Relating Instructional Practices in Mathematics to Student Success: Focus on Math 7 for Grade 7

Office of Shared Accountability

July 2012

Rachel A. Hickson, M.A.
Shahpar Modarresi, Ph.D.

Montgomery County Public Schools

OFFICE OF SHARED ACCOUNTABILITY

Mr. Adrian B. Talley, Associate Superintendent
850 Hungerford Drive
Rockville, Maryland 20850
301-279-3553

Dr. Joshua P. Starr
Superintendent of Schools

Dr. Kimberly A. Statham
Deputy Superintendent
of Teaching, Learning, and Programs

Table of Contents

Executive Summary v
Summary of Method v
Summary of Findings vii
Recommendations xi
Organization of the Report xii
Acknowledgements xii
Background 1
Math 7 Course in the MCPS Mathematics Sequence 1
Current Initiatives in MCPS Mathematics 1
Review of Literature 3
Study Questions 6
Method 7
Formative Study 7
Summative Study 9
Analytical Procedures 11
Strengths and Limitations Associated with the Study 13
Findings 15
Findings for Formative Study 15
Detailed Findings for Question One 15
Summary of Findings for Question One 27
Findings for Summative Study 30
Detailed Findings for Question Two 31
Summary of Findings for Question Two 36
Detailed Findings for Question Three 38
Summary of Findings for Question Three 39
Detailed Findings for Question Four 39
Summary of Findings for Question Four 46
Recommendations 47
References 48
Appendix A 51
Technical Details 51
Appendix B 56
Data Collection Materials 56

List of Tables

Table 1 Number Of Math 7 for Grade 7 Teachers in FY 2011 Eligible For the Formative Study of Instructional Practices 7

Table 1A Use of Individual Lesson Components 17

Table 1B Classroom Structures That Support Learning 18

Table 1C Critical Thinking and Questioning 19

Table 1D Discourse and Group Work 20

Table 1E Differentiation, Variety, and Learning Styles 21

Table 1F Formative Assessment 22

Table 1G Teacher Use of Interactive Technology 23

Table 1H Teachers' Self Reports on Use of Discourse and Group Work in Lessons Near Date of Observed Lesson 24

Table 1I Teachers' Self Reports on Differentiation Practices and Learning Styles Used in Lessons Near Date of Observed Lesson 24

Table 1J Teachers' Self Reports on Use of Formative Assessment Practices in Lessons Near Date of Observed Lesson 25

Table 1K Teachers' Self Reports on Use of Classroom Technology to Enhance Learning in Lessons Near Date of Observed Lesson 25

Table 1L Lesson Topics 27

Table 1M Summary of Evidence: Delivery of Key Components of Math 7 Instruction 29

Table 2 Teachers and Students Included in the Analysis of Instructional Practices 30

Table 2A Multiple Regression Results for Classroom Structures That Support Learning 31

Table 2B Multiple Regression Results for Critical Thinking and Questioning 32

Table 2C Multiple Regression Results for Discourse and Group Work 33

Table 2D Multiple Regression Results for Differentiation, Variety, and Learning Styles 33

Table 2E Multiple Regression Results for Formative Assessment 34

Table 2F Multiple Regression Results for Teacher Use of Interactive Technology 35

Table 2G Multiple Regression Results for Other Indicators 36

Table 3 Adjusted Means, Mean Difference for MSA Math Scores for Students in Observed Teachers' Classes and their Peers Taught by Non-Observed Teachers 38

Table 4A Math 7 for Grade 7 Students Grade 8 Mathematics Enrollment Fall 2011 40

Table 4B MCPS Middle School Students and Math 7 for Grade 7 Students, FY 2011, by Demographic Characteristics and Services 41

Table 4C Math 7 for Grade 7 Students Grade 8 Mathematics Enrollment, by Demographic Characteristics and Services 42

Table 4D Math 7 for Grade 7 Students Grade 8 Mathematics Enrollment, by Grade 7 Final Course Mark 43
Table 4E Math 7 for Grade 7 Students Grade 8 Mathematics Enrollment, by Articulation Tool Selection 44
Table 4F Math 7 for Grade 7 Students Grade 8 Enrollment, by Grade 7 Math MSA Proficiency Level 45
Table A-1 Factor Pattern Matrix for Critical Thinking and Questioning Indicators 52
Table A-2 Factor Pattern Matrix for Differentiation, Variety, Learning Styles Indicators 53
Table A-3 Factor Pattern Matrix for Formative Assessment Indicators 54
Table A-4 Factor Pattern Matrix for Teacher Use of Technology 55

List of Figures

Figure 1. Components of MCPS mathematics instructional block. 15

Executive Summary

The Office of Shared Accountability (OSA) conducted a study of the relationship between instructional practices in mathematics and student success in Math 7 in Montgomery County Public Schools (MCPS). This study was requested by the Office of Curriculum and Instructional Programs (OCIP).

The main purpose of the study was to examine the extent to which teacher use of recommended instructional practices related positively to the performance of students taking the Math 7 course during Grade 7 ("on level" students). Results are expected to be used to inform the teaching of mathematics at a variety of levels and to a broad population of students.

Summary of Method

A multimethod data collection strategy was used to conduct both formative and summative studies. Four questions guided the data collection and analyses presented in this report.

Formative study. The formative study was designed to answer **Question One. Are Math 7 teachers of Grade 7 students using recommended instructional practices?**

The formative study was conducted by collecting and analyzing observations of Math 7 for Grade 7 classes. All teachers of Math 7 for Grade 7 students for at least two of the past three years (2010–2011, plus 2009–2010 and/or 2008–2009) were observed. There were 45 eligible teachers working in 32 middle schools who met these criteria and were included in the formative study.

Two observations with each selected teacher took place during Unit 2 of the Math 7 course (fall 2010). The first observation was conducted during a two-week period in late October/early November ("Time One"). A second two-week period about four weeks later was used for conducting the second observation ("Time Two").

Teachers completed pre-observation logs, to record activities and practices of interest for the week of the observed lesson. Clarifying questions were answered by teachers via e-mail after each observation.

Department of Curriculum and Instruction (DCI) instructional specialists reviewed lesson topics and handouts used in observed classes, collected for every observed lesson, to determine whether content and topics were within the scope of the Math 7 course.

Later, teacher information was combined with information about Math 7 for Grade 7 students, to create a database for the summative analyses.

Summative study. The summative study relied on a quasi-experimental design. This design emphasized maximizing internal validity by controlling for confounding variables. The methodology and findings for two questions addressed in this part of the study are summarized below.

Question Two. Are recommended instructional practices used by Math 7 teachers significantly related to student outcomes, as measured by Maryland School Assessment (MSA) mathematics?[1]

For measuring the use of recommended practices, an observation instrument identifying specific indicators of instructional practice was developed and used in Math 7 classrooms. The recommended practices in the observation instrument measured two parts. In part one, several indicators in the instrument were grouped into four categories or constructs, measuring (frequency of observation) the following: a) critical thinking and questioning; b) differentiation, variety, and learning styles; c) classroom technology; and d) formative assessment.

In part two, several dichotomous indicators were used to measure the presence of the following practices: a) discourse and group work, b) classroom structure, and c) exit card/summarizer. The outcome measure (or the dependent variable) for addressing Question Two was the student performance on Grade 7 MSA mathematics.

Several statistical analyses were performed on groups or constructs of practice (based on the number of times each practice was observed):

1. First, exploratory factor analysis (principal component) was applied to indicators in each group of the instructional practices (or index) in Math 7 classrooms. The factor scores were then placed in variables and saved in the data set for the purpose of multiple regression analysis.

2. Second, the coefficient alpha was computed separately for each factor to ascertain the reliability of the measures (the extent to which measures making up each factor share a common core).

3. Third, multiple regression procedures were used to examine whether the better Grade 7 students' mathematics outcome would be significantly associated with the higher use of the recommended instructional strategies or indicators of the Math 7 classroom practices. For the dichotomous observation indicators (coded as 0 and 1), only multiple regression analyses were used to test these indicators' associations (negative or positive) with students' MSA mathematics scores. The multiple regression analytical procedures were performed separately for each factor (or group) of observation indicators as well as individual indicators of the practice.

[1]Unit assessments were not available for this study.

Question Three. Are there differences in mathematics performance between students of observed teachers (more recent experience teaching Math 7 for Grade 7) and students of non-observed teachers (less recent experience)?

For question three, the outcome measure (or the dependent variable) was the Grade 7 MSA mathematics scores. The Analysis of Covariance (ANCOVA) was used to statistically control for the effects of possible pre-existing differences between the two groups of students (students of observed teachers vs. students of non-observed teachers). Effect size measures were used to examine the magnitude of mathematics achievement differences between the two groups of Grade 7 students.

Question Four. Which mathematics course do Math 7 for Grade 7 students take in Grade 8?

To answer question four, simple descriptive information (percentages, totals) was constructed using a variety of school system data sources about student characteristics and services, mathematics performance, and Grade 8 enrollment.

Summary of Findings

Question One. Are Math 7 teachers of Grade 7 students using recommended instructional practices?

Lesson components. Observed implementation was high for warm-up and focus lesson components. Homework review and other pre-lesson components, independent practices, and small group or partner activities were at a moderate level of implementation. The extent of evidence for lesson closure was low.

Classroom structures that support learning. Extent of implementation was found to be high for two indicators of structures:

- Students appear to know what to do when they come into the room or move into groups.
- Class ground rules or expectations are posted.

Evidence for the indicator, "Students can drop off completed work and get homework without the teacher's help," was moderate. The extent of evidence for the indicator, "Students can get texts, calculators . . . without teacher's help," was low.

Critical thinking and questioning. Extent of implementation was found to be high for the following indicators:

- Teacher asks students questions that focus on problem-solving strategies and reasoning.
- Teacher models thinking process.
- Teacher reinforces students' use of the language of mathematics.
- Teacher helps students make connections to prior knowledge.
- Teacher presents or demonstrate multiple strategies.

The indicator "Teacher uses 'real world' applications of mathematical concepts" was at a moderate level of implementation.

Discourse and group work. Extent of implementation was at a moderate level for the indicator of "teacher has students work in small groups or pairs to solve problems." However, the extent of evidence was low for two other indicators:

- Teacher facilitates student discussions.
- Teacher has students discuss in groups or pairs.

Differentiation, variety, and learning styles. Extent of implementation was high for the indicator, "Teacher uses of a variety of materials and modalities to teach the lesson to the whole class." A moderate level of implementation was evident for the indicator "Teacher encourages students to try a variety of materials and methods."

Implementation was at a low level for the following indicators:

- Teacher differentiates activities, formats, or outcomes for different groups of students.
- Teacher has students use strategies or seek resources other than getting information from the teacher.
- Teacher gives students opportunities to make choices.

Formative assessment. Implementation was found to be at a high level for the following indicators of formative assessment:

- Asking direct questions to check for understanding
- Visual walk-around and check of work at students' desks
- Asking student to clarify thinking or justify responses aloud
- Asking questions at a variety of levels (recall, comprehension, inference)

Implementation was at a moderate level for the indicators for dipsticking (every pupil responds) and for "Calls students to the front of class to solve a problem." Implementation was at a low level for using exit cards, and for "Listens to students discussing in pairs or groups."

Interactive technology. This analysis found a moderate level for teachers having students interact with the Promethean board. Other indicators of the use of interactive technology were implemented at a low level, including "Teacher has students use calculators to understand concepts," and "Teacher uses Internet tools to enhance instruction."

Question Two. Are recommended instructional practices used by Math 7 teachers significantly related to student outcomes, as measured by MSA mathematics?[2]

After controlling for the students' prior ability (Grade 6 MSA) and characteristics, the multiple regression analyses found that several Math 7 instructional practices were significantly related to Grade 7 MSA mathematics scores. These significant (positive or negative) relationships are summarized below.

Classroom structures. The analyses revealed that the presence of two of the four indicators of classroom structure in Math 7 classrooms were positive significant predictors ($p < .05$) of students' MSA test scores. These indicators were: "Students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups)," and "Students can drop off completed work and get copies of homework or make-up work without teacher's help."

Critical thinking. Teachers' higher use of three instructional practices in Math 7 classrooms was positively and significantly ($p < .05$) associated with students' higher scores on MSA mathematics. These practices included: "Teacher asks students questions that focus on problem-solving strategies and reasoning," "Teacher models thinking process for developing strategies and discovering relationships," and "Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing)."

Discourse and group work. The findings revealed significant and positive effects ($p < .05$) of the presence of the following indicator in Math 7 classrooms on the students' MSA test scores: "Teacher has students discuss in groups or pairs (turn to a partner or think pair share)." Similar analyses found that the presence of another practice placed in this category, "Teacher has students work in small groups or pairs to solve problems" in Math 7 classrooms was negatively associated with students' MSA mathematics score.

Formative assessment. The higher use of four instructional practices (loaded on the same factor) in Math 7 classrooms was significantly associated ($p < .05$) with lower students' mathematics scores as measured by MSA mathematics. These practices included: "Teacher asks direct questions to check for understanding and listening to students' responses," "Visual walk-around and check of homework or work at students' desks," "Every pupil responds/ dipsticking/thumbs up," and "Call students to front of class to solve problem." Another practice of formative assessment also was negatively associated ($p < .05$) with students' MSA mathematics scores, suggesting that the teachers' higher use of listening to students discussing in pairs or groups strategy is related with students' lower scores on MSA. Similar analyses found that the use of the following recommended practice was significantly and positively related ($p < .05$) to students' math performance as measured by Grade 7 MSA mathematics: "Asking student to clarify thinking or justify response aloud (critical thinking)."

Other indicators. The analyses found that the use of an exit card or summarizer in the Math 7 classroom was positively significantly associated ($p < .05$) with Math 7 students' MSA test scores.

[2] Unit assessments were not available for this study.

Question Three. Are there differences in mathematics performance between students of observed teachers and students of non-observed teachers?

