in his discussion with students.

He checked students' understanding by asking questions requiring different types of responses: "What could I do to make it more accurate?" "Why do we start at zero?" "Could I tell from the graph? How?" He encouraged questions from students, "to make sure you get the characteristics down."

Ms. T.'s On-Level Algebra 2 class. Another on-level Algebra 2 class, which took place the following week at another high school, was a single-period class of 26 students in grades 9 and 10. The teacher, Ms. T., told the observer ahead of time that the class included three students with IEPs and two students who were repeating Algebra 2.

Students worked with a partner for the warm-up, using algebra tiles to complete the square. Her rationale for planning this warm-up was based on her perception that a review from Algebra 1 was needed: "I am not sure how much the students will remember about completing the square . . . I am assuming that it will take some time to review the process before talking about complex numbers and vertex form."

After the students tried the problem, the teacher demonstrated the tiles on an overhead projector: "x squared plus 6x plus 9 equals the sum of the parts . . . You can also find the area by length times width: $(x+3)(x+3)=(x+3)^2$."

The focus lesson featured the steps for converting an equation to a perfect square trinomial by adding $(b/2)^2$ to each side. Factoring the perfect square trinomial and solving the quadratic by taking the square came next.

As in Mr. H.'s lesson, Ms. T. modeled her thought process throughout the lesson and demonstrated multiple strategies for problem solving. She also had the students solve problems using multiple strategies. She asked questions to check for student understanding, including asking the students to provide the steps needed to solve each problem. In post-observation correspondence, Ms. T. said she thought the lesson met her objectives for student learning; she also gave students a quiz on the lesson later in the week.

Mr. C.'s Honors Algebra 2 class. Mr. C.'s Honors Algebra 2 class at a third high school was learning how to graph quadratics. This single-period class of 31 students in grades 9 and 10 was observed the week after Ms. T.'s class. Mr. C. displayed on the Promethean board that students would be graphing quadratic equations from standard, vertex, and intercept forms.

Students reviewed the standard and vertex forms, which had been introduced in a prior lesson, then learned about the intercept form during this class. Students worked several of the practice problems with a partner and were encouraged to check their answers with their neighbors. As Mr. C. modeled the thinking process, he offered memory tips to students. He also had them check their work on the calculator.

Mr. C. checked for student understanding by asking questions at a variety of levels ("How come this is wrong?") as well as dipsticking ("How confident are you that you could get this with a calculator? Hands raised?"). Mr. C. had not given a preassessment for this lesson, but did give a follow-up quiz the next day. When asked whether the lesson met his objectives for student learning, he replied: "The immediate feedback from the class was that they understood the material. For students that did not understand the lesson, I provide[d] before- and after-school help. . . I had also preplanned a review day for today to make sure any lingering questions could be answered."

Summary of Implementation of Key Components of the Delivery of Algebra 2 Instruction

Table 17 summarizes the level of implementation of the observed indicators, including lesson components, teacher instructional practices, formative assessment, and additional helpful practices for the delivery of Algebra 2 instruction.

Table 17
Summary of Implementation:
Key Components of Delivery of Algebra 2 Instruction

	Extent of implementation in observed classes (N = 49)		
Components	High	Moderate	Low
Lesson components (time sensitive)			
Warm-up; Focus lesson(s)	x		
Small groups/partners	Block classes		Single classes
Independent practice		Single classes	Block classes
Closure	Block classes		Single classes
Teacher instructional practices (not time sensitive)			
Models thinking process; uses variety of materials and modalities; helps students connect to prior knowledge; demonstrates multiple strategies to students; has students solve problems using multiple strategies	x		
Has students use calculators; reinforces students' use of mathematical language; describes or demonstrates use of technology		x	
Has students work in small groups or pairs; uses "real world" applications of mathematics; facilitates interactive student discussions; has students engage in class discussions about problem solving strategies and reasoning; provides differentiated activities for different groups of students			x
Formative assessment			
Asks questions to check for understanding; asks recall, comprehension, inference questions; walk-around checks of student work	x		
Asks students to clarify thinking out loud; calls students up front to solve a problem; uses dipsticking		x	
Uses exit card or summarizer; written pre-assessment or quiz; listens to student discussions			x
Additional helpful practices			
Models or prompts study skills; uses equitable calling-on methods	x		
Announces tutoring or help sessions; posts current materials on EdLine		x	
Displays strategies in classroom; distributes review packets; distributes lesson notes			x
Other indications of implementation of Algebra 2 course			
Class work and written work are consistent with Algebra 2 curriculum	x		
Focus vocabulary words are consistent with Algebra 2 curriculum and with links to earlier mathematics courses	x		

Note. x = all class lengths, regardless of block period or single period. High = more than one half of classes. Moderate = about 4 out of 10 classes. Low = fewer than 4 out of 10 classes.

Summary

Extent of implementation was found to be high for warm-up and focus lesson components. Other components, including independent practice, use of small group or partner activities, and lesson closure were dependent on whether an observed class period was a single period or a block class.

The evidence of implementation of teacher instructional practices recommended in MCPS look-fors was high for teachers modeling the thinking process, using a variety of materials and modalities to teach the lesson, helping students connect to prior knowledge, demonstrating multiple strategies, and having students use multiple strategies to solve problems. Evidence of implementation was low for practices promoting differentiated learning such as having students work in small groups or pairs, facilitating student discussions, or providing differentiated activities for different groups of students.

Evidence of implementation of formative assessment techniques was high for asking questions to check for understanding, asking questions at a variety of levels (recall, comprehension, inference), and conducting walk-around checks of students' work. Evidence of implementation was low for using exit cards or summarizers, using written preassessments or quizzes, or listening to student discussions.

Recommendations and Conclusions

The final evaluation question is intended to summarize information from evaluation questions asked in Year One as well as the questions asked in Year Two. The recommendations are intended to relate to all of the evaluation questions.

Question 6: Do current instructional practices, materials, and professional development support the needs indicated by the evaluation findings? What additional refinements are indicated?