On average, students of observed teachers (those with more recent experience teaching Math 7 for Grade 7) performed as well as students of non-observed teachers, as measured by their Grade 7 MSA mathematics after controlling for students' initial abilities (Grade 6 MSA scores), demographics, and service receipt measures.

Question Four. Which mathematics courses do Math 7 for Grade 7 students take in Grade 8?

Overall enrollment. More than half of Math 7 for Grade 7 students (56.6%) are enrolled in either Algebra Prep (48.5%) or Investigations into Mathematics (IM [a coding used at four middle schools]) (288 students, 8.1%). Most other students are enrolled in Algebra 1 (39.7%).

Demographic characteristics and services. Compared with the middle school population as a whole, the Math 7 cohort was more likely to be Hispanic/Latino (34.3% of Math 7 for Grade 7 students, versus 23.8% of all middle school students) or Black or African American (31.6% of Math 7 for Grade 7 students, versus 22.2% of all middle school students), more likely to be current recipients of Free and Reduced-price Meals System (FARMS) services (47.2% versus 29.9%, respectively), more likely to receive English for Speakers of Other Languages (ESOL) services (8.8% versus 4.7%, respectively), and more likely to receive special education services (15.5% versus 11.6%, respectively).

Compared with students taking Algebra 1, students enrolled in Algebra Prep are more likely to be Hispanic/Latino (38.2% of students in Algebra Prep, versus 30.3% of students in Algebra 1) or Black or African American (34.3% versus 25.7%, respectively). They are more likely to receive ESOL services (10.2%, versus 6.9%, respectively), and more likely to receive special education services (20.5%, versus 11.5%, respectively). Higher proportions of Algebra Prep and IM students are FARMS eligible, now or in the past, when compared with students taking Algebra 1 (67.5% of Algebra Prep students, 66.0% of IM students, versus 48.0% of Algebra 1 students).

Algebra 1 students are more likely to be female (54.2%) when compared with students in the other two courses (46.6% in Algebra Prep, 49.0% in IM).

Course marks. Students taking Algebra Prep in Grade 8 had received a wide range of final course marks in Math 7. A final grade of C was most common (42.3%), followed by B (28.2%), or D (20.5%). Investigations into Mathematics students in Grade 8 showed a Math 7 grade distribution similar to that for Algebra Prep. Nearly one half had received a grade of C (46.2%) in Math 7; most of the remaining students had received a grade of B (25.7%) or D (18.1%). Students taking Algebra 1 in Grade 8 were most likely to have received a final grade of B (50.6%) or A (30.2%) in the Math 7 course.

Recommendations

Instructional Practices That Support Student Performance

- Enhance the use of those instructional practices in Math 7 lessons that have been identified by this study to have positive and significant associations with MSA mathematics test scores. These practices include:

  Classroom structures: Students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups); Students can drop off completed work and get copies of homework or make-up work without teacher's help.

  Critical thinking: Teacher asks students questions that focus on problem-solving strategies and reasoning; Teacher models thinking process for developing strategies and discovering relationships; Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing).

  Discourse and group work: Teacher has students discuss in groups or pairs (turn to a partner or think pair share)

  Formative assessment: Asking student to clarify thinking or justify response aloud (critical thinking).

  Other indicators: The use of an exit card or summarizer in the Math 7 lesson.

- Collaborate with the staff from the mathematics office to further improve the reliability and validity of the measures of Math 7 practice in the observation instrument. This will involve OSA refining the observation instrument further, with assistance from OCIP.

- Replicate the study over time, using different student populations and settings to see if the findings of this study are stable.

Grade 8 Mathematics Enrollment

- Continue to explore inequities in the population of Math 7 students being moved to Algebra 1 when compared to students being moved to lower level courses in Grade 8.

- Consider the value of the M-Stat articulation tool and related tools in determining placements for Grade 8 mathematics. When actual Grade 8 enrollment for mathematics courses was compared with articulation tool recommendations, many students were not in the recommended courses.

Organization of the Report

This Executive Summary is followed by a Background section laying out key information about MCPS mathematics, the Math 7 course, and current literature on issues in this study.

The Study Questions and Method sections describe the questions, objectives, and methods used to collect and analyze the data found in this report. Then, detailed findings from the study are presented, followed by recommendations generated by the findings.

Acknowledgements

The authors thank Karen Roberts, Edward Nolan, Brian Crane, and Heather Jones of the Department of Curriculum and Instruction for their assistance with all facets of this study.

The authors thank Kecia Addison-Scott, Elizabeth Cooper-Martin, Helen Wang, Trisha McGaughey, and Natalie Wolanin for assistance with logistics, data collection, and analysis.

Finally, the authors are especially grateful to 45 middle school mathematics teachers who welcomed us to 32 schools to conduct observations of 89 Math 7 lessons.

Relating Instructional Practices in Mathematics to Student Success: Focus on Math 7 for Grade 7

Rachel A. Hickson, M.A.
Shahpar Modarresi, Ph.D.

Background

Math 7 Course in the MCPS Mathematics Sequence

According to MCPS middle school course descriptions, Math 7 (formerly known as Math B) is a full-year course for students who have completed the kindergarten to Grade 5 mathematics curriculum as well as the indicators in Math 6 (Math A). Students in Math 7 continue to Algebra Prep (Math C), Investigations into Mathematics (IM), or Algebra 1 the following school year.

Math 7 students build on their understanding of numbers and computation, conduct operations with integers, connect their knowledge of ratios to the development of proportional reasoning, and apply geometric and measurement skills. Other areas of focus for the Math 7 course include functional relationships, arithmetic and geometric sequences, and data analysis and representation using box and whisker plots and scatter plots.

Grade 7 mathematics offers a last opportunity for students to complete Algebra 1 during middle school. Course content is important to the students' development of abstract thinking and reasoning skills that are needed in higher levels of mathematics. Students' learning is enriched through challenge indicators and through connections to prior content that will be needed in higher courses, such as working flexibly with rational numbers and solving multistep algebraic equations.

Students who take Math 7 in Grade 7 but do not make the transition to accelerated instruction will not take Algebra 1 until Grade 9. This group traditionally includes students who may have difficulty: a) passing the High School Assessment (HSA) for Algebra 1, b) passing Algebra 1 and Geometry for credit, and c) preparing for upper level mathematics courses in high school.

Current Initiatives in MCPS Mathematics

MCPS is engaged in a districtwide review of its mathematics program for prekindergarten through Grade 12. This review takes the form of several activities, including those described in this section. These initiatives in MCPS mathematics provide helpful context in issues of interest to MCPS in improving mathematics curriculum and instruction. Please note that these initiatives may pre- or post-date efforts connected to improving Math 7 performance, or be otherwise unconnected to the research described in this document. Some current and recent initiatives follow.

Seven Keys to College and Career Readiness. Successful completion of advanced mathematics courses (Math 6 in Grade 5, Algebra 1 by Grade 8, and Algebra 2 by Grade 11), defined as completion with a grade of C or higher, are now being monitored among a set of milestones associated with readiness for college. These milestones are known as the "Seven Keys to College Readiness" (MCPS, 2009).

M-Stat process. According to the MCPS strategic plan, "the M-Stat process provides a framework for the systematic and systemic 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, p. 7). Three of the M-Stat teams focus on access to and successful performance in mathematics and are closely aligned with the goals of this study. They are charged with developing systemwide processes and guidelines to support enrollment in and successful course completion. The understanding developed for each of these courses supports mathematics instruction generally for Grades K–12.

- ***Advanced Math in Grade 5 M-Stat***. Successful completion of advanced mathematics in Grade 5 is a Goal 2 milestone of the Montgomery County Public Schools (MCPS) Strategic Plan (MCPS, 2008). This team has focused on understanding characteristics of exemplary mathematics teaching to students at this level, as well as on the selection criteria for student placement in advanced mathematics in Grade 5.

- ***Algebra 1 by Grade 8 M-Stat***. Algebra 1 is an area of focus in MCPS as a: 1) subject of the Maryland HSAs; 2) high school graduation requirement; and 3) prerequisite to taking challenging high school mathematics courses. This M-Stat team has focused on analyzing data on race and performance in middle school mathematics, understanding exemplary teaching practices to close performance gaps, and on selection criteria for placement in middle school algebra.

- ***Algebra 2 by Grade 11 M-Stat***. A logical extension of the initiative to increase middle school mathematics acceleration is the interest in Algebra 2. This group has focused on understanding student performance trends in Algebra 2, identifying exemplary teaching, and building placement criteria models for student placement in Algebra 2.

Common Core State Standards. Maryland recently adopted the Common Core State Standards, a national curriculum framework led by the National Governors Association and the Council of Chief State School Officers. MCPS is currently reviewing its curriculum framework in light of the new standards, which will affect course content and also course order and preparation pathways.

K–12 Mathematics Work Group. The K–12 Mathematics Work Group formed 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. A broad set of final recommendations from this group was delivered in November 2010; action plans to address those recommendations are in process.

Sherwood Cluster Mathematics Project (2008–2010). This project is one example of activities intended to help MCPS schools improve mathematics performance. Together, all schools and all grade levels in the cluster established a unified approach to address the needs of students in mathematics. The cluster goals were: 1) to improve mathematics instruction for successful completion of Algebra 1 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. The goal of 80% of all Grade 8 students successfully completing Algebra was met.

Review of Literature

Teacher instructional practices related to student achievement. The amount of ready advice for mathematics teachers to engage in a wide variety of instructional practices is available and perhaps overwhelming. One source exhorts new mathematics teachers to control their class yet be flexible, vary the activities, encourage participation from students, teach problem-solving skills, and connect mathematics to the real world, just to name a few (Glosser, 2010).

There is a long-standing interest in determining whether and how teachers' instructional practices in mathematics are related to student achievement. Darling-Hammond (1999) found teacher preparation and certification to correlate strongly to student achievement in reading and mathematics, using a wide variety of data on teacher qualifications and school inputs and controlling for differences in student characteristics. House (2002) used data from the Third International Mathematics and Science Study (TIMSS) to discover significant relationships between classroom teachers' practices and students' achievement in mathematics. A large scale study of over 300 California middle schools found a predictive relationship between teacher and school practices and middle school students' performance in mathematics and reading, including a schoolwide focus on academic outcomes, standards-based instruction and curricula, use of data, proactive interventions, and teacher competencies (EdSource, 2010).

Research studies also have attempted to identify specific instructional practices that support student learning, such as exposing students to particular concepts, allowing them to discover new knowledge, solving problems intuitively, providing opportunities to discuss and interact with each other, supporting individual and group work with whole-class discussion, and focusing on number sense (Cebulla, 2000). Hattie (1992) found the giving of feedback by teachers to be a critical characteristic of effective teaching. In secondary mathematics courses where instructional practices were aligned to recommended reforms in mathematics instruction, student achievement improved (McGaffrey et. al, 2001).

Teachers of advanced mathematics for Grade 5 students. The MCPS M-Stat team, Advanced Math in Grade 5, and the Office of Shared Accountability (OSA) collaborated to study the experiences of elementary school teachers of advanced mathematics for Grade 5 students. The key research question was: What aspects of teachers' background, professional development, and characteristics contribute to Grade 5 students' successful performance in middle school math? Individual interviews with 25 teachers at 25 schools, plus interviews with individuals who work with these teachers (e.g., math content coach), were conducted in spring 2009. A higher percentage of more successful teachers (based on student achievement data) used course assessments and previous teaching experience for planning a unit; indicated that student-to-student discourse and stages of learning (i.e., concrete, representational, abstract) were helpful to their students; and reported that college courses and support from other teachers within the building were helpful to them for teaching Math 6 to Grade 5 students (Cooper-Martin & McGaughey, 2010).

General issues in secondary mathematics.[3] ***Algebra, the "gateway" course***. One interest in Grade 7 mathematics in MCPS is its role as a key course in preparing for Algebra 1. Algebra courses have been under scrutiny across the United States for several years. The National Center for Education Statistics (NCES) launched a rigorous review of the teaching and content of "introductory" algebra. NCES selected this topic because of the role Algebra 1 as the "gateway to college," the prerequisite course to most higher-level courses (Cavanaugh, 2004).

Algebra as a force for social mobility. An influential book about algebra presented the course as a social equalizer, smoothing the way for students of all backgrounds to take advanced courses and be prepared for college (Moses, 1995). But no sooner was algebra presented as a "civil right" for minority children than the critics began to line up in protest. Local school districts expressed concern about inadequate mathematics proficiency scores once students began enrolling in eighth grade algebra (Moran, 2003). In a new study by the Brookings Institution, these concerns are vindicated. Students are "lost in eighth-grade algebra," according to an examination of the consequences of accelerated algebra enrollment by middle school students, particularly by 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, p. 3). 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 studies about secondary mathematics in MCPS. These are described briefly below.

Implementation studies. *Preparing students for Algebra 2.* In FY 2009 and FY 2010, OSA conducted a multimethod study to examine the readiness of MCPS students to successfully complete Algebra 2 by Grade 11 with a C or higher (Hickson, 2010). The study also was intended to provide information of general interest regarding mathematics curriculum, instruction, and performance in MCPS. Findings indicated mixed implementation of desirable instructional practices in the delivery of Algebra 2 instruction. In particular, more work is recommended on providing differentiated instruction, conducting continuous and varied formative assessments, providing feedback to students, and making explicit connections between skills in the Algebra 1, Geometry, and Algebra 2 courses.

[3] MCPS instructional specialists expressed an initial interest in student engagement. The focus on teacher practices points to a focus on teacher behaviors rather than student behaviors in observations of lessons, and it was mutually agreed that student engagement will not be explored within the context of this study. A review of literature specific to the topic of student engagement is not included here.