Instructional Practices and Materials

- **Reinforce the role of differentiation and the skills and environment needed to make it work in Algebra 2 classes.**[8] Observed Algebra 2 lessons lacked evidence of differentiation, such as small group and partner activities, student discussions, and differentiated activities. Differentiation is critical if students from a wider range of skill levels are to succeed in the Algebra 2 course, as called for by the Seven Keys. Physical space arrangements and classroom management practices may also need revisiting in making differentiation work in high school classrooms.
- **Reexamine the use of specific lesson components, and instructional time for those components, specified for Algebra 2 classes in the instructional guide.** Based on findings from observations, warm-ups take up a disproportionate amount of class time. Additional class time is used in non-lesson focused activities, such as handing back papers. Time for independent practice, small group opportunities, and lesson closure is squeezed as a result.
- **Encourage formative assessment techniques that will allow rapid adjustments in instruction and delivery of continuous feedback**, such as calling students up front to solve problems, dipsticking, and using exit cards. Evidence from classroom observations was low for these opportunities. High school Algebra 2 classes are large, many at capacity with 32 students. Teachers typically grade homework "for completion" and count on students to review their own learning. Weekly quizzes provide formative information, but written feedback from quiz performance may be too late for some students. Ongoing formative assessment supports differentiation.
- **Continue to develop classroom technology skills for teaching Algebra 2.** Both students and teachers identified Promethean classroom technology as an exciting and helpful resource for Algebra 2 classes. Continue to expand teachers' ability to use Promethean technology for conducting formative assessments, adjusting instruction, determining groupings, and storing lesson notes. A related technology skill is using the Smart View calculator, which should be made available to all schools.
- **Consider the role of summer preparation for Algebra 2.** Teachers discussed the need to review algebra content forgotten by students between the end of Algebra 1 and the

[8] An exploration of why teachers do not differentiate may be indicated. For example, do teachers lack some of the skills needed to make differentiation work? Do teachers believe that high school students need to figure out on their own what they do not understand? Do teachers think course placement in high school provides the needed differentiation (Honors versus on level)? Do teachers think lunch and after-school help opportunities are an effective time and place for differentiation?

beginning of Algebra 2. Summer preparation differs by school, and student awareness is mixed. Courses offered at MCPS high schools, the MCPS summer semester, and the Algebra 2 prep course at Montgomery College are resources that can be publicized. Clarify and publicize expectations for use of a summer math packet for Algebra 2.

- **Work with geometry teachers to make more explicit connections during the Geometry course between algebra skills and geometry.** Teacher comments indicated that the need to review Algebra 1 skills is a major feature of their instructional planning. During observations in the second marking period, teachers were spending considerable time on skills they identified as "review" because students had forgotten basics such as factoring polynomials.

Professional Development

- **In addition to professional development needs suggested by the recommendations above, clarify expectations for "mandatory" training for secondary teachers.** There has been no recent district professional development for Algebra 2. Many current teachers of Algebra 2 did not attend the county training which took place in 2005. Bridge to Algebra 2 professional development (2008) may offer fresh ideas and approaches.
- **Strengthen opportunities for job-embedded professional development for Algebra 2.** These opportunities are currently limited. These sessions should stress best practices, differentiation techniques, and ways to support struggling students.

Additional Refinements: Planning and Using Data to Support Instruction

- **Explore creative ways to review and reinforce algebraic skills from Algebra 1 with rising Algebra 2 students.** Teachers are very concerned that course order does not support success in Algebra 2 because students forget skills in the intervening time and because the time used to prepare students for the High School Assessment (HSA) affects what was covered in Algebra 1.
- **Encourage collaboration, data chats, and course-alike planning for Algebra 2 teachers.** High school mathematics schedules limit the opportunity for professional development and collaborative planning specific to Algebra 2. Schedule time for course-alike data chats and instructional planning. Use data to plan ways to build weak or forgotten algebra skills.
- **Consider developing county unit assessments for Algebra 2.** Teachers currently have only their own grades to use in understanding student performance. Data on specific indicators within the course are not readily available. County unit assessments will help to identify common issues and build students' skills.
- **Explore ways that SAT data can support Algebra 2 planning.** The content of Algebra 2 is supposed to support SAT performance. However, the majority of students now take Algebra 2 in Grades 9 or 10, with a time lag before they take SAT. This lag weakens the direct link between course content and SAT, especially for students who do not take precalculus the following year. Teachers report that they do not have access to SAT data and cannot use it for planning.
- **Make background information about students more accessible to teachers.** This may be a multifaceted issue involving communication, technology resources, and professional

development. Resource teachers consulting on the study said teachers needed to know the service needs and course history of Algebra 2 students in order to plan effectively and offer differentiation. However, many teachers were unable to produce this information (such as whether students were repeating the course). Observations of Algebra 2 lessons did not reveal evidence of differentiation.

Additional Refinements: Course Sequence

- **Research the benefits of experimenting with different course sequences; consider piloting an alternative sequence (e.g., Algebra 1, Algebra 2, Geometry) in several clusters.** Teachers say that Algebra 2 skills align more closely with Algebra 1 than with geometry. Several counties in Maryland are experimenting with different numbers and sequences of mathematics courses in high school. Should MCPS decide to pilot an alternative sequence, student performance in courses, exams, and SAT can be compared to students following a traditional sequence.

Additional Refinements: Acceleration

- **Review the effectiveness of district efforts to accelerate mathematics articulation and achievement, particularly with regard to algebra.** Analysis is needed to see whether acceleration ultimately supports successful completion of college preparatory mathematics courses, such as precalculus and calculus. Examine cohorts of students with marginal performance in middle school Algebra 1, such as students who received a final grade of D, students who needed to repeat the course, and students who needed additional support to complete the course. How did they fare with high school mathematics? A related examination should focus on high school students who took Algebra 1 in middle school. Did they in fact take more advanced mathematics courses in high school than did earlier cohorts without middle school algebra?

Additional Refinements: Support for Struggling and Failing Students

- **Standardize practices regarding: 1) successful completion of geometry as a prerequisite for Algebra 2; 2) the articulation pathway for students failing geometry, weak in Algebra 1, or otherwise needing support in order to take Algebra 2; and 3) retaking of the (failed) Algebra 2 course.** With the MAPS and PGA[9] courses gone, a review is needed for ways to support students who are repeating Algebra 2 or taking Algebra 1, Geometry, and/or Algebra 2 out-of-sequence. Develop a placement recommendation for students failing the first semester of Algebra 2 similar to that developed for middle school (Kress & Leleck, 2007).

[9] MAPS = Mathematical Approach to Problem Solving; PGA = Principles of Geometry and Algebra.