Algebra 1 curriculum. In 2003–2004, a new Algebra 1 curriculum was introduced to better align with the requirements of the HSA. OSA conducted a comprehensive multimethod evaluation of implementation of the new curriculum to determine the extent of implemention and to suggest refinements and improvements (Hickson & 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 & Gower, 1997), designed by Research for Better Teaching and modified for MCPS to support professional development. In 2005, the Department of Shared Accountability (DSA)[4] conducted an evaluation to determine the impact of the SST1 course on Algebra 1 teacher practices. Algebra 1 teachers who had taken SST1 were observed more frequently teaching a mastery lesson than teachers who had not taken SST1 (Merchlinsky, 2007).

Outcome studies. *Skillful teaching for Algebra 1 teachers*. An outcome evaluation was conducted to examine the effectiveness of the SST or the Observing and Analyzing Teaching (OAT) training in improving students' achievement on the Algebra HSA. A nonrandomized comparison group pre- and post-test 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 & Wolanin, 2007).

[4] Former name of the Office of Shared Accountability (OSA).

Study Questions

The primary objective of the study was to examine whether teacher use of recommended instructional practices has a significant positive relationship to academic performance for on-level (rather than advanced) students. The focus course for this study was Math 7 in Grade 7.

There is an ongoing and particular interest in MCPS in confirming the need to utilize recommended instructional practices to support the success of a diverse student population such as that enrolled in Math 7 for Grade 7.

The secondary objective was to confirm the value of critical instructional practices in the teaching of mathematics to a broad population of students. These practices are believed to support successful learning regardless of the mathematics course level.

The following questions guided this study:

1. Are Math 7 teachers of Grade 7 students using recommended instructional practices?

2. Are recommended instructional practices used by Math 7 teachers significantly related to student outcomes, as measured by mathematics unit assessments and MSA mathematics?[5]

3. Are there differences in mathematics performance between students of observed teachers (teachers with more recent experience teaching the course) and students of non-observed teachers?

4. Which mathematics course do Math 7 for Grade 7 students take in Grade 8?

[5] Ultimately, unit assessments were not available for this study.

Method

This study utilized a multimethod data collection strategy, designed to conduct both formative and summative studies.

- The formative study was conducted by collecting and analyzing observations of Math 7 classes to answer the first question.

- The summative study, designed to answer the second and third questions, relied on a quasi-experimental design (Shadish, Cook & Campbell, 2002). This design emphasized the maximizing of internal validity by controlling confounding variables. The main control technique for addressing confounding variables, and consequently improving internal validity, was achieved through the use of advanced statistical techniques.

- Additional descriptive information about Grade 8 enrollment in mathematics was achieved by compiling school system information on student characteristics, student services (e.g., special education), mathematics course grades, Grade 7 MSA proficiency level, and course enrollment. The articulation tool developed by the Algebra 1 by Grade 8 M-Stat was also used to compare actual course placement to expected (tool) placement.

Formative Study

Observed teachers. Teachers were identified for data collection and analysis activities. All teachers of the Math 7 for Grade 7 course for at least two of the past three years (2010–2011, plus 2009–2010 and/or 2008–2009) were observed in this study.[6] There were 45 eligible teachers working in 32 middle schools who met the selection criteria for observation (Table 1).

Table 1
Number Of Math 7 for Grade 7 Teachers in FY 2011 Eligible For the Formative Study of Instructional Practices

Eligible teachers per school:	Number of observed teachers (*N* = 45)	Number of MCPS middle schools (*N* = 38)
3 eligible teachers	3	1
2 eligible teachers	22	11
1 eligible teacher	20	20
No eligible teachers	0	6

Later, teacher information was combined with information about Math 7 for Grade 7 students, to create a database for analysis.

[6] While other characteristics were of interest, such as the number of sections taught, there were not enough Math 7 for Grade 7 teachers to allow for additional screening without compromising the number of eligible teachers needed for meaningful analysis.

Observations. This activity focused on collecting observational data for the selected group of Math 7 teachers (see Figure 1 above). Its purpose was to answer Question One: *Are Math 7 teachers of Grade 7 students using recommended instructional practices?*

Observation protocol. An observation protocol was designed in consultation with mathematics program staff from the Department of Curriculum and Instruction (DCI). MCPS curriculum quick reference ("look-fors") for Math 7, the instructional (course) guide, and other resources from the educational literature were considered in designing observational indicators (MCPS, 2003; MCPS, 2007). Some indicators were repeated from past OSA mathematics and middle school evaluations, including Algebra 2 implementation (Hickson, 2010).

Indicators were drawn from practices of interest, including:

- Emphasis on critical thinking and questioning
- Use of multiple strategies, materials, and modalities
- Use of classroom technology
- Use of small groups; use of discourse (teacher-student, student-student)
- Evidence of classroom structures that support learning
- Use of formative assessment and checking for understanding

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

- Observational data from other MCPS studies in mathematics were re-analyzed to help determine critical instructional practices of interest for Math 7.

- The protocol was pre-tested in a non-sampled class, updated based on the pretest experience, then reviewed again by representatives of DCI.

A copy of the observation protocol is in Appendix B.

Observation activities. The observation plan was based on the identified number of eligible teachers, their class sections, and schools (see Figure 1 above).

- *Observers*. All observers from the study had recently conducted mathematics observations for OSA studies. Mathematics program staff supported the process of training OSA observers.

- *Schedule of observations*. Class schedules for selected teachers were reviewed and a class section for observation was identified.

  Two observations with each selected teacher took place during Unit 2 of the Math 7 course (fall 2011). The first observation was conducted during a two-week period in late October/early November ("Time One"). A second two-week period about four weeks later was used for conducting the second observation ("Time Two"). Brief data collection windows help reduce potential biases that might be introduced into the learning environment over time.

- *Length of observations*. The length of MCPS mathematics classes can vary widely by school. The majority of the observed Math 7 classes were scheduled to last 50 minutes or less. The average length of all of the observed classes was 58 minutes, with a range of 42 minutes to 95 minutes.

  Observers observed for the entire class period, or for 50 minutes, whichever was shorter. To ensure comparable observations at Time One and Time Two, observers of classes lasting longer than 50 minutes observed the first 50 minutes of the period at Time One and the last 50 minutes of the period at Time Two. This practice helped ensure that observers saw those practices associated with certain lesson components during at least one observation (e.g., a warm-up at the beginning, an exit card at the end). (See Table 1A for details on the use of lesson components.)

Pre- and post-observation data collection. At the time observations were scheduled, teachers also were contacted about receiving pre-observation logs, to record activities and practices of interest for the week of the observed lesson. Clarifying questions were answered by teachers via e-mail after each observation.

Teachers' self reports of instructional practices. The study design accounted for additional instances of use of instructional practices on non-observation days through the use of a "lesson log." Teachers were asked to complete a description of the four lessons or lesson sequences leading up to the observed lesson. Lesson logs prepared by the observed teachers were later analyzed to determine whether recommended instructional practices were among those practices described in the logs for the non-observed lessons. For detailed findings from the logs, please see Tables 1H, 1I, 1J, and 1K.

Scope of content and topics in the Math 7 course. DCI instructional specialists reviewed lesson topics and handouts used in observed classes to determine whether content and topics were within the scope of the Math 7 course. Descriptions of the topics of observed lessons were classified into categories (see Table 1L).[7] See Findings for Question One for observation results.

Summative Study

For the summative study, the study relied on a quasi-experimental design as described by Shadish, Cook & Campbell (2002). The emphasis in this design is to maximize internal validity of the findings by controlling confounding variables. The following two questions were addressed by the summative study:

- Question Two. Are recommended instructional practices used by Math 7 teachers significantly related to student outcomes, as measured by MSA mathematics?[8]

[7] Since self-reporting can inflate reporting of recommended practices, observation data helped to confirm the self-reported information.
[8]Unit assessments were not available for this study.

- Question Three. Are there differences in mathematics performance between students of observed teachers (experienced) and students of non-observed teachers (less experienced)?

For question two, the internal validity of the findings was improved by controlling for the students' prior performance on mathematics, teachers' years of experience, students' initial abilities, demographics, and service receipt measures in the statistical models. To avoid the problem of multicollinearity, the factor analytical procedures (principal component) were applied to a number of student background information to create two orthogonal factors. The background information included students' initial abilities, demographics, and service receipt measures. Teachers' experience measure was removed in the final analyses since it did not explain significant variation in students' mathematics performance as measured by MSA.

For question three, the main control technique for confounding variables and consequently improving the internal validity was done through the use of advanced statistical techniques. The confounding variables were controlled for through the use of the propensity score method as well as advanced analytical procedures. The propensity scores based on students' background characteristics (e.g., race, gender, and receipt of Free and Reduced-price Meals System (FARMS) or special education services) were computed using logistic regression models as suggested by the literature **(**Luellen, Shadish, & Clark, 2005)**.** The propensity scores were divided into five categories and used as covariates in the statistical models, which included prior ability (Rosenbaum & Rubin, 1983, 1984, 1985). Both statistical significance tests and effect size statistics were used to address this question.

Measures used in the summative study.

MSA. The Grade 7 students' MSA mathematics scores were used as outcome measures. MSA is a standardized test that demonstrates how well Maryland students have learned the skills specified in the state curriculum. The test is administered annually in Grades 3 through 8. In this study, Grade 7 MSA scores were used as the outcome measures and Grade 6 MSA scores were used to control for students' initial abilities in the statistical models. The correlation between the Grade 7 MSA and 6 Grade MSA was significant ($r = .84$; $p < .001$). The MSA mathematics scores were used to address both the second and third questions.

Observation measures. To address the second question, this study used indicators of recommended Grade 7 mathematics practices as captured by an observation instrument. The measures in the instrument were available for observation in every class. These included:

1) Four categories of indicators (groups of practices) were relevant to address the second question. These categories were: a) critical thinking and questioning; b) differentiation, variety, and learning styles; c) classroom technology; and d) formative assessment. The response format for indicators in the above stated categories was a scale for number of observations, ranging from not observed during the lesson (0) to observed six or more times (6).

2) Other indicators of Math 7 instructional practices included: a) three measures of Discourse and Group Work; b) four measures of Classroom Structure; and c) two additional indicators: "asking questions at a variety of levels (recall, comprehension, inference)," and "Exit Card/Summarizer." These indicators were operationalized as "0" (not observed in the lesson) or

"1" (observed one or more times during the lesson). Each observed teacher and his or her students received a series of scores based on the observed use of the recommended indicators as collected by the observation instrument. Since each teacher was observed teaching twice (two different lessons on different days), scores were averaged for the two observations for each observed teacher and used for advanced statistical analyses.

See Appendix A for technical information.

Study samples for the summative study.

Question Two. The analytical samples included students of 44 observed Math 7 teachers during FY 2011. Observed teachers were selected because they taught Math 7 for Grade 7 for at least the second time in three years (2009–2010 and/or 2008–2009).[9] The final sample included those students of observed teachers who had valid scores on both Grade 7 MSA and Grade 6 MSA mathematics.[10] Student selection criteria is discussed in the Findings section.

Question Three. Students of both observed teachers (44) and non-observed teachers (43) who taught Math 7 for Grade 7 in FY 2011 comprised the final sample for addressing this question. As a group, non-observed teachers had fewer years of recent experience teaching Math 7 for Grade 7; on average non-observed teachers had fewer years of overall experience.

Analytical Procedures[11]

Analytical procedures for Question One. Each observed instructional practice included in the Math 7 observation protocol was used for descriptive analysis (to add the number of times observed, to determine the percentage of classes in which particular indicators was seen, and so forth). Similar treatment was given to observations of lesson components and other lesson profile descriptors.

Analytical procedures for Question Two.[12] For measuring the use of recommended practices, an observation instrument identifying specific indicators of instructional practice was developed and used in Math 7 classrooms. The recommended practices in the observation instrument measured two parts.

- In the first part, several indicators in the instrument were grouped into four categories or constructs, measuring (frequency of observation) the following: a) critical thinking and questioning; b) differentiation, variety, and learning styles; c) classroom technology; and d) formative assessment.

---

[9] While other characteristics were of interest, such as the number of sections taught, there were not enough Math 7 for Grade 7 teachers to allow for additional screening without compromising the number of eligible teachers needed for meaningful analysis.

[10] Analyses requiring MSA data include only those students who took the MSA, and exclude students who took a Mod-MSA or Alt-MSA. Scale scores resulting from modified or alternative versions of the test cannot be combined with those from the standard administration.

[11] All multivariate analyses were guided by What Works Clearinghouse *Procedures and Standards Handbook* (U.S. Department of Education, 2008).

[12] Unit assessments were not available for this study.

- In the second part, several dichotomous indicators were used to measure the presence of the following practices: a) discourse and group work; b) classroom structure, and c) exit card/summarizer. The outcome measure (or the dependent variable) for addressing Question Two was student performance on Grade 7 MSA mathematics.

Several statistical analyses were performed on groups or constructs of practice (based on the number of times each practice was observed):

1. First, exploratory factor analysis (principal component) was applied to indicators in each group of the instructional practices (or index) in Math 7 classrooms. The factor scores were then placed in variables and saved in the data set for the purpose of multiple regression analysis.

2. Second, the coefficient alpha was computed separately for each factor to ascertain the reliability of the measures (the extent to which measures making up each factor share a common core).

3. Third, multiple regression procedures were used to examine whether the better Grade 7 students' mathematics outcome would be associated with the higher use of the recommended instructional strategies or indicators of the Math 7 classroom practices. For the dichotomous observation indicators (coded as 0 and 1) only multiple regression analyses were used to test these indicators' associations (negative or positive) with students' MSA mathematics scores. The multiple regression analytical procedures were performed separately for each factor (or group) of observation indicators as well as individual indicators of the practice.

Analytical procedures for Question Three. For this question, the outcome measure (or the dependent variable) was the Grade 7 MSA mathematics score. Analysis of Covariance (ANCOVA) was used to statistically control for the effects of possible pre-existing differences between the two groups of students (students of observed teachers vs. students of non-observed teachers). Effect size measures were used to examine the magnitude of mathematics achievement differences between the two groups of Grade 7 students.

Analytical Procedures for Question Four. This question addressed Grade 8 mathematics enrollment. Mathematics program staff were interested to know whether Math 7 students moved to Algebra 1 in Grade 8 or to less advanced courses such as Algebra Prep. Simple descriptive information (percentages, totals) was constructed using a variety of school system data sources about student characteristics and services, mathematics performance, and Grade 8 enrollment.

Strengths and Limitations Associated with the Study

In examining the effects of Math 7 classroom practices on students' MSA mathematics performance, it is important to consider that measuring instructional strategies in practice is not an easy task. In general, no measure is perfect, specifically measuring practices such as differentiation that needs concrete indicators and associated operational definitions. Therefore, achieving a psychometrically sound operationalization of Math 7 instructional practices is necessary when studying the impact of indicators of practice on the students' mathematics performance.

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

1. All Math 7 for Grade 7 teachers meeting the experience criteria were observed.

2. The inclusion of nearly all Math 7 for Grade 7 students, and the inclusion of all Math 7 for Grade 7 teachers, in the analysis allows findings to be generalized to all MCPS middle schools and ensures the external validity of results for Question Three. (Generalization of findings for Question Two is limited to students of observed teachers.)

3. The use of multiple data sources (observations, lesson logs, course materials and handouts, teacher information, and extensive student information) provides a more complete view of implementation and the current status of the Math 7 for Grade 7 course in MCPS.

4. The use of relevant literature and MCPS mathematics content experts to guide the development of indicators or measures of Math 7 practices ensures that the findings: a) provide a set of relevant measures and their psychometric properties that are useful for the future studies of Math 7 instructional practices, and b) identify those recommended practices in Math 7 lessons that are significantly associated with student performance on Grade 7 MSA mathematics.

5. Observations were conducted during brief and specific time periods (once at the beginning of Unit 2 and once at the end of Unit 2), strengthening the ability to assess the Math 7 environment at a specific point in time and at a specific point in the course curriculum.

6. Each eligible teacher was observed twice. Multiple observations using the same protocol help to ensure that instructional practices not seen in one class may be seen in another.

The following limitations pertain to this study:

- Isolating the effects of the recommended practices on students' test scores is not an easy task. There are many factors that can also affect students' test scores but could not be controlled in this study due to their unavailability. Only a classical experiment with the random assignment of students safeguards against each of the sources of internal invalidity in a study (e.g., selection bias, maturation, history, attrition). (Babbie, 1992; Judd, Smith, & Kidder, 1991).

- MCPS has not done another study relating instructional practices to student performance, so a comparison to method or findings for any prior MCPS study is not available.

Finally, in drawing conclusions from this study, three caveats must be noted:

1. Generalization of the findings for Question Two is limited only to: a) the students of observed teachers and b) those students who took the Grade 7 MSA in mathematics. Students who took the Mod-MSA or Alt-MSA were excluded from analyses since the scale scores resulting from modified or alternative versions of the MSA cannot be combined with or compared with those from the standard MSA administration.

2. Only one criterion of students' mathematics achievement which was available was used to examine the relation between recommended Math 7 practices and students' mathematics performances. The relation may change if, for example, unit assessments were used as the outcome measure in the analyses. In addition, other outcomes of recommended Math 7 practices (e.g., having better aptitude in mathematics learning, etc.) were not addressed in this study.

3. Although the findings obtained from this study were based on sound design as well as appropriate analyses, it should be noted that causality may not be inferred from this study due to the lack of an experimental design. The outcomes of the instructional practices, whether measured in terms of MSA or other tests, depend on a complex set of interactive factors that can be better addressed by a randomized study.

Findings

Findings for Formative Study

Findings for Question One. Are Math 7 teachers of Grade 7 students using recommended instructional practices?[13]

This section details findings from observations that provided critical data for exploring relationships between instructional practices and student performance.

The MCPS mathematics program provides curriculum look-fors to help teachers know what instructional practices are desirable and expected in their classes (MCPS, 2007). While the frequency with which teachers implement recommended practices is not quantified, teachers are expected to utilize them on an ongoing and regular basis. These practices should be apparent regardless of which class and which lesson component is observed, and by which observer(s).

To assess whether key instructional practices were being implemented in Math 7 for Grade 7 classes, OSA evaluators observed 45 Math 7 teachers at 32 middle schools during Unit 2 of instruction. Each teacher was observed teaching the same class period twice: once in late October or early November (Time One, 45 classes) and again in late November or early December (Time Two, 44 classes).[14]

Please see the Method section for a detailed discussion of study methodology, including the observation methodology.

Detailed Findings for Question One

Lesson components. MCPS instructional guides for mathematics specify the recommended components of an instructional block and the recommended amount of time to devote to each (MCPS, 2003). Figure 1 displays these components.

Mathematics Instructional Block (45 minutes)

5 minutes—Warm up
- Connection to prior learning
- Essential question

20 minutes—Focus Problem/Lesson
- Exploration
- Direct instruction
- Guided practice

15 minutes—Independent Practice/Evaluation
- Differentiation

5 minutes—Closure

Figure 1. Components of MCPS mathematics instructional block.

[13] Exact wording of observational indicators can be found in the tables in the section, as well as in Appendix B.
[14] One teacher was not available for the second observation; data for that teacher were dropped from some of the analyses in this report, where appropriate.

Observers looked to see which lesson components were included in each observed lesson. While not every lesson was automatically expected to include every lesson component, there was an interest in seeing whether teachers followed the recommended block format and how many lesson components were utilized for each lesson (Table 1A).

To ensure that each class was observed for about the same amount of time, observers of classes lasting longer than 50 minutes observed the first 50 minutes of the period at the first observation and the last 50 minutes of the period at the second observation. This is particularly pertinent to observation of lesson components since warm-up is expected to occur only near the beginning of class and closure only near the end.

Use of individual lesson components. Observers looked to see which lesson components were being included during each lesson (or, for blocked classes, portion of each lesson) observed. Observers noted all components used.

- The most commonly observed component in Math 7 lessons was a warm-up. This was used in nearly all observations at Time One (95.6%) and in three fourths of observed lessons at Time Two (77.3%). (Among classes where observers saw the entire class, the figures were 96.5% at Time One and 83.3% at Time Two.)

- The next most commonly observed component was the focus lesson for the day. A focus lesson was observed in a large majority of Time One observations (86.7%) and in three fourths of Time Two observations (77.3%).

- The next most commonly observed components were a homework review or other non-lesson components (two thirds of Time One observations and one half of Time Two observations included this component) and a period of independent practice during the class (64.4% at Time One; 52.3% at Time Two).

- In about one half of observed lessons, observers saw a small group or partner activity. This was the case in just over one half of Time One observations (53.3%) and just under one half of Time Two observations (47.7%).

- Other components were far less common in the observed lessons. An additional focus lesson, such as one starting a new or second topic, was observed in five Time One observations (11.1%) and nine of the Time Two observations (20.5%). (Among classes where observers saw the entire class, these figures were 10.7% at Time One and 17.8% at Time Two.)

- Closure of the lesson, a teacher or student discussion or summary of material from the lesson and not just a student exit card, was not frequently used. This component was observed in only four Time One observations (8.9%) and six Time Two observations (13.6%). (Among classes where observers saw the entire class, these figures were 13.7% at Time One and 16.6% at Time Two.)

Table 1A
Use of Individual Lesson Components

	Time One October–November 2010 (*N* = 45 classes)		Time Two November–December 2010 (*N* = 44 classes)	
Lesson component	*n*	%	*n*	%
Warm-up (related to lesson)	43	95.6	34	77.3
Focus lesson	39	86.7	34	77.3
Homework review, other pre-lesson or non-lesson components	30	66.7	22	50.0
Independent practice	29	64.4	23	52.3
Small group or partner activity	24	53.3	21	47.7
Additional focus lesson	5	11.1	9	20.5
Closure (discussion or elaboration, not just exit card)	4	8.9	6	13.6

Note. Each class included multiple components.

Use of multiple lesson components.[15] Observations of Math 7 lessons indicate that teachers are not using the recommended block structure of four components—warm-up, focus lesson, practice, and closure—for their lessons. Only 6 out of 10 observations at Time One (64.4%) and fewer than 4 out of 10 observations at Time Two (38.6%) featured at least four lesson components.

Classroom structures that support learning. Each observer looked for several indicators showing that classes had some established structures for supporting middle school learning. These indicators refer to the types of rules and routines that teachers put in place that allow students to be more independent and to reduce non-teaching and learning time during class. Indicators of structure are a new area of observation for MCPS (Table 1B).

- In a large majority of observed classes, students appeared to know what to do upon entering class, such as finding their seat, picking up work for the day, or finding their group members when they moved into a group (88.9% of classes at Time One, 88.6% at Time Two).

- In two thirds of all observed classes, ground rules or expectations were posted.

- Remaining indicators of classroom structures that support learning were seen in less than one half of observed classes. Evidence that students dropped off completed work or picked up homework or make-up work without the teacher's help was apparent in 42.2% of classes at Time One and 36.4% of classes at Time Two.

[15] Observers of classes lasting longer than 50 minutes observed the first 50 minutes of the period at Time One and the last 50 minutes of the period at Time Two. This practice helped ensure that observers saw those practices associated with certain lesson components during at least one observation (e.g., a warm-up at the beginning, an exit card at the end).

- Structures for students to get out materials such as textbooks, calculators, or ActiVotes without the teachers' help were even less in evidence (28.9% at Time One; 31.8% at Time Two).

Table 1B
Classroom Structures That Support Learning

	Time One October–November 2010 (*N* = 45 classes)		Time Two November–December 2010 (*N* = 44 classes)	
Indicators of structure	*n*	%	*n*	%
Students appear to know what to do when they come into the room (find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups).	40	88.9	39	88.6
Class ground rules or expectations are posted.	30	66.7	29	65.9
Students can drop off completed work and get copies of homework or make-up work without teacher's help.	19	42.2	16	36.4
Students can get textbooks, calculators, ActiVotes, etc. without teacher's help.	13	28.9	14	31.8

Note. Teachers were observed conducting multiple indicators of practice.

Critical thinking and questioning. Observers looked to see whether teachers were using one or more indicators of critical thinking and questioning in their classes (Table 1C).

- Most teachers asked students questions that focus on problem-solving strategies and reasoning (97.8% of teachers at Time One; 90.9% at Time Two). A large proportion also modeled the thinking process for developing strategies and discovering relationship (95.6% of teachers at Time One; 84.1% at Time Two).

- A sizeable majority of teachers reinforced students' use of the language of mathematics (84.4% at Time One; 72.7% at Time Two). About 7 out of 10 helped students make connections to prior knowledge (71.1% at Time One; 65.9% at Time Two).

- About two thirds of teachers presented or demonstrated multiple strategies to students (64.4% at Time One; 65.9% at Time Two).

- Finally, about one half of teachers used "real world" applications of mathematical concepts (51.1% at Time One; 47.7% at Time Two).

Table 1C
Critical Thinking and Questioning

Indicators of critical thinking and questioning	Time One October–November 2010 (*N* = 45 classes)		Time Two November–December 2010 (*N* = 44 classes)	
	n	%	*n*	%
Teacher asks students questions that focus on problem-solving strategies and reasoning.	44	97.8	40	90.9
Teacher models thinking process for developing strategies and discovering relationships.	43	95.6	37	84.1
Teacher reinforces students' use of the language of mathematics (vocabulary, speaking, and writing).	38	84.4	32	72.7
Teacher helps students make connections to prior knowledge.	32	71.1	29	65.9
Teacher presents or demonstrates multiple strategies to students.	29	64.4	29	65.9
Teacher uses "real world" applications of mathematical concepts.	23	51.1	21	47.7

Note. Teachers were observed conducting multiple indicators of practice.

Discourse and group work. Observers looked to see whether and how teachers had students engage in discussions of mathematics, and whether they had students work or discuss in groups or pairs (Table 1D).

- Small group or partner work was observed in about one half of observed classes (53.3% at Time One; 45.5% at Time Two).

- Other indicators of discourse and group work were less common. Teachers facilitated student discussions about mathematical concepts and processes in a minority of classes (17.8% at Time One; 11.4% at Time Two). Also in a minority of classes, teachers had students discuss in groups or pairs (17.8% at Time One; 20.5% at Time Two).

Table 1D
Discourse and Group Work

Indicators of discourse and group work	Time One October–November 2010 (*N* = 45 classes)		Time Two November–December 2010 (*N* = 44 classes)	
	n	%	*n*	%
Teacher has students work in small groups or pairs to solve problems.	24	53.3	20	45.5
Teacher facilitates student discussions about mathematical concepts and processes.	8	17.8	5	11.4
Teacher has students discuss in groups or pairs ("turn to a partner" or "think pair share").	8	17.8	9	20.5

Note. Teachers were observed conducting multiple indicators of practice.

Differentiation, variety, and learning styles. A variety of indicators were used to see whether teachers were differentiating instruction for students and whether they were addressing a variety of learning styles within their classes (Table 1E).

- In nearly all classes at Time One (93.3%) and a large majority of classes at Time Two (79.5%), teachers used a variety of materials and modalities to teach the lesson to the whole class (for example manipulatives, paper-and-pencil activities, technology, and discussion).

- Just under one half of teachers encouraged students to try a variety of materials and methods to solve problems or generate responses (44.4% at Time One; 47.7% at Time Two).

- In about one third of classes, teachers varied activities, formats, or outcomes to support individual students' learning. (Some of this was accomplished by having a special educator assigned to the class.)

- In one fourth of classes at Time One (24.4%) and one third of classes at Time Two (36.3%), students were directed to use strategies or seek resources other than getting information from the teacher.

- Choice or self-selection is a form of differentiation. In one fifth of classes at Time One (22.2%) and three out of ten classes at Time Two (29.5%), teachers gave students opportunities to make choices about tasks, products, processes, or content.