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Appendixes

Appendix A
Student Enrollment and Performance Tables
2008–2009 Cohort

Completion Experience

Table A-1
Course Completion

Completion Status	All enrolled Algebra 2 students Fall 2008 (*N* = 9,488) *n*	*%*
Completed and passed two semesters of Algebra 2	8,216	86.6
Did not complete Algebra 2	1,272	13.4
Failed Algebra 2 (grade of E) after two semesters	673	7.1
Withdrew from MCPS during school year	336	3.5
Failed Algebra 2A, took other math or no math Semester B	210	2.2
Passed Algebra 2A, took other math or no math Semester B	53	0.6

Note. Algebra 2 students enrolled Semester A 2008–2009.

Table A-2
Course Completion by Grade Level

	Completed and passed Algebra 2			
	Among all enrolled Algebra 2 students Fall 2008		Among students completing two semesters of Algebra 2 2008–2009[a]	
Grade level	*N*	*%*	*n*	*%*
All Students	9,488	86.6	8,889	92.4
Grade 7	6	100.0	6	100.0
Grade 8	102	98.0	100	100.0
Grade 9	1,775	97.4	1,755	98.5
Grade 10	4,038	91.1	3,918	93.9
Grade 11	2,755	80.0	2,528	87.1
Grade 12	812	60.9	581	85.1

[a]Students who withdrew from MCPS during the school year, or took only one semester of Algebra 2, are excluded.

Table A-3a
Course Enrollment, by Student Characteristics

Subgroup			All enrolled Algebra 2 students Fall 2008 (*N* = 9,488)	All MCPS high school students Fall 2009[b] (*N* = 44,724)	
Gender	Female	*n*	4,826		
		%	50.9	%	48.6
	Male	*n*	4,662		
		%	49.1	%	51.4
Race	American Indian	*n*	27		
		%	n/a	%	n/a
	Asian American	*n*	1,585		
		%	16.7	%	15.1
	African American	*n*	1,906		
		%	20.1	%	23.7
	White	*n*	4,501		
		%	47.4	%	40.0
	Hispanic	*n*	1,469		
		%	15.5	%	20.9
Special Education	Current	*n*	463		
		%	4.9	%	11.3
FARMS	Current	*n*	1,537		
		%	16.2	%	22.4
ESOL[a]	Current	*n*	280		
		%	2.9	%	5.2

Notes. Algebra 2 students enrolled Semester A 2008–2009.
N/a = less than 0.5%. FARMS = Free and Reduced-price Meals System;
ESOL = English for Speakers of Other Languages.
[a] Percentages based on students with available ESOL information (9,428).
[b] Source of all MCPS fall 2009 information: Schools at a Glance.

Table A-3b
Course Completion, by Student Characteristics

Subgroup			Completion status: Completed: Completed and passed two semesters of Algebra 2 (*N* = 8,216)	Completion status: Did not complete: Failed Algebra 2 after two semesters (*N* = 673)	Completion status: Did not complete: Withdrew from MCPS during school year (*N* = 336)	Completion status: Did not complete: Failed Algebra 2A, took other math or no math Semester B (*N* = 210)	Completion status: Did not complete: Passed Algebra 2A, took other math or no math Semester B (*N* = 53)	All enrolled Algebra 2 students Fall 2008 (*N* = 9,488)
Gender	Female	*n*	4,277	284	163	84	18	4,826
		%	52.1	42.2	48.5	40.0	34.0	50.9
	Male	*n*	3,939	389	173	126	35	4,662
		%	47.9	57.8	51.5	60.0	66.0	49.1
Race	American Indian	*n*	24	2	0	1	0	27
		%	n/a	n/a	0.0	n/a	0.0	n/a
	Asian American	*n*	1,462	74	26	16	7	1,585
		%	17.8	11.0	7.7	7.6	13.2	16.7
	African American	*n*	1,550	176	113	61	6	1,906
		%	18.9	26.2	33.6	29.0	11.3	20.1
	White	*n*	4,101	198	58	113	31	4,501
		%	49.9	29.4	27.6	33.6	58.5	47.4
	Hispanic	*n*	1,079	223	84	74	9	1,469
		%	13.1	33.1	25.0	35.2	17.0	15.5
Special Education	Current	*n*	374	40	19	23	7	463
		%	4.6	5.9	5.7	11.0	13.2	4.9
FARMS	Current	*n*	1,168	195	98	65	11	1,537
		%	14.2	29.0	29.2	31.0	20.8	16.2
ESOL[a]	Current	*n*	216	28	26	6	4	280
		%	2.6	4.2	7.8	2.9	7.7	2.9

Notes. Algebra 2 students enrolled Semester A 2008–2009. N/a=less than 0.5%. FARMS = Free and Reduced-price Meals System; ESOL = English for Speakers of Other Languages.
[a] Percentages based on students with available ESOL information (9,428).

Academic Performance

Table A-4
Performance Standard

Performance standard, Final course mark, Algebra 2		All enrolled Algebra 2 students Fall 2008[a] (*N* = 9,488)		Students completing two semesters of Algebra 2 2008–2009[b] (*N* = 8,889)
		n	%	%
Completed, Seven Keys:	A, B, C	6,773	71.4	76.1
	A	1,643	17.3	18.4
	B	2,424	25.5	27.2
	C	2,706	28.5	30.4
Completed, did not meet Seven Keys:	D	1,443	15.2	16.2
Did not complete:	E	542	5.7	6.0
	Did not take Semester B	638	6.7	n/a
	Other incomplete	92	1.0	n/a

[a]Algebra 2 students enrolled Semester A 2008–2009. Incomplete grades can include E, F, I, L, M, N, P, X, no data.
[b]Students who withdrew from MCPS during the school year, or took only one semester of Algebra 2, are excluded.