- Differentiation for different groups of students was rarely observed. In just six classes at Time One (13.3%) and seven classes at Time Two (15.9%), teachers provided differentiated activities, formats, or outcomes for different groups of students.

Table 1E
Differentiation, Variety, and Learning Styles

Indicators of differentiation, variety, learning styles	Time One October–November 2010 (*N* = 45 classes)		Time Two November–December 2010 (*N* = 44 classes)	
	n	%	*n*	%
Teacher uses a variety of materials and modalities to teach the lesson to the whole class (manipulatives, drawings, paper-and-pencil problem solving, using computers, using books, discussion).	42	93.3	35	79.5
Teacher encourages students to try a variety of materials and methods to solve problems or generate responses.	20	44.4	21	47.7
Teacher varies activities, formats, or outcomes to support individual students' learning.	16	35.6	13	29.5
Teacher has students use strategies or seek resources other than getting information from the teacher to solve problems or generate responses.	11	24.4	16	36.3
Teacher gives students opportunities to make choices about tasks, products, processes, or content.	10	22.2	13	29.5
Teacher provides differentiated activities, formats, or outcomes, for different groups of students.	6	13.3	7	15.9

Note. Teachers were observed conducting multiple indicators of practice.

Formative assessment. Observers looked for a number of indicators that teachers were checking for understanding and using methods of formative assessment (Table 1F). Please note that observers tried to avoid visiting classes on days when structured assessments such as tests and quizzes were being administered.

- Nearly all teachers (95.6% of classes at Time One; 100% at Time Two) asked direct questions to check for understanding and listen to students' responses. Nearly as many (93.3% at Time One; 90.9% at Time Two) did visual checks of students' work or homework at their desks (walking around to look at their answers, not just to see if students did something).

- A large majority of teachers asked students to clarify their thinking or justify responses out loud, and asked questions at a variety of levels such as recall, comprehension, and inference (for both indicators, 86.7% at Time One; 77.3% at Time Two).

- About one half of teachers used dipsticking methods or every-pupil-responds methods (57.8% of classes at Time One; 47.7% of classes at Time Two). Similar proportions called students up front to solve problems (53.3% at Time One; 45.5% at Time Two).

- Exit cards or summarizers were used in about one third of classes at Time One (31.1%) and one fifth of classes at Time Two (20.5%). (Among classes where observers saw the entire class, these figures were 42.8% at Time One and 28.5% at Time Two.)

- Teachers listened to student discussions in pairs or groups in one fifth of classes (22.2% at Time One; 20.5% at Time Two).

Table 1F
Formative Assessment

	Time One October–November 2010 (*N* = 45 classes)		Time Two November–December 2010 (*N* = 44 classes)	
Indicators of formative assessment	*n*	%	*n*	%
Asking direct questions to check for understanding and listening to students' responses	43	95.6	44	100.0
Visual walk-around and check of homework or work at students' desks (for content, not just that students did something)	42	93.3	40	90.9
Asking student to clarify thinking or justify response aloud (critical thinking)	39	86.7	34	77.3
Asking questions at a variety of levels (recall, comprehension, inference)	39	86.7	34	77.3
Every pupil responds/ dipsticking/ thumbs up	26	57.8	21	47.7
Calls students to front of class to solve a problem	24	53.3	20	45.5
Exit card/Summarizer	14	31.1	9	20.5
Listens to students discussing in pairs or groups	10	22.2	9	20.5

Note. Teachers were observed conducting multiple indicators of practice.

Teacher use of interactive technology. Observers looked to see whether and how teachers used interactive classroom technology to enhance learning. Such use was limited in the observed Math 7 classes (Table 1G).

- The only somewhat common application of classroom technology was teachers using the Promethean board interactively, by calling up students to solve problems or uncover correct answers at the board (62.2% of Time One classes, 50% of Time Two classes).

- Teachers had students use calculators as tools for understanding concepts in one fourth of Time One classes (24.4%) and less than one tenth of Time Two classes (9.1%).

- Teachers used Internet resources (problem-solving sites, video sites) very infrequently (8.9% of classes at Time One; 13.6% of classes at Time Two).

Table 1G
Teacher Use of Interactive Technology

Indicators of teacher use of interactive technology	Time One October–November 2010 (*N* = 45 classes) *n*	%	Time Two November–December 2010 (*N* = 44 classes) *n*	%
Teacher uses Promethean board interactively so that students participate	28	62.2	22	50.0
Teacher has students use calculators as tools for understanding concepts (not just for checking work)	11	24.4	4	9.1
Teacher uses Internet tools to enhance instruction (problem-solving websites, videos)	4	8.9	6	13.6

Note. Teachers were observed conducting multiple indicators of practice.

Teachers' self reports of instructional practices. The study design sought to account for additional instances of using recommended practices on non-observed days through the use of a "lesson log."

Teachers were asked to complete a description of the four lessons or lesson sequences leading up to the observed lesson. Most teachers submitted a log (42 of 45 teachers at Time One; 40 of 44 at Time Two). The logs were analyzed to determine which instructional practices were used on the non-observed days (Tables 1H, 1I, 1J, 1K). A copy of the log is in Appendix B.

Descriptions from teachers' logs were classified into the same categories of practice as those used during observations. However, some observed practices were not necessarily obvious in the reading and analyzing of the logs. For example, an attempt was made to examine critical thinking and questioning practices identified in the logs. However, very few teachers noted these practices (see also Table 1C).

Based on content from the logs, the largest proportion of teachers at both observation times reported using the following instructional practices:

- Having students work in small groups or pairs (57.1% at Time One; 45% at Time Two)
- Using a variety of materials and modalities to teach the lesson to the whole class (28.6% at Time One; 40% at Time Two)
- Giving a formative assessment (38.1% at Time One; 32.5% at Time Two)
- Using an exit card or summarizer (23.8% at Time One; 20% at Time Two)
- Using Internet tools, such as a video, to enhance instruction (33.3% at Time One; 17.5% at Time Two)

- Using the Promethean board interactively so that students participate (23.8% at Time One; 27.5% at Time Two).

Table 1H
Teachers' Self Reports on Use of Discourse and Group Work
in Lessons Near Date of Observed Lesson

	Time One October–November 2010 (*N* = 42 teachers)		Time Two November–December 2010 (*N* = 40 teachers)	
Indicators of discourse and group work	*n*	%	*n*	%
Has students work in small groups or pairs to solve problems	24	57.1	18	45.0
Facilitates student discussions about mathematical concepts and processes	5	11.9	1	2.5
Has students discuss in groups or pairs	3	7.1	4	10.0

Note. Teachers used multiple indicators of practice. Descriptions from teachers were classified into the categories listed above.

Table 1I
Teachers' Self Reports on Differentiation Practices and Learning Styles
Used in Lessons Near Date of Observed Lesson

	Time One October–November 2010 (*N* = 42 teachers)		Time Two November–December 2010 (*N* = 40 teachers)	
Indicators of differentiation, variety, learning styles	*n*	%	*n*	%
Uses a variety of materials and modalities to teach the lesson to the whole class	12	28.6	16	40.0
Has students use strategies or seek resources other than getting information from the teacher	4	9.5	2	5.0
Gives students opportunities to make choices about tasks, products, processes, or content	2	4.8	0	0.0
Provides differentiated activities, formats, or outcomes, for different groups of students	1	2.4	1	2.5
Varies activities, formats, or outcomes to support individual students' learning	1	2.4	0	0.0
Encourages students to try a variety of materials and methods to solve problems or generate responses	1	2.4	0	0.0

Note. Teachers used multiple indicators of practice. Descriptions from teachers were classified into the categories listed above.

Table 1J
Teachers' Self Reports on Use of Formative Assessment Practices
in Lessons Near Date of Observed Lesson

	Time One October–November 2010 (*N* = 42 teachers)		Time Two November–December 2010 (*N* = 40 teachers)	
Indicators of formative assessment	*n*	%	*n*	%
Gives a formative assessment	16	38.1	13	32.5
Uses exit card or summarizer	10	23.8	8	20.0
Gives a quiz	7	16.7	3	7.5
Calls students to front of class to solve a problem	3	7.1	2	5.0
Uses every pupil responds/dipsticking/thumbs up	1	2.4	0	0.0

Note. Teachers used multiple indicators of practice. Descriptions from teachers were classified into the categories listed above.

Table 1K
Teachers' Self Reports on Use of Classroom Technology to Enhance Learning
in Lessons Near Date of Observed Lesson

	Time One October–November 2010 (*N* = 42 teachers)		Time Two November–December 2010 (*N* = 40 teachers)	
Indicators of use of classroom technology	*n*	%	*n*	%
Uses Internet tools to enhance instruction	14	33.3	7	17.5
Uses Promethean board interactively so that students participate	10	23.8	11	27.5
Has students use calculators as tools for understanding concepts	1	2.4	1	2.5

Note. Teachers used multiple indicators of practice. Descriptions from teachers were classified into the categories listed above.

Profile of observed classes. At both observation times, observers recorded basic profile information for each observed class, including the number of students present, class length, the presence of any other adults in class (e.g., paraeducator), whether and how the lesson objective was communicated, whether the classroom is equipped with interactive technology (e.g., Promethean), and how classroom furniture was arranged. A summary of this information follows.

- At both observations, the average number of students in class was about 23.
- Average class length was about 58 minutes each time.
- About one half of classes included a special education co-teacher at Time One (48.9% of observed classes). The number was lower at Time Two (38.6%), in part because some co-teachers were by that time taking groups of students to other rooms to work separately. Just over one third of classes had a paraeducator present at both observations.

- All teachers communicated the day's objective at Time One (48.9% in writing, the remainder both orally and in writing). At Time Two, most teachers communicated the objective (59.1% in writing, 2.3% orally, and 29.5% both orally and in writing). (Among classes where observers saw the entire class, these figures were very similar.)

- All classrooms in the study were equipped with Promethean technology or another interactive technology.

- At Time One, more than two thirds of classes were arranged with rows of desks facing the teacher (68.9%). The remaining classes had desks clustered together, not necessarily facing the teacher (31.1%). At Time Two, three fourths of classes were arranged in rows and one fourth arranged in clusters.

- Students or furniture were rearranged during the lesson in 9 classes at Time One and 14 classes at Time Two.

Lesson topics and scope. Staff from DCI reviewed lesson topics and handouts provided by Math 7 teachers to assist OSA with analysis of lesson topics and course scope.

Lesson topics. Lesson topics, most of which were displayed in the classrooms in writing, were noted by observers. Since teachers use different words to describe some of the same or similar topics, DCI staff read and grouped all of the lesson topics into common categories (Table 1L).

It was expected that many classes would be working on the same or similar topics. This was confirmed by the observations. At both observation times, a majority of lessons focused on four topics. These were:

- Expressions, equations, and inequalities (18 classes at Time One; 21 classes at Time Two)
- Scientific notation and magnitude (10 classes at Time One; 3 classes at Time Two)
- Working with integers (7 classes at Time One; 10 classes at Time Two)
- Working with exponents (6 classes at Time One; 8 classes at Time Two)

Lesson scope. Based on a DCI review of all handouts, including in-class work sheets, exit cards, homework, quizzes, and related materials provided by teachers, it was determined that all 89 observed lessons (both at Time One and at Time Two) fit the Math 7 scope and sequence outlined by MCPS.

Table 1L
Lesson Topics

	Time One October–November 2010 (*N* = 45 classes)	Time Two November–December 2010 (*N* = 44 classes)
Lesson topics	*n*	*n*
Expressions, equations, and inequalities	18	21
Scientific notation and magnitude (representing and comparing large and small numbers)	10	3
Integers (operations with ordering and comparing)	7	10
Exponents (laws and rules, notation, relationship between squares and square roots)	6	8
Order of operations	2	0
Absolute value	1	1
Properties (which math property is being used)	1	1
Using tables to display and analyze patterns and relationships in functions	0	1
Combining like terms (an accelerated topic from Algebra Prep)	0	1

Note. Multiple topics possible. Descriptions, most of them posted or announced by teachers, were classified into the categories listed above.

Summary of Findings for Question One

Key components of Math 7 instruction.

Lesson components. While teachers have flexibility to make their own instructional decisions about which components to use each day, it is expected that every class will include both the warm-up and closure components.

Observed implementation was high for warm-up and focus lesson components. Homework review and other pre-lesson components, independent practices, and small group or partner activities were at a moderate level of implementation. Evidence for closure was low.

Classroom structures that support learning. These indicators refer to the types of rules and routines that teachers put in place that allow students to be more independent and to increase teaching and learning time during class. Evidence of implementation was found to be high for two of these structures: students know what to do when they come into class or move into groups, and class rules or expectations are posted. Evidence that students could drop off completed work or get homework without the teacher's help was at a moderate level of implementation. The extent of evidence for students being able to get texts or calculators without the teacher's help was low.

Critical thinking and questioning. Extent of implementation was found to be high for the following indicators: teachers ask questions that focus on problem-solving strategies and reasoning, teachers model the thinking process, teachers reinforce students' use of the language of mathematics, teachers help students make connections to prior knowledge, and teachers present or demonstrate multiple strategies. Teachers' use of "real world" applications of mathematical concepts was at a moderate level of implementation.

Discourse and group work. Evidence of implementation was at a moderate level for teachers having students work in small groups or pairs. The extent of evidence was low for teachers facilitating student discussions and teachers having students discuss in groups or pairs.

Differentiation, variety, and learning styles. Extent of implementation was high for teachers using a variety of materials and modalities to teach the lesson. A moderate level of implementation was evident for teachers encouraging students to try a variety of materials and methods. Implementation was at a low level for the following indicators: teachers differentiate for individuals or for different groups or students (varied activities, formats, or outcomes), teachers have students use strategies or seek resources other than the teacher, and teachers give students opportunities to make choices.