Table A-5
Final Course Mark, by Grade Level

Final course mark, Algebra 2		Grade level 2008–2009						All enrolled Algebra 2 students Fall 2008 (*N* = 9,488)
		7 (*N* = 6)	8 (*N* = 102)	9 (*N* = 1,775)	10 (*N* = 4,038)	11 (*N* = 2,755)	12 (*N* = 812)	
A	*n*	4	53	691	702	165	28	1,643
	%	n/a	0.6	7.3	7.4	1.7	n/a	17.3
B	*n*	2	40	627	1220	467	68	2,424
	%	n/a	n/a	6.6	12.9	4.9	0.7	25.5
C	*n*	0	5	333	1226	992	150	2,706
	%	0.0	n/a	3.5	12.9	10.5	1.6	28.5
D	*n*	0	2	78	534	580	249	1,443
	%	0.0	n/a	0.8	5.6	6.1	2.6	15.2
Did not take Semester B	*n*	0	1	23	134	240	240	638
	%	0.0	n/a	n/a	1.4	2.5	2.5	6.7
E	*n*	0	0	19	192	265	66	542
	%	0.0	0.0	.2	2.0	2.8	0.7	5.7
Other incomplete	*n*	0	1	4	30	46	11	92
	%	0.0	n/a	n/a	n/a	0.5	n/a	1.0

Note. Algebra 2 students enrolled Semester A 2008–2009. Incomplete grades can include E, F, I, L, M, N, P, X, no data. N/a = less than 0.5%.

Student Characteristics

Table A-6
Student Characteristics, Algebra 2 Students
Enrolled Semester A, 2008–2009, by Grade Level

Subgroup			Grade in 2008–2009						Total (*N* = 9,488)
			7 (*N* = 6)	8 (*N* = 102)	9 (*N* = 1,775)	10 (*N* = 4,038)	11 (*N* = 2,775)	12 (*N* = 812)	
Gender	Female	*n*	1	30	858	2,152	1,402	383	4,826
		%	n/a	n/a	9.0	22.7	14.8	4.0	50.9
	Male	*n*	5	72	917	1,886	1,353	429	4,662
		%	n/a	0.8	9.7	19.9	14.3	4.5	49.1
Race	American Indian	*n*	0	0	6	16	5	0	27
		%	0.0	0.0	n/a	n/a	n/a	0.0%	n/a
	Asian American	*n*	4	42	486	718	282	53	1,585
		%	n/a	n/a	5.1	7.6	3.0	0.6	16.7
	African American	*n*	0	5	155	644	779	323	1,906
		%	0.0	n/a	1.6	6.8	8.2	3.4	20.1
	White	*n*	2	55	1,021	2,098	1,123	202	4,501
		%	n/a	0.6	10.8	22.1	11.8	2.1	47.4
	Hispanic	*n*	0	0	107	562	566	234	1,469
		%	0.0	0.0	1.1	5.9	6.0	2.5	15.5
Special Education	Current	*n*	1	3	21	141	211	86	463
		%	n/a	n/a	n/a	1.5	2.2	0.9	4.9
FARMS	Current	*n*	0	3	117	543	617	257	1,537
		%	n/a	n/a	1.2	5.7	6.5	2.7	16.2
ESOL[a]	Current	*n*	0	0	7	58	129	86	280
		%	0.0	0.0	n/a	0.6	1.3	0.9	2.9

Note. Algebra 2 students enrolled Semester A 2008–2009. N/a = less than 0.5%. FARMS = Free and Reduced-price Meals System; ESOL = English for Speakers of Other Languages.
[a] Percentages based on students with available ESOL information (9,428).

Course Progression

Table A-7
Mathematics Course Progression of the Algebra 2 Cohort,
Students Completing Algebra 2 in 2008–2009

	Mathematics Course, Semester A 2009–2010					
SY2010 →	Below Algebra 2 (*N* = 28[a])	Algebra 2 repeaters and Bridge (*N* = 114)	Precalculus (*N* = 3,080)	Honors Precalculus (*N* = 2,698)	Advanced courses (*N* = 154)	SAMM and QL (*N* = 986)
SY2009 →	Algebra 2 and Honors Algebra 2					
SY2008 →	Geometry 39.3% Honors Geometry 14.3% Algebra 1 21.4% Other Math or No Math 25.0%	Algebra 2 1.8% Geometry 52.6% Honors Geometry 32.5% Other Math or No Math 13.1%	Algebra 2 and Honors Algebra 2 1.0% Geometry 43.3% Honors Geometry 47.8% Algebra 1 1.7% Other Math 1.5% No Math or No Information 4.7%	Algebra 2 and Honors Algebra 2 0.3% Geometry 4.7% Honors Geometry 85.2% Algebra 1 1.8% Other Math 0.1% No Math or No Information 8.0%	Algebra 2 and Honors Algebra 2 3.8% Geometry 31.8% Honors Geometry 43.5% Algebra 1 0.6% Other Math 1.3% No Math or No Information 18.2%	Algebra 2 and Honors Algebra 2 2.1% Geometry 68.2% Honors Geometry 21.7% Algebra 1 1.7% Other Math 3.1% No Math or No Information 3.1%
Number of students in this pathway	(*N* = 28[a])	(*N* = 114)	(*N* = 3,080)	(*N* = 2,698)	(*N* = 154)	(*N* = 986)
% of students in this pathway	0.4%	1.6%	44.1%	38.7%	2.2%	14.1%

Note. Table shows students enrolled in a mathematics course in fall 2009. Totals may not match numbers from other tables in this report. Table shows students still in MCPS as of fall 2009. SY2008 course is a course in which a student was enrolled in spring 2008. SAMM = Statistics and Mathematical Modeling. QL = Quantitative Literacy.
[a] Very small base. Interpret with caution.

Table A-8
Mathematics Course Progression of the Algebra 2 Cohort,
Students Not Completing Algebra 2 in 2008–2009

	Mathematics Course, Semester A 2009–2010					
SY2010 →	Below Algebra 2 (*N* = 31)	Algebra 2 repeaters and Bridge (*N* = 317)	Precalculus (*N* = 105)	Honors Precalculus (*N* = 11[a])	Advanced courses (*N* = 13[a])	SAMM and QL (*N* = 221)
SY2009 →	Algebra 2 and Honors Algebra 2					
SY2008 →	Geometry 48.4% Honors Geometry 12.9% Other Math 19.3% No Math 19.4%	Algebra 2 and Honors Algebra 2 1.9% Geometry 60.3% Honors Geometry 22.1% Algebra 1 3.2% Other Math 6.9% No Math or No Information 5.7%	Algebra 2 and Honors Algebra 2 2.0% Geometry 39.0% Honors Geometry 48.6% Algebra 1 20.% Other Math 3.8% No Math or No Information 4.8%	Algebra 2 9.1% Geometry 27.3% Honors Geometry 45.5% Algebra 1 9.1% No Math or No Information 9.1%	Algebra 2 and Honors Algebra 2 30.8% Geometry 7.7% Honors Geometry 23.1% Other Math 7.7% No Math or No Information 30.8%	Algebra 2 and Honors Algebra 2 3.2% Geometry 67.9% Honors Geometry 12.7% Algebra 1 4.5% Other Math 4.1% No Math or No Information 7.7%
Number of students in this pathway	(*N* = 31)	(*N* = 317)	(*N* = 105)	(*N* = 11[a])	(*N* = 13[a])	(*N* = 221)
% of students in this pathway	4.4%	45.4%	15.0%	0.1%	0.4%	31.6%

Note. Table shows students enrolled in a mathematics course in fall 2009. Totals may not match numbers from other tables in this report. Table shows students still in MCPS as of fall 2009. SY2008 course is a course in which a student was enrolled in spring 2008. SAMM = Statistics and Mathematical Modeling. QL = Quantitative Literacy.
[a]Very small base. Interpret with caution.