Formative assessment. Implementation was found to be at a high level for the following indicators of formative assessment: teachers ask direct questions to check for understanding, teachers conduct visual walk-arounds and checks of students' work, teachers ask students to clarify their thinking or justify their responses out loud, and teachers ask questions at a variety of levels (comprehension, recall, inference).

Implementation was at a moderate level for dipsticking (e.g., thumbs up/thumbs down; hold up white boards) and for calling students to the front of class to solve problems. Evidence was at a low level for using exit cards and for listening to students discuss in groups or pairs.

Interactive technology. Implementation was at a moderate level for teachers having students interact with the Promethean board. Additional indicators of the use of interactive technology were implemented at a low level, including: teachers have students use calculators to understand concepts, and teachers use Internet tools to enhance instruction.

Teachers' self-reports of instructional practices. The study design accounted for additional instances of use of instructional practices on non-observation days through the use of a "lesson log." Teachers were asked to complete a description of the four lessons or lesson sequences leading up to the observed lesson. The logs were analyzed to provide additional information about which instructional practices were used (see Tables 1H, 1I, 1J and 1K).

Based on an analysis of content of the logs prepared by teachers, the largest proportion of teachers at both observation times reported using the following instructional practices:

- Having students work in small groups or pairs
- Using a variety of materials and modalities to teach the lesson to the whole class
- Giving a formative assessment
- Using an exit card or summarizer
- Using Internet tools, such as a video, to enhance instruction
- Using the Promethean board interactively so that students participate

Summary: Evidence of delivery of key components of Math 7 instruction. The extent of evidence found in the observations was summarized into high level (at least 60% of classes), moderate level (about 40 to 50% of classes), and low level (fewer than 40% of classes). Table 1M summarizes the extent of evidence of each component in the observed classes.

Table 1M
Summary of Evidence:
Delivery of Key Components of Math 7 Instruction

	Extent of evidence in observed classes[a] (N = 89 classes)		
Practices	High	Moderate	Low
Lesson components			
Warm-up, focus lesson	x		
Homework review, other pre-lesson components, independent practice, small group or partner activity		x	
Closure			x
Classroom structures that support learning			
Students know what to do when they come into class (find seat, pick up work, move into groups); class group rules or expectations are posted.	x		
Students can drop off completed work, get homework without teacher's help.		x	
Students can get texts or calculators without teacher's help.			x
Critical thinking and questioning			
Teacher asks questions that focus on problem-solving strategies and reasoning, teacher models thinking process, teacher reinforces students' use of the language of mathematics, teacher helps students make connections to prior knowledge, teacher presents or demonstrates multiple strategies.	x		
Teacher uses "real world" applications of mathematical concepts.		x	
Discourse and group work			
Teacher has students work in small groups or pairs.		x	
Teacher facilitates student discussions about mathematical concepts and processes; teacher has students discuss in groups or pairs.			x
Differentiation, variety, and learning styles			
Teacher uses a variety of materials and modalities to teach the lesson.	x		
Teacher encourages students to try a variety of materials and methods.		x	
Teacher varies activities, formats, or outcomes for individual students; teacher has students use strategies or seek resources other than the teacher; teacher gives students opportunities to make choices; teacher provides differentiated activities, formats, or outcomes for different groups of students.			x
Formative assessment			
Asking direct questions to check for understanding, walking around and visually checking students' work, asking student to clarify thinking or justify response aloud, asking questions at a variety of levels	x		
Every pupil responds/dipsticking; calling students to front of class to solve a problem		x	
Exit card/summarizer; listens to students discussing in groups or pairs			x
Interactive technology			
Promethean board used interactively so that students participate		x	

[a] High = six out of ten classes or more. Moderate = about four or five out of ten classes. Low = fewer than four out of ten classes.

Findings for Summative Study

Teacher and student information in the summative study. The analysis discussed in this section included 87 teachers. This total included 44 observed teachers (see previous section) and 43 teachers not eligible for observation. Eligible teachers for observation were teaching Math 7 for Grade 7 for at least the second time in the past three school years (2010–2011, plus 2009–2010 and/or 2008–2009).

The students used for the analyses described in this section met all of the following criteria:

- *Students completed Math 7 for Grade 7.* These students were in Grade 7 in FY 2011, they took Math 7 for Grade 7 (MCPS course 3017) in FY 2011, they started the course by September 10, 2010, and they completed the course.
- *Students have complete academic data.* These students received a report card grade in Math 7 for each marking period, and they received a Maryland School Assessment (MSA) scale score in Grade 7 mathematics.[16]
- *Students had teachers with an impact on the Math 7 program.* These students had teachers who taught at least 10 students in Math 7 for Grade 7 during FY 2011.

Table 2 summarizes the relationships between teachers and students whose information appears in this section.

Table 2
Teachers and Students Included in the
Analysis of Instructional Practices

	Math 7 for Grade 7 teachers (N = 87)	
Students completing Math 7 for Grade 7 (N = 3,562)	Observed (N = 44 teachers)	Not observed (N = 43 teachers)
Students in an observed class section	966	not applicable
Students with an observed teacher but not in an observed class section	1,036	not applicable
Students with a teacher who was not observed	not applicable	1,560

Findings for Question Two. Are recommended instructional practices used by Math 7 teachers significantly related to student outcomes, as measured by MSA mathematics?

Multiple regression procedures were applied to examine the relationship between teachers' use of instructional strategies in Math 7 lessons and students' mathematics performance. The

[16] Analyses requiring MSA data include only those students who took the MSA, and exclude students who took a modified assessment. Scale scores resulting from modified assessments cannot be combined with those from the standard administration.

procedures were done separately for each factor as well as individual dichotomous indicators of the practice as identified in the methodology. The outcome measure (or the dependent variable) for the following findings was the Grade 7 MSA mathematics. The expectation for the findings was that better mathematic performance would be associated with the higher use of the recommended instructional strategies or indicators of the Math 7 instructional practices.

Detailed Findings for Question Two[17]

Classroom structures. Four dichotomous indicators were used to measure classroom structures that support learning in Math 7 (Table 2A). The analyses revealed that the presence of two indicators in Math 7 classrooms were significant predictors *($p < .05$)* of students' MSA test scores. These indicators were: "Students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups)," and "Students can drop off completed work and get copies of homework or make-up work without teacher's help."

Similar analyses for the following two indicators of classroom structures showed no significant effect (positive or negative) of these indicators on students' MSA mathematics scores: "Class ground rules or expectations are posted," and "Students can get textbooks, calculators, active egg, etc. without teacher's help."

Table 2A
Multiple Regression Results for Classroom Structures That Support Learning

	B	Std. error	*t*	Degrees of Freedom*	*p*
Indicators					
1. Class ground rules or expectations are posted.	1.335	0.958	1393	1,718	0.164
2. Students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups).	8.895	0.979	9.089	1,718	0.000**
3. Students can get textbooks, calculators, active egg, etc. without teacher's help.	0.012	0.791	0.015	1,718	0.988
4. Students can drop off completed work and get copies of homework or make-up work without teacher's help.	2.26	0.80	2.815	1,718	0.005**

*The degrees of freedom for these analyses are N- # covariates- 1
**Significant in positive direction

Critical thinking. The principal component analyses revealed that two factors underlie the six observation indicators measuring critical thinking and questioning in Math 7 lessons. The first factor explained the highest proportion of the variance associated with the six indicators, and hence, is the most informative one.

The results from multiple regression showed that the first factor was significantly *($p < .05$)* associated with students' performance in MSA mathematics (Table 2B). The following three indicators had high loadings on the significant factor: "Teacher asks students questions that focus on problem solving strategies and reasoning," "Teacher models thinking process for developing

[17] Exact wording of observational indicators can be found in the tables in the section, as well as in Appendix B.

strategies and discovering relationships," and "Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing)." This finding suggests that teachers' higher use of the above stated indicators in Math 7 lessons was significantly associated with students' higher scores on Grade 7 MSA mathematics.

The second factor of practice was not significant *(p < .05)*, suggesting the three indicators of practice loaded on this factor (Table 2B) do not influence the students' MSA mathematic scores. The nonsignificant factor had high loadings for the following: "Teacher uses 'real world' applications of mathematical concepts," "Teacher presents or demonstrates multiple strategies to students," and "Teacher helps students make connections to prior knowledge."

Table 2B
Multiple Regression Results for Critical Thinking and Questioning

Indicators	B	Standard error	*t*	Degrees of freedom*	*p*
Factor 1	1.08	0.396	2.73	1,718	0.006**
1. The teacher asks students questions that focus on problem solving strategies and reasoning.					
2. Teacher models thinking process for developing strategies and discovering relationships.					
3. Teacher reinforces students' use of language of mathematics (vocabulary, speaking and writing).					
Factor 2	-0.543	0.397	-1.37	1,718	0.17
1. Teacher uses "real world" applications of mathematical concepts.					
2. Teacher presents or demonstrates multiple strategies to students.					
3. Teacher helps students make connections to prior knowledge.					

* The degrees of freedom for these analyses are: N- # covariates- 1
** Statistically significant in the positive direction

Discourse and group work. Three observation indicators measuring discourse and group work in Math 7 classes were dichotomous and therefore included separately in the multiple regression models.

The findings (Table 2C) reveal significant and positive effects *(p < .05)* of the presence of one of the three indicators in Math 7 classes on the students' MSA test scores: "Teacher has students discuss in groups or pairs (turn to a partner or think pair share)."

Similar analyses found a significant negative association between the presence of the following indicator and students' MSA scores: "Teacher has students work in small groups or pairs to solve problems."

Finally, there was no significant association between the indicator "Teacher facilitates student discussions about mathematical concepts and processes" and students' MSA mathematics scores.

Table 2C
Multiple Regression Results for Discourse and Group Work

Indicators	B	Std. error	*t*	Degrees of freedom*	*p*
1. Teacher facilitates student discussions about mathematical concepts and processes.	-.047	0.998	-0.047	1,718	0.96
2. Teacher has students discuss in groups or pairs ("turn to a partner" or "think pair share").	2.388	0.935	2.555	1,718	0.011**
3. Teacher has students work in small groups or pairs to solve problems.	-5.52	0.87	-6.34	1,718	.000***

*The degrees of freedom for these analyses are N- # covariates- 1
** Significant in positive direction
*** Significant in negative direction

Differentiation, variety, learning styles. Five observation indicators (Table 2D) were used to measure differentiation in Math 7 lessons. The principal component procedures found a three-factor solution from the five indicators. Further analyses (multiple regression) revealed that none of the three factors had a significant effect on students' mathematics performance as measured by Grade 7 MSA mathematics.

Table 2D
Multiple Regression Results for Differentiation, Variety, and Learning Styles

Indicators	B	Std. error	*t*	Degrees of freedom*	*p*
Factor 1	0.018	0.393	0.046	1,718	0.96
1. Teacher provides differentiated activities, formats, or outcomes, for different groups of students.					
2. Teacher varies activities, formats, or outcomes to support individual students' learning.					
Factor 2	0.389	0.398	0.978	1,718	0.328
1. Teacher uses a variety of materials and modalities to teach the lesson to the whole class (manipulative, drawing, paper-and-pencil problem solving, using computers, using books, discussion).					
Factor 3	-0.219	0.393	-0.56	1,718	0.577
1. Teacher encourages students to try a variety of materials and methods to solve problems or generate responses.					
2. Teacher gives students opportunities to make choices about tasks, products, processes, or content.					

Note. The findings for this group of indicators should be interpreted with caution, due to the low frequencies of use of several of the instructional practices placed in this group.
*The degrees of freedom for these analyses are N- # covariates- 1

Formative assessment. The principle component procedures revealed a three-factor solution (Table 2E) from the six indicators of formative assessment. The first factor had high loadings for four of the indicators and was negatively associated with the students' performance as measured by Grade 7 MSA mathematics. This finding implies that the higher use of the following indicators of the practice in Math 7 lessons was associated with lower students' MSA mathematics scores: "Asking direct questions to check for understanding and listening to students' responses," "Visual walk-around and check of homework or work at students' desks," "Every pupil responds/dipsticking/thumbs up," and "Calls students to front of class to solve a problem."

The second factor was also negatively associated with the students' mathematics performance, suggesting the teachers' higher use of listening to students discussing in pairs or groups is associated with lower students' scores on MSA mathematics.

The third factor, however, had a significant positive association with students' MSA mathematics. This suggests the use of the following strategy was significantly related to Grade 7 mathematics performance: "Asking student to clarify thinking or justify response aloud (critical thinking)."

Table 2E
Multiple Regression Results for Formative Assessment

Indicators	B	Std. error	*t*	Degrees of freedom*	*p*
Factor 1	-1.17	0.394	-2.97	1,718	0.003**
1. Asking direct questions to check for understanding and listening to students' responses					
2. Visual walk-around and check of homework or work at students' desks (for content, not just that students did something)					
3. Every pupil responds/dispsticking/thumbs up					
4. Calls students to front of class to solve a problem					
Factor 2	-0.847	0.394	-2.148	1,718	0.032**
1. Listens to students discussing in pairs or groups					
Factor 3	0.859	0.401	2.14	1,718	0.032***
1. Asking student to clarify thinking or justify response aloud (critical thinking)					

*The degrees of freedom for these analyses are N- # covariates- 1
** Significant in negative direction
*** Significant in positive direction

Technology. Four indicators constituted the measurement system for the use of technology in Math 7 classrooms (Table 2F). These indicators measured teachers' use of Smart View (display) calculator with Promethean board or overhead projector, students' use of calculators as tools for understanding concepts, teachers' use of Internet tools to enhance instruction, and teachers' use of Promethean board interactively so that students participate. Two factors were extracted from the four indicators (Table 2F) and were further included in the multiple regression analyses. The findings revealed that both factors of Math 7 practices were unrelated *($p < .05$)* to Math 7 students' achievement as measured by MSA mathematics. This suggests that the teachers' use of technology in Math 7 classrooms as measured by those indicators listed above does not significantly explain Grade 7 students' test scores in MSA mathematics.