Bridge to Algebra 2, Fall 2008

Table A-9
Student Characteristics, Bridge to Algebra 2 Students
Enrolled Semester A, 2008–2009, by Grade Level

Subgroup	All students (*N* = 1,265)	Grade level 12 *n* = 370	11 *n* = 668	10 *n = 217*	9 *n* = 10
	%	%	%	%	%
Gender					
Male (*n*=675)	53.4	54.9	51.5	56.2	60.0
Female (*n*=590)	46.6	45.1	48.5	43.8	40.0
Race/Ethnicity					
American Indian (*n=7*)	0.6	0.0	0.9	0.5	0.0
Asian American (*n*=74)	5.8	6.5	5.8	5.1	0.0
African American (*n*=477)	37.7	38.6	37.0	39.2	20.0
White (*n*=338)	26.7	24.1	28.3	25.3	50.0
Hispanic (*n*=369)	29.2	30.8	28.0	30.0	30.0
Special Education					
Current (*n*=222)	17.5	18.4	19.3	11.1	10.0
ESOL					
Current (*n*=50)	4.0	6.2	3.3	2.3	0.0
FARMS					
Current (*n*=416)	32.9	33.5	32.0	34.1	40.0

Note. Students with a final grade in Bridge to Algebra 2 for Semester A (January 2009) who were still enrolled in MCPS at the end of Semester A. ESOL = English for Speakers of Other Languages; FARMS = Free and Reduced-price Meals System.

Table A-10
Bridge to Algebra 2 2008–2009
Final Course Grade

Final grade	All students (N = 1,265) *n*	*%*
A	151	11.9
B	316	25.0
C	363	28.7
D	226	17.9
E	90	7.1
No grade	85	6.7
Other incomplete grade	34	2.7

Note. Students with a final grade in Bridge to Algebra 2 for Semester A (January 2009) who were still enrolled in MCPS at the end of Semester A.

Table A-11
2008–2009 Bridge to Algebra 2 Students,
Mathematics Course, Semester A, 2009–2010

Mathematics course, Semester A	2008–2009 Bridge to Algebra 2 students (N = 1,265)	
	n	*%*
No mathematics course, or no longer in MCPS	556	44.0
Algebra 1A	6	0.5
Algebra 1B	n/a	n/a
Geometry A	31	2.5
Geometry B	16	1.3
Bridge To Algebra 2A	39	3.1
Algebra 2A	489	38.7
Honors Algebra 2A	22	1.7
Precalculus A	8	0.6
Quantitative Literacy A	90	7.1
Statistics/Math Modeling A	5	n/a

Note. Students with a final grade in Bridge to Algebra 2 for Semester A (January 2009) who were still enrolled in MCPS at the end of Semester A.
n/a=Less than 0.5%.

Table A-12
2008–2009 Bridge to Algebra 2 Students,
Mathematics Course Semester A, 2009–2010, by Grade Level

Mathematics course, Semester A		Grade level 11 (*N* = 188)	Grade level 12 (*N* = 510)	Bridge to Algebra 2 students (*N* = 698)
Algebra 1A	*n*	n/a	4	6
	%	n/a	0.6	0.9
Algebra 1B	*n*	0	n/a	n/a
	%	0.0	n/a	n/a
Geometry A	*n*	10	17	27
	%	1.4	2.4	3.9
Geometry B	*n*	n/a	15	16
	%	n/a	2.1	2.3
Bridge To Algebra 2A	*n*	10	25	35
	%	1.4	3.6	5.0
Algebra 2A	*n*	142	346	488
	%	20.3	49.6	69.9
Honors Algebra 2A	*n*	15	7	22
	%	2.1	1.0	3.2
Precalculus A	*n*	n/a	6	8
	%	n/a	0.9	1.1
Quantitative Literacy A	*n*	5	84	89
	%	0.7	12.0	12.8
Statistics/Math Modeling A	*n*	n/a	4	5
	%	n/a	0.6	0.7

Note. Grade 11 and 12 students with a final grade in Bridge to Algebra 2 for Semester A (January 2009) who were still enrolled in MCPS at the end of Semester A.
n/a=Less than 0.5%.

Appendix B: Review of Literature

General Issues

Higher Mathematics

Upper-level secondary mathematics courses help prepare students for college mathematics and career-related skills. Upper-level mathematics courses in high school are prerequisites for more rigorous high school science and technology courses. The National Center for Educational Statistics investigated course-taking experiences of high school juniors and seniors examining transcripts and scores from mathematics assessments to see whether mathematics skills improve during the last two years of high school. While students did improve mathematics skills during their last two years of high school, skills in problem solving and analytic logic still needed more improvement (NCES, 2008).

One trend in seeking better preparation for college, work, and a competitive future for American students has been to increase the number of credits of high school mathematics required for graduation (Council of Chief State School Officers, 2004). The National Mathematics Advisory Panel reported on multiple factors related to student and teacher preparation for higher mathematics courses. Professional development recommendations for teachers included the need for teachers to be able to teach the skills needed for courses both below and above the level of mathematics they teach, in addition to the level they currently teach (U.S. Department of Education, 2008).

Algebra, the "Gateway" Course

Algebra courses have been under scrutiny across the United States for several years. NCES launched a rigorous review of the teaching and content of "introductory" algebra. NCES selected this topic mainly because of Algebra 1's role as the "gateway to college," the prerequisite course to most higher-level courses (Cavanaugh, 2004). The Urban Systemic Initiative of the National Science Foundation awarded grants to urban districts with academic goals that include all students completing algebra by the end of Grade 9 (Olson, 1994). Initiatives that effectively require every eighth grader to take Algebra 1 continue, such as the recent decision in the State of California (California Department of Education, 2008).

Algebra as a Force for Social Mobility

An influential book about algebra presented the course as a social equalizer, helping to smooth the way for students of all backgrounds to take more advanced courses and be better prepared for college (Moses, 1995). But no sooner had algebra been presented as a "civil right" for minority children than the critics in the popular press began to line up in protest. Local school districts expressed concern about inadequate mathematics proficiency scores once more students began enrolling in eighth grade algebra (Moran, 2003). In a new study released by the Brookings Institution, these types of concerns are vindicated. Students are "lost in eighth-grade algebra," according to a study which examines the consequences of accelerating algebra enrollment by middle school students, particularly African American and Hispanic students. "The push for

universal eighth-grade algebra is based on an argument for equity, not on empirical evidence" (Loveless, 2008). The release of the Brookings study, featuring careful analysis of results from low-scoring students on the National Assessment of Educational Progress, is garnering major attention from the education community, including those who had previously supported the algebra push (Mathews, 2008).

MCPS Studies of Secondary Mathematics

OSA has conducted several recent evaluations that relate to secondary mathematics in MCPS. It is helpful to consider the experience of OSA evaluators in conducting a variety of data collection activities in schools, and with pertinent school system personnel. These evaluations are described briefly below.

Implementation Studies

Algebra 1 curriculum. In 2003–2004, a new Algebra 1 curriculum was introduced to better align with the requirements of HSAs. OSA conducted a comprehensive multimethod evaluation of implementation of the new curriculum to determine the extent to which the new curriculum was implemented and to suggest refinements and improvements to the curriculum and related professional development for Algebra 1 (Hickson and Merchlinsky, 2007). The study concluded that implementation was incomplete and inconsistent from school to school and made recommendations for enhancing classroom practice and professional development.

Skillful teaching for Algebra 1 teachers. Studying Skillful Teaching 1 (SST1) is a 36-hour course based on *The Skillful Teacher* (Saphier and Gower, 1997), designed by Research for Better Teaching and modified for MCPS to support professional development efforts. In 2005, the Department of Shared Accountability (DSA) conducted an evaluation to determine the impact of the Studying Skillful Teaching 1 on Algebra 1 classroom practices. Teachers who had taken SST1 were observed more frequently teaching a mastery lesson than teachers who had not taken SST1 (Merchlinsky, 2007).

High School Plus. High School Plus (HS+) is an academic support and intervention program begun in MCPS in FY 2007. Intended to replace Evening High School (EHS), HS+ targets students who failed required courses related to the HSAs and those who failed other courses required for graduation. OSA conducted an evaluation to assess the implementation of HS+ in all high schools implementing the program during the 2007–2008 school year. High school mathematics courses were among the HS+ courses taken by MCPS students surveyed for the evaluation. Findings suggest that students and teachers appreciated the opportunity to participate in HS+ and found the attendance policy for HS+ to be fair. The majority of students and teachers also agreed that HS+ is offered at a convenient time of day. Teacher concerns focused on student attendance issues. Student concerns focused on the length of daily class time, attendance policy, and the need for snacks to be available (Addison-Scott, 2008).

Outcome Studies

Skillful teaching for Algebra 1 teachers. An outcome evaluation was conducted to examine the effectiveness of the SST or OAT training in improving students' achievement in the Algebra HSA. A nonrandomized comparison group pre- and posttest design was used to assess the effectiveness of the training program on students' performance on the Algebra HSA. No statistically significant differences were found for performance on the Algebra HSA for students of teachers who had the training compared with students of teachers who had not had the training (Modarresi and Wolanin, 2007).

High School Plus. An outcome evaluation in four MCPS pilot high schools (Kennedy, Rockville, Wheaton, and Einstein high schools) provided comparisons of academic performance of HS+ students in pilot high schools with those of students in the EHS. Outcomes varied based on semester and course. Student and teacher characteristics were also examined (Modarresi, 2008).

MCPS research and regulatory information. OSA also publishes periodic research briefs on topics relevant to this evaluation (one example is Von Secker, 2007). An annual report on successful completion of Algebra 1 or higher mathematics is prepared by the Department of Policy, Records, and Reporting for the Maryland State Department of Education (Steinberg and Gumula, 2007).

Appendix C: Data Collection Materials

- Principal Interview Questions
- Teacher and Resource Teacher Interview Questions
- Student Group Interview Questions
- Classroom Observation Protocol
- Teacher Pre- and Post-Observation Questions

Algebra 2 Interviews 2008–2009
Principal Interview Questions

Background

Before I ask you about mathematics at your school, I have a few quick questions about your professional background.

How long have you been principal here? _____ Years

How long have you worked for MCPS? _____ Years

Have you ever taught high school math? [ ] Yes [ ] No

Principal's comments:

Preparing Students

I'd like to start by asking you about student preparation for mathematics in high school. Do your teachers tell you they find students here to be **more prepared** for high school mathematics, **less prepared**, or **about the same** when compared with two or three years ago?

(What have teachers said about this? If changed: What seems to account for the changes?)

Performance

Next I'd like to ask about students' performance in high school mathematics.

Over the past two or three years, **has math performance changed** among students at this school? How? (Are students doing better? Worse?) If changed: What do you think accounts for the change?

If better or worse: What kinds of things have your mathematics teachers done to **address** these changes? Do you have evidence that these efforts worked?

Other

Now I have just a few other questions about high school mathematics.

What **data** do you use **to monitor** students' participation, progress and grades in mathematics? What data do you find particularly helpful?

Over the past two or three years, has the **number of students electing to take Algebra 2** at this school increased, decreased or stayed about the same? (How about for pre-calculus and calculus?) If changed: Why do you think the number has increased/decreased?

(If not mentioned above:) Do you, yourself, have a particular role in **monitoring teachers' efforts to address the changes** you mentioned in student preparation, participation and performance in mathematics, particularly in Algebra 2 and higher courses? Please tell me about that.

If Time

Over the past two or three years, has math performance on the SAT changed at this school? How? What do you think accounts for the changes?

All

Is there anything else you'd like to tell me that you think impacts student preparation for and performance in Algebra 2, that I did not ask?