Table 2F
Multiple Regression Results for Teacher Use of Interactive Technology

Indicators	B	Std. error	*t*	Degrees of freedom*	*p*
Factor 1	-0.55	0.39	-1.41	1,718	0.16
1. The teacher uses a Smart View (display) calculator with Promethean board or overhead projector as a tool for understanding concepts.					
2. Teacher has students use calculators as a tool for understanding concepts (NOT just for checking work).					
3. Teacher uses Internet tools to enhance instruction (e.g., taking students to a problem solving website, showing video streamed from the Internet.					
Factor 2	-0.06	0.397	-0.137	1,718	0.89
1. Teacher uses Promethean board interactively so that students participate (e.g., problem for students to come up and solve, students drag or uncover correct answers, board used for interactive game).					

Note. The findings for this group of indicators should be interpreted with caution, due to the low frequencies of use of several of the instructional practices placed in this group.
*The degrees of freedom for these analyses are N- # covariates- 1

Other indicators. The analysis found (Table 2G) that the use of an exit card or summarizer in Math 7 lessons was significantly associated *(p* < .05*)* with Math 7 students' MSA test scores. The same analysis did not show a significant relationship between Math 7 students' test scores and the presence of teachers' use of the indicator: "Asking questions at a variety of levels (recall, comprehension, inference)."

Table 2G
Multiple Regression Results for Other Indicators

Indicators	B	Std. error	*t*	Degrees of freedom*	*p*
1. Asking questions at a variety of levels (recall, comprehension, inference)	0.269	2.035	0.132	1,718	0.895
2. Exit card/Summarizer	2.344	0.788	2.976	1,718	0.003**

*The degrees of freedom for these analyses are N- # covariates- 1
**Significant in positive direction

Summary of Findings for Question Two

This question examined the extent to which the recommended instructional practices in Math 7 classrooms contribute to students' mathematics achievement. The recommended practices used to address Question Two covered two parts. The first part included four categories or groups of practices including critical thinking, technology, formative assessment, and differentiation indicators. These indicators were measured on frequency scales, ranging from zero (not observed) to six (observed six times or more) for the number of times the groups of practices were observed in Math 7 classes.

The second part included dichotomous observation indicators that were coded as 1 (observed during the lesson) and 0 (not observed). These included measures of classroom structure, discourse, and group work. The outcome measure (or the dependent variable) was the Grade 7 MSA mathematics. Multiple regression procedures were conducted to examine the relationship between teachers' use of instructional strategies in Math 7 classrooms and students' mathematics performance.

After controlling for the students' prior ability and characteristics, several Math 7 instructional practices were found to be significantly ($p < .05$) related to Grade 7 MSA mathematics scores.

Classroom structures. The analysis revealed that the presence of two of the four indicators of classroom structure in Math 7 classrooms were significant predictors *(p* < .05*)* of students' MSA test scores. These indicators were: "students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups)," and "students can drop off completed work and get copies of homework or make-up work without teacher's help."

Critical thinking. Teachers' higher use of three instructional practices in Math 7 classrooms was significantly associated with students' higher scores on MSA mathematics. These practices included:

- Teacher asks students questions that focus on problem solving strategies and reasoning,
- Teacher models thinking process for developing strategies and discovering relationships.
- Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing).

Discourse and group work. The findings revealed significant and positive effects ($p < .05$) of the presence of the following indicator in Math 7 classes on the students' MSA test scores: "Teacher has students discuss in groups or pairs (turn to a partner or think pair share)."

Similar analyses found that the presence of another practice placed in this category, "Teacher has students work in small groups or pairs to solve problems" in Math 7 lessons was negatively associated with students' MSA mathematics score.

Finally, there was no significant association between the indicator "Teacher facilitates student discussions about mathematical concepts and processes" and students' MSA mathematics scores.

Formative assessment. The higher use of four instructional practices (loaded on the same factor) in Math 7 classrooms was significantly associated with lower students' mathematics scores as measured by MSA mathematics. These practices included:

- Asks direct questions to check for understanding and listening to students' responses
- Visual walk-around and check of homework or work at students' desks
- Every pupil responds/dipsticking/thumbs up
- Call students to front of class to solve problem

Another practice of formative assessment also was negatively associated with students' MSA mathematics scores, suggesting that the teachers' higher use of listening to students discussing in pairs or groups strategy was related to students' lower scores on MSA.

Similar analyses found that the use of the following recommended practice was significantly and positively related to students' mathematics performance as measured by Grade 7 MSA mathematics: "asking student to clarify thinking or justify response aloud (critical thinking)."

Technology. The study found that technology-related instructional practices in Math 7 lessons were not significantly associated (either positively or negatively) with students' performance in MSA mathematics. These practices were:

- Teacher uses Smart View (display) calculator with Promethean board or overhead projector.
- Students use calculators as tools for understanding concepts.
- Teacher uses Internet tools to enhance instruction.
- Teacher uses Promethean board.

Other indicators. The analysis found that the use of an exit card or summarizer in Math 7 lessons was significantly associated ($p < .05$) with Math 7 students' MSA test scores. The same analysis did not show a significant relationship between Math 7 students' test scores and the presence of the teachers' use of the indicator: "Asking questions at a variety of levels (recall, comprehension, inference)."

Findings for Question Three. Are there differences in mathematics performance between students of observed teachers and students of non-observed teachers?

Detailed Findings for Question Three

Eligible teachers for observation ("experienced teachers") were teaching Math 7 for Grade 7 for at least the second time in the past three school years (2010–2011, plus 2009–2010 and/or 2008–2009). There were 45 eligible teachers in 32 MCPS middle schools. These teachers are referred to as "observed teachers" below.

The analysis used Analyses of Covariance (ANCOVA) procedures to statistically control for the effects of possible pre-existing differences between the two groups of students (students of observed teachers vs. students of non-observed teachers).

The findings from the ANCOVA are presented in Table 3. The results showed that the main effect of the teachers' experience was not significant (F = 0.615; df = 1; $p < .05$), after controlling for demographics, service receipt measures, and academic performance. On average, students in the observed teachers' classroom scored the same as their peers in the non-observed teachers' classrooms. This finding is further confirmed by the calculated effect size (0.02).

Table 3
Adjusted Means, Mean Difference for MSA Math Scores for Students in Observed Teachers' Classes and their Peers Taught by Non-Observed Teachers

	Adjusted means				Teacher effect		
	Students of observed teachers		Students of non-observed teachers				
2010–2011 MSA Math	Mean	N	Mean	N	Mean difference	St. error	*p*
Mathematics	402.596	1,723	402.113	1,302	.483	.623	0.438

The interaction effect[18] was not statistically significant at $p = .05$ level ($F = .70$; $p = .40$).[19]

Summary of Findings for Question Three

This question addressed the impact of Math 7 teachers' experience in improving students' test scores as measured by the Grade 7 MSA in mathematics. The analysis used the ANCOVA technique to statistically control for the effects of possible pre-existing differences between the two groups of students (students of observed teachers vs. students of non-observed teachers). Effect size measures were used to examine the magnitude of mathematics achievement differences between the two groups of Grade 7 students. A nonequivalent control group design was used to address this question.

On average, students of observed teachers (who were more experienced) performed as well as students of non-observed teachers as measured by their MSA mathematics after controlling for students' initial abilities, demographics, and service receipt measures.

Findings for Question Four: Which mathematics course do Math 7 for Grade 7 students take in Grade 8?

Detailed Findings for Question Four

Grade 8 mathematics enrollment. Mathematics program staff expressed interest in student progress from Math 7 to their next mathematics course, in part to see how many students were able to make a successful transition to Algebra 1 during middle school (an MCPS Key to College Readiness; see Background section).

Grade 8 mathematics course enrollment information is organized by characteristics and Math 7 performance for students completing Math 7 for Grade 7 in FY 2011.[20] This information was created by analyzing descriptive statistics (frequencies, cross-tabulations) for 3,562 students meeting all of the following criteria:

- *Students completed Math 7 for Grade 7.* These students were in Grade 7 in FY 2011, they took Math 7 for Grade 7 (MCPS course 3017) in FY 2011, they started the course by September 10, 2010, and they completed the course.
- *Students have complete academic data.* These students received a report card grade in Math 7 for each marking period, and they received a Maryland School Assessment (MSA) scale score in Grade 7 mathematics.

---

[18] The product term between the independent variable (students of observed teachers vs. students of non-observed teachers) and the covariate (Grade 6 MSA) was included in the ANCOVA model. The coefficient of this product was used to test for non-parallelism or interaction.
[19] Levene's test for the equality of error variances between the two groups of students found that the variances were not significantly different ($F = 1.64$, $p < .05$).
[20] An October 6, 2011, memorandum (Hickson, 2011) included information presented in this section. Some information has been updated since the initial date of issue.

- *Students had teachers with an impact on the Math 7 program.* These students had teachers who taught at least 10 students in Math 7 for Grade 7 during FY 2011.

Relationship to observed teachers. There were 3,562 students eligible for this analysis. Students whose information appears in this section have the following relationship to the observed teachers:

- 966 students were in an observed class section.
- 1,036 students had an observed teacher, but were not in the teacher's observed class section.
- 1,560 students had a teacher who was not observed.

Grade 8 mathematics enrollment, fall 2011. Mathematics enrollment for Grade 8 students who took Math 7 in Grade 7 is displayed in Table 4A.

More than half of Math 7 for Grade 7 students (56.6%) are enrolled in either Algebra Prep (48.5%) or Investigations into Mathematics (IM) (288 students, 8.1%). Most other students are enrolled in Algebra 1 (39.7%).

There were 108 students from the Math 7 group who were no longer enrolled in MCPS as of the start of Grade 8. This includes 71 students who transferred to other public schools, 20 who transferred out of the country, 16 who transferred to nonpublic schools, and one student whose whereabouts are not known.

Table 4A
Math 7 for Grade 7 Students
Grade 8 Mathematics Enrollment Fall 2011

	Math 7 for Grade 7 Students (N = 3,562)		
Grade 8 mathematics course	*n*	%	
Algebra Prep (Math 8)	1,729	48.5	56.6%
Investigations into Mathematics (IM) Grade 8	288	8.1	
Algebra 1A	1,414	39.7	
No longer MCPS	108	3.0	

Note. The students of both observed and nonobserved teachers are included in this table.
Twenty-three students repeated Math 7, took Language Math A ESOL, or had some other mathematics placement during Grade 8.

Demographic characteristics and services for the Math 7 cohort. Table 4B displays characteristics and services for the full cohort of middle schools from FY 2011 (Grades 6 through 8) and for students who took Math 7 as Grade 7 students in FY 2011.

Compared with the middle school population as a whole, the Math 7 cohort was more likely to be Hispanic/Latino (34.3% of Math 7 for Grade 7 students, versus 23.8% of all middle school students) or Black or African American (31.6% of Math 7 for Grade 7 students, versus 22.2% of all middle school students), more likely to be current recipients of FARMS services (47.2% versus 29.9%, respectively), more likely to receive ESOL services (8.8% versus 4.7%, respectively), and more likely to receive special education services (15.5% versus 11.6%, respectively).

Table 4B
MCPS Middle School Students and Math 7 for Grade 7 Students, FY 2011, by Demographic Characteristics and Services

Demographic characteristics and services	MCPS middle school students FY 2011 (*N = 30,500*) %	Math 7 for Grade 7 students FY 2011 (*N = 3,562*) %
Female	48.9	49.8
Male	51.1	50.2
Hispanic/Latino	23.8	34.3
Black or African American	22.2	31.6
White	35.2	23.8
Asian	14.3	7.2
Two or More Races	4.3	2.8
American Indian	#	#
Ever FARMS	40.7	58.9
Now FARMS	29.9	47.2
Now ESOL	4.7	8.8
Now Special Ed	11.6	15.5

Note. Math 7 for Grade 7 students are included in both columns.
Less than 0.5%.
Source: *MCPS Schools at a Glance 2010–2011*.

Grade 8 mathematics enrollment, by demographic characteristics and services. Table 4C displays characteristics and services for students who took Math 7 as Grade 7 students in FY 2011, separated by their Grade 8 mathematics course.

Compared with students taking Algebra 1, students enrolled in Algebra Prep are more likely to be Hispanic/Latino (38.2% of students in Algebra Prep, versus 30.3% of students in Algebra 1) or Black or African American (34.3% versus 25.7%, respectively). They are more likely to receive ESOL services (10.2%, versus 6.9%, respectively), and more likely to receive special education services (20.5%, versus 11.5%, respectively).

Higher proportions of Algebra Prep and IM students are FARMS eligible, now or in the past, when compared with students taking Algebra 1 (67.5% of Algebra Prep students, 66.0% of IM students, versus 48.0% of Algebra 1 students).

Algebra 1 students are more likely to be female (54.2%) when compared with students in the other two courses (46.6% in Algebra Prep, 49.0% in IM).

Table 4C
Math 7 for Grade 7 Students
Grade 8 Mathematics Enrollment, by Demographic Characteristics and Services

Demographic characteristics and services	Grade 8 mathematics course: Algebra Prep (*n* = 1,729)		Investigations into Mathematics IM (*n* = 288)		Algebra 1A (*n* = 1,414)	
	n	%	*n*	%	*n*	%
Female	805	46.6	141	49.0	766	54.2
Male	924	53.4	147	51.0	648	45.8
Hispanic/Latino	661	38.2	97	33.7	429	30.3
Black or African American	593	34.3	111	38.5	364	25.7
White	332	19.2	50	17.4	436	30.8
Asian	88	5.1	26	9.0	134	9.5
Two or more races	50	2.9	#	1.0	45	3.2
American Indian	#	#	0	0.0	#	#
Language other than English at home	521	30.1	45	15.6	393	27.8
Ever FARMS	1,167	67.5	190	66.0	679	48.0
Now FARMS	950	54.9	155	53.8	530	37.5
Prior FARMS	217	12.6	35	12.2	149	10.5
Now ESOL	176	10.2	18	6.3	97	6.9
Prior ESOL	479	27.7	78	27.1	381	26.9
Now Special Ed	354	20.5	28	9.7	163	11.5
Exited Special Ed past two years	141	8.2	39	13.5	24	1.7

Note. Students no longer enrolled in MCPS or enrolled in a noncomprehensive public school placement in MCPS are not detailed in the table.
Less than 1% or fewer than five students.