Here is my business card. (GIVE CARD) If you think of anything later that you would like to add to our discussion, please feel free to contact me.

Thank you again for your school's participation in this study. I look forward to hearing from your Algebra 2 teachers and students later in the year.

Algebra 2 Interviews 2008–2009
Teacher and Resource Teacher Interview Questions

Background

Before I ask you about mathematics at your school, I have a few quick questions about your professional background and teaching assignments.

How long have you been a resource teacher/math teacher here? _____ # Years

Notes: _____

How long have you worked for MCPS? _____ # Years

Teachers: How many years have you taught Algebra 2? _____ # Years

(Refer to information above **.) Is it correct that you teach **x** sections of Algebra 2 and **x** sections of Honors Algebra 2 this semester? [ ] Yes [ ] No – note correction: _____

Ask Everyone

Student Preparation

I'd like to start by asking you about student preparation for mathematics in high school. Do you find your students to be more prepared for high school mathematics, less prepared, or about the same when compared with two or three years ago?

If changed: What seems to account for the changes in preparation? (Listen for: certain skills lacking; changes in course taking patterns in middle school, etc.)

What support does your school offer students to help them prepare for Algebra 2? Tell me about those. Are there any new or recently-added efforts to support students in their preparation? What is your role in doing these things? (Note: Be sure teacher comments stay focused on preparation.)

Student Performance

Next I'd like to ask about students' performance in Algebra 2. Over the past few years, **has performance in Algebra 2 changed** among students at this school? How? (Are students doing better? Worse?) If changed: What do you think accounts for the change?

If better or worse: What kinds of things have you/your teachers needed to do to **address** these changes? (Listen for in-class instructional practices, e.g. grouping, as well as out-of-class supports.) Do you have evidence that these efforts work?

(Note: Be sure teacher comments stay focused on performance.)

What **data** are available to you **to monitor** students' participation, progress and grades in Algebra 2? Do you use these? Why or why not?

What data do you find particularly helpful?

How about data on SAT performance? What is available? Do you use it?

Teaching Algebra 2

What instructional resources and materials are available to support teachers in the delivery of Algebra 2 instruction? (Examples: Textbook, MCPS curriculum guide, supplemental texts/math books, web sites, supplemental workbooks/written materials/worksheets for students, manipulatives, computer software.) What have you found to be most helpful? What else would you request from MCPS if you could, that you think would be useful for teaching Algebra 2?

Is SAT preparation included in Algebra 2 classes? (What kinds of things do you/your teachers do?)

What MCPS professional development is available to support teachers in teaching Algebra 2? What have you taken? Was it helpful? (How?) What else would you request that you think would be helpful?

Ask Resource Teachers

What criteria are used to determine student eligibility to take Algebra 2? Is there a rubric you and your teachers use? Tell me about that. How about determining eligibility for Honors versus on-level Algebra 2?

Does your school work with feeder middle schools on articulation for students who may be ready for Algebra 2 in Grade 9? What is that process?

Are there things you do at this school to encourage high school students to take Algebra 2 who might not otherwise consider taking it? Tell me about those things.

Are there some special things that you, as the RT, do to support teachers or students in helping students be successful in Algebra 2? Tell me about those. Do you have evidence that certain efforts are particularly helpful? What evidence do you have?

Ask Everyone

Is there anything else you'd like to tell me that you think impacts student preparation for and performance in Algebra 2, that I did not ask?

Here is my business card. (GIVE CARD) If you think of anything later that you would like to add to our discussion, please feel free to contact me.

Thank you again for your participation in this study.

Algebra 2 Interviews Spring 2009
Student Group Interview Questions

For introduction: You were asked to join this discussion today because you're talking Algebra Two this year. We're going to be talking about Algebra Two and what is important for students and teachers to do in order to make the course successful for everyone.

Introduce self, note taker. Ground rules. We'll be here 30 minutes, talk one at a time, etc. Everyone should mark the sign-in form. Everyone should get a pencil and an index card.

Why are you taking Algebra 2 this year? (Listen for: next course in the sequence; my school expects everyone to take this; my teacher recommended me; I need it for college, etc.) LIST.

What support does your **school** offer to help students **prepare** to take Algebra 2? (Listen for: summer course, summer math packet, summer math help at school, tutoring) LIST IF NEEDED.

Compared to the last few math classes you took, would you say Algebra 2 is harder, easier, or about the same? Why do you say that?

What kinds of things does your teacher do in your Algebra 2 class that you find particularly helpful for learning? Tell us about that. (Technology; books and materials; grouping practices; math games; special projects, etc.) LIST. *If students say something about coming in for extra help, tell them we'll get to that next.*

If you don't understand something, what kinds of things can you do to get help? (For example, after school help, teacher has office hours, lunch help) LIST. Who has done these things? (HANDS) Why or why not?

What else could your teacher do to help you be successful in this course?

To close, if you could tell your principal **one really important thing** about Algebra 2, what would it be? Please write it on your index card.

Thank you very much for being part of this group today. **Please hand me your index card and your pencil on the way out. Also, please be sure you have put your information on the sign-in form.**

Algebra Two Discussion
Sign-In Form

School:
Date:
Time:

First Name (Please Print)	Current Grade: (please circle one)				I am: (please circle one)		I took Algebra One in Grade: (please circle one)
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
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	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11
	9	10	11	12	Boy	Girl	Before Grade 7 Grade 7 8 9 10 11

Algebra Two 2009–2010
Classroom Observation Protocol Fall 2009

<table>
<tr><td>Observer:</td><td>HIGH SCHOOL:</td></tr>
<tr><td>Teacher Name:</td><td></td></tr>
<tr><td>Date of observation:</td><td rowspan="3">Class period number: _____

From ____:___ to _____:____

Length of period: _____</td></tr>
<tr><td>Room Number:</td></tr>
<tr><td>Number of Students in this section (see colored schedule):

Number of Students Today:</td></tr>
<tr><td>Level: [ ] Alg 2 Honors [ ] Alg 2 On-Level</td><td>Unit and Lesson Taught (if known) (see pre-message):</td></tr>
<tr><td>Grade level of students (check all that apply):

[ ] 9 [ ] 10 [ ] 11 [ ] 12</td><td rowspan="4">Student information from teacher (check all that apply):

[ ] Class includes English Language Learners

[ ] Class includes students with IEP

[ ] Class includes Algebra 2 repeaters

[ ] Class includes students who took Bridge to Algebra 2 last year</td></tr>
<tr><td>Did an instructional specialist from DCI attend this observation? [ ] Yes [ ] No</td></tr>
<tr><td>Is this classroom equipped with Promethean technology?
[ ] Yes [ ] No</td></tr>
<tr><td colspan="2">ESSENTIAL QUESTION(S)

[ ] Unit 3: How do polynomial functions model real-world problems and their solutions?