Grade 8 mathematics enrollment, by Grade 7 final course mark. Final course marks are one indication of readiness to be successful at the next level of mathematics. Table 4D displays the Grade 8 mathematics course segmented by the final mark received for the Math 7 course.

- Students taking Algebra Prep in Grade 8 received a wide range of final course marks in Math 7. A final grade of C was most common (42.3%), followed by B (28.2%), or D (20.5%).

- Investigations into Mathematics students in Grade 8 showed a grade distribution similar to that for Algebra Prep. Nearly one half received a grade of C (46.2%); most of the remaining students received a grade of B (25.7%) or D (18.1%).

- Students taking Algebra 1 in Grade 8 were most likely to receive a final grade of B (50.6%) or A (30.2%).

Table 4D
Math 7 for Grade 7 Students
Grade 8 Mathematics Enrollment, by Grade 7 Final Course Mark

Grade 8 mathematics course		Math 7 for Grade 7 Final Course Mark (*N* = 3,562) A (*n* = 544)	B (*n* = 1,325)	C (*n* = 1,140)	D (*n* = 453)	E/inc. (*n* = 100)
Algebra Prep (*n* = 1,729)	*n*	80	488	732	355	74
	%	4.6%	28.2%	42.3%	20.5%	4.3%
Investigations into Mathematics (*n* = 288)	*n*	14	74	133	52	15
	%	4.9%	25.7%	46.2%	18.1%	5.2%
Algebra 1A (*n* = 1,414)	*n*	427	715	240	29	#
	%	30.2%	50.6%	17.0%	2.1%	#

Note. Students no longer enrolled in MCPS or enrolled in a noncomprehensive public school placement in MCPS are not detailed in the table.
Less than 0.5% or fewer than five students.

Grade 8 mathematics enrollment, by articulation tool selection. The Algebra 1 by Grade 8 M-Stat created an articulation tool in FY 2011 to help schools place students in mathematics courses. The tool relies on unit assessment data and final course marks to determine recommended placements. Unit assessment data were not posted by schools for most Math 7 students, so course marks were used to explore the relationship between articulation tool recommendations and Grade 8 placements for FY 2012.

Table 4E displays the recommended placements, informed solely by course marks.

For students receiving a final course mark of A or B, the articulation tool would recommend 1,798 students for Algebra 1A. In fact 1,414 students enrolled in Algebra 1A.

For students receiving a final course mark of C, D, or E, the articulation tool would recommend 1,633 students for Algebra Prep. In fact, 1,729 students enrolled in Algebra Prep.

Table 4E
Math 7 for Grade 7 Students
Grade 8 Mathematics Enrollment, by Articulation Tool Selection

		Math 7 for Grade 7 Final Course Mark				
Grade 8 mathematics course		A	B	C	D	E
Algebra Prep (*n* = 1,729)	*n*	80	488	732	355	74
Investigations into Mathematics (*n* = 288)	*n*	14	74	133	52	15
Algebra 1A (*n* = 1,414)	*n*	427	715	240	29	#
		Articulation Tool selects Algebra 1A (*n* = 1,798)		Articulation Tool selects Algebra Prep (*n* = 1,633)		

Note. The articulation tool was developed by the Algebra 1 M-Stat. The articulation tool relies on final course marks and on unit assessment data. Unit assessment data were not available for most students, and are not included in this table.
[#] Less than 0.5% or fewer than five students.

Grade 8 enrollment, by Grade 7 Math MSA proficiency level. The standardized test in mathematics for the grade level can be another indication of readiness to be successful at the next level of mathematics.

Table 4F displays the Grade 8 mathematics course segmented by the scale score received for the Grade 7 MSA in mathematics. (A different, modified assessment was administered to 180 students; it does not yield a comparable scale score.)

Table 4F
Math 7 for Grade 7 Students
Grade 8 Enrollment, by Grade 7 Math MSA Proficiency Level

		Math 7 Students (*N* = 3,562) Math MSA Proficiency Level			
Grade 8 mathematics course		Basic (<396) (*n* = 1,370)	Proficient (396–450) (*n* = 1,885)	Advanced (>450) (*n* = 127)	Other assessment (*n* = 180)
Algebra Prep (*n* = 1,729)	*n*	960	615	#	147
	%	55.5%	35.6%	#	8.5%
Algebra 1A (*n* = 1,414)	*n*	220	1,066	112	16
	%	15.6%	75.4%	7.9%	1.1%
Investigations into Mathematics (*n* = 288)	*n*	133	136	#	16
	%	46.2%	47.2%	#	5.6%
Other MCPS (*n* = 23)	*n*	19	#	#	#
	%	82.6%	#	#	#
No longer MCPS (*n* = 108)	*n*	38	66	#	0
	%	35.2%	61.1%	3.7%	0.0

[#] Less than 0.5% or fewer than five students.

Summary of Findings for Question Four

More than half of Math 7 for Grade 7 students (56.6%) are enrolled in either Algebra Prep (48.5%) or Investigations into Mathematics (IM) (288 students, 8.1%). Most other students are enrolled in Algebra 1 (39.7%).[21]

Compared with the middle school population as a whole, the Math 7 cohort was more likely to be Hispanic/Latino or Black or African American, more likely to be current recipients of FARMS services, more likely to receive ESOL services, and more likely to receive special education services.

Compared with students taking Algebra 1 in Grade 8, students enrolled in Algebra Prep are more likely to be Hispanic/Latino or Black or African American, more likely to receive ESOL services, and more likely to receive special education services. Higher proportions of Algebra Prep and IM students are FARMS eligible, now or in the past, when compared with students taking Algebra 1. Algebra 1 students are more likely to be female when compared with students in the other two courses.

[21] 108 students from the Math 7 group were no longer enrolled in MCPS as of the start of Grade 8.

Recommendations

Instructional Practices That Support Student Performance

- Enhance the use of those instructional practices in Math 7 classes that have been identified by this study to have positive and significant associations with MSA mathematics test scores. These practices include:

  Classroom structures: Students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups); Students can drop off completed work and get copies of homework or make-up work without teacher's help.

  Critical thinking: Teacher asks students questions that focus on problem-solving strategies and reasoning; Teacher models thinking process for developing strategies and discovering relationships; Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing).

  Discourse and group work: Teacher has students discuss in groups or pairs (turn to a partner or think pair share)

  Formative assessment: Asking student to clarify thinking or justify response aloud (critical thinking).

  Other indicators: The use of an exit card or summarizer in the Math 7 lesson.

- Collaborate with the staff from the mathematics office to further improve the reliability and validity of the measures of Math 7 practice in the observation instrument. This will involve OSA refining the observation instrument further, with assistance from OCIP.

- Replicate the study over time, using different student populations and settings to see if the findings of this study are stable.

Grade 8 Mathematics Course Enrollment

- Continue to explore inequities in the population of Math 7 students being moved to Algebra 1 when compared to students being moved to lower level courses in Grade 8.

- Consider the value of the M-Stat articulation tool and related tools in determining placements for Grade 8 mathematics. When actual Grade 8 enrollment for mathematics courses was compared with articulation tool recommendations, many students were not in the recommended courses.

References

Babbie, Earl. (1992). *The practice of social research*, 6th Edition. Belmont, CA: Wadsworth.

Cattell, R. (1966). *Handbook of multivariate experimental psychology*. Chicago: Rand McNally.

Cavanaugh, S. (2004, September 1). NCES to examine content of Algebra 1 courses. *Education Week 24*(1), 5.

Cebulla, K. (2000). *Improving student achievement in mathematics, part 1: Research findings.* Columbus, OH: ERIC Clearinghouse for Science, Mathematics and Environmental Education.

Cooper-Martin, E., & McGaughey, T. (2010). *A study of classroom experiences of teachers of advanced mathematics to grade 5 students.* Rockville, MD: Montgomery County Public Schools.

Darling-Hammond, L. (1999) *Teacher quality and student achievement: A review of state policy evidence.* University of Washington: Center for the Study of Teaching and Policy.

EdSource (2010). *Gaining ground in the middle grades: Why some schools do better*. Mountain View, CA: EdSource, Inc.

Glosser, Gisele (2010). *Tips for new math teachers.* Colchester, CT: Mrs. Glosser's Math Goodies, Inc.

Hattie, J.A. (1992). Towards a model of schooling: A synthesis of meta-analyses. *Australian Journal of Education*, 36, 5–13.

Hickson, R. (2010) *Evaluation study: Preparing students for Algebra 2.* Rockville, MD: Montgomery County Public Schools.

Hickson, R. (2011) *Grade 8 mathematics enrollment for students who completed Math 7 for Grade 7.* Memorandum dated October 6, 2011. Rockville, MD: Montgomery County Public Schools.

Hickson, R., & Merchlinsky, S. (2007). *Evaluation of the Algebra 1 curriculum in Montgomery County Public Schools, 2003–2004.* Rockville, MD: Montgomery County Public Schools.

House, J.D. (2002). Instructional practices and mathematics achievement of adolescent students in Chiese Taipei: results from the TIMSS 1999 assessment. *Child Study Journal, 32*(3).

Judd, C.M., Smith, E.R., & Kidder, L.H. (1991). *Research methods in social relations*. Holt, Rinehart and Winston, Inc. San Francisco.

Loveless, T. (2008). *The misplaced math student: Lost in eighth-grade Algebra*. Brown Center on Educational Policy, The Brookings Institution, Washington, DC.

Luellen, J.K., Shadish, W.R., & Clark, M.H. (2005). Propensity scores: An introduction and experimental test. *Evaluation Review*, Vol. 29, No. 6, 530–558.

Mathews, J. (2008, September 22). Recalculating the 8th-grade Algebra rush*. The Washington Post*, pp. B2.

McGaffrey, D., Hamilton, L., Stecher, B., Klein, S., Bugliari, D. & Robyn, A. (2001). Interactions among instructional practices, curriculum, and student achievement: the case of standards-based high school mathematics. *Journal for Research in Mathematics Education*, *32*(5), 493–517.

Merchlinsky, S. (2007). *The impact of Studying Skillful Teaching 1 (SST1) on Algebra 1 classroom practices.* Rockville, MD: Montgomery County Public Schools.

Modarresi, S., & Wolanin, N. (2007). *The effects of Studying Skillful Teaching training program on students' algebra achievement.* Rockville, MD: Montgomery County Public Schools.

Montgomery County Public Schools. (2003). *Mathematics instructional guide, Math B,* Draft, 2003. Rockville, MD: Author.

Montgomery County Public Schools. (2007). *Curriculum quick reference, mathematics, Math 7/ Math B,* Draft, 2007. Rockville, MD: Author.

Montgomery County Public Schools. (2008). *Our call to action: Pursuit of excellence 2008–2013.* Rockville, MD: Author.

Montgomery County Public Schools. (2009). *Seven keys to college readiness: A parent's resource for grades K–12*. Rockville, MD: Author.

Moran, C. (2003, August 3). A divisive subject: Teaching algebra in eighth grade has advocates and opponents. *San Diego Union Tribune*.

Moses, R. (1995). Algebra, the new civil right. In C. Lacampagne (Ed.), *The Algebra Initiative Colloquium*, Vol. II, 53–67. Washington, DC: U.S. Department of Education.

Rosenbaum, P.R., & Rubin, D.B. (1983). The central role of the propensity score in observational studies for causal effects*. Biometrika, 70,* 41–45.

Rosenbaum, P.R., & Rubin, D.B. (1984). Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American Statistical Association, 79,* 561–524.

Rosenbaum, P.R., & Rubin, D.B. (1985). Constructing a control group using multivariate matched sampling that incorporates the propensity score. *The American Statistician*, *39*, 33–38.

Saphier, J., and R. Gower. (1997). *The skillful teacher: Building your teaching skills*. Acton, MA: Research for Better Teaching.

Shadish, W.R., Cook, T.D., & Campbell, D.T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston, MA: Houghton Mifflin Company.

U.S. Department of Education (USDE). (2008). Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse. *Procedures and standards handbook*. Author. Retrieved from http://ies.ed.gov/ncee/wwc/references/idocviewer/Doc.aspx?docId=19&tocId=1.

Appendix A

Technical Details

The following analyses were done for the following groups of practices or constructs, as measured by the observation instrument:

1. An exploratory factor analysis was applied to the observation indicators for each group of practices. Observers counted the number of times each practice was observed (measured on a scale from zero to six times). The factor extraction method was the principal component with a Varimax rotation. The Scree test (Cattell, 1966) supplemented with Kaiser's criterion determined the number of factors to be extracted from the indicators of each group of practices. Regression techniques were used to calculate the scores on the measures for each of the factors. The factor scores were then placed in variables and saved in the data set for the purpose of multiple regression analysis.

2. The coefficient alpha (Cronbach's alpha) was computed separately for each factor, to ascertain the extent to which the indicators making up a factor share a common core.

3. Multiple regression (MR) analytical procedures were applied to examine whether or not there is a significant relationship between each factor of practices (those extracted from component procedures) and students' mathematics performance as measured by MSA. MR provides estimation of the effect of each factor on MSA scores while holding constant the effect of student characteristics and initial abilities.

This appendix details the first and second analytical procedures.

Findings of Factor and Reliability Analyses

Critical thinking. The principal component procedures produced a fairly interpretable model of critical thinking by reducing the six observation