[ ] Unit 3: Why are complex numbers necessary?

[ ] Unit 3: How are operations and properties of complex numbers related to those of real numbers?

[ ] Other:</td></tr>
</table>

How did the teacher communicate [the EQs and] the day's plan to students?

[ ] written on PB
[ ] written on BB/WB
[ ] orally
[ ] multiple methods

What was communicated? (e.g., SWBAT . . .)

DESCRIPTION OF LESSON	
Sample formulas/problems from warm-up here:	
Sample formulas/problems from focus lesson here:	
Mathematics vocabulary introduced or reviewed during the lesson (note words below):	

LESSON COMPONENTS

Component observed? (✓ = yes)	Order	Lesson Component	Approx. minutes	Activity/Notes
❑		HW review, SAT prep question, other pre-lesson components		
❑		Warm up (related to day's lesson)		
❑		Focus lesson 1		
❑		Focus lesson 2		
❑		Small groups		
❑		Independent practice		
❑		Closure		
		TOTAL LESSON TIME		

INSTRUCTIONAL PRACTICES

Please note evidence of instructional practices.

Practice		Extent of evidence			Notes
		Not Observed	Once or Twice	Multiple/ Throughout	
1	Teacher models thinking process for developing strategies and discovering relationships				
2	Teacher provides differentiated activities, such as different activities, formats, or outcomes, for different groups of students				
3	Teacher facilitates interactive student discussions about mathematical concepts and processes				
4	Teacher presents or demonstrates multiple strategies to students				
5	Teacher helps students make connections to prior knowledge				
6	Teacher uses “real world” applications of mathematical concepts				
7	Teacher describes or demonstrates use of technology (e.g. calculator, graphing calculator, computer) to solve problems				
8	Teacher uses a variety of materials and modalities to teach the lesson (manipulatives, drawings, paper-and-pencil problem solving, using computers, using books, discussion)				
9	Teacher has students work in small groups or pairs				
10	Teacher has students solve problems using multiple strategies				
11	Teacher has students use calculators to solve problems (e.g. setting up, functions)				
12	Teacher has students engage in class discussions that focus on problem solving strategies and reasoning				
13	Teacher reinforces students’ use of the language of mathematics (through speaking and writing)				

FORMATIVE ASSESSMENT

How did the teacher check for student understanding during the lesson?

Practice		Extent of Evidence			If Promethean Board used, note how:
		Not Observed	Once or Twice	Multiple/ Throughout	
1	Warm-up activity that links to prior learning and/or last night's homework				
2	Visual walk-around and check of homework or work at students' desks **(checking for understanding)**				
3	Calls students to front of class to solve a problem				
4	Listens to students discussing in pairs or groups				
5	Written pre-assessment or assessment (describe, get copy):				
6	Every pupil responds/ dipsticking/thumbs up				
7	Asking questions to check for understanding/listening to students' responses				
8	Asking questions at a variety of levels (recall, comprehension, inference)				
9	Asking student to clarify thinking or justify response aloud (critical thinking)				
10	Exit card/Summarizer				
11	Other evidence that teacher uses assessment to guide instruction (how?):				

EVIDENCE OF ADDITIONAL HELPFUL PRACTICES

Check all that apply:	Evidence That:	Notes (how done/how announced)
❑	Teacher uses random/equitable methods for calling on students, calls on a variety of students	
❑	Teacher models study skills (note taking/outlining/creating graphic organizer/having students prepare a review packet) – **includes verbal modeling "Be sure you are noting the formula/definition"**	
❑	Teacher distributes notes related to today's lesson	
❑	Teacher distributes review packet/outline/test or quiz review information	
❑	Strategies (e.g. problem solving steps, graphic organizers, charts) are displayed in the classroom	
❑	Teacher announces tutoring or teacher help sessions after class or after school	
❑	Teacher posts notes, outlines, day's material, homework, information on EdLine (written or verbal notice to students that it is available)	What is available?

Pre-Observation Questions
Algebra 2 Teachers

I will be observing your class on **date, period**.

Will there be any other adults in the class that day, such as a special education teacher, paraeducator, or student teacher? Who will that be?

I would like to receive copies of any handouts pertinent to the day I visit your class (notes, review packets, exit cards, Promethean slides, homework problems, etc.). You can send them to me in an e-mail if you have them ahead of time. My goal is to have copies of the class's work from the class before, the class I observe, and the next class after my visit.

Do you make class materials available for students on EdLine? On a website?

Do you know what you will be working on the day of my visit? (Please reference unit and guide lesson, etc., if applicable.)

Is/was there a pre-assessment for the lesson I will see? If so, please describe:

Did this topic require any special previewing or reteaching of skills prior to student being able to access the content of this lesson? If so, please describe:

What grade levels are included in the class I will see?

Does the class I will see include:

- Any English language learners? (ESOL)
- Any students with an IEP? (Special Ed)
- Any students repeating the Algebra 2 course?
- Any students who took Bridge to Algebra 2 last year?

Post-Observation Questions
Algebra 2 Teachers

(Remind of date of observation, class period, content of lesson.)

Did the lesson meet your objectives for student learning? How do you know?

How will you (or how did you) assess your students' performance on today's/that lesson? *(If the teacher has a rubric or other assessment tool, please ask for a copy).*

How will you be working with students who have not met the learning objective for this lesson?

Ask any clarifying questions (specific to the lesson observed):

IF SMALL GROUPS, TEAMS OR PARTNERS WERE OBSERVED, ASK: How did you determine who would go into the student groups I saw during this lesson? (random/equitable, or intentional based on pre-assessment, instructional levels, special needs, ActiVote data, etc.)

For your Algebra 2 classes, what in general is the proportion of students' grades assigned to assessments, homework, and so forth?

(List for the teacher what you have collected from before, during and after the lesson.) What other written work, notes, handouts, assessments are there from those dates that I still need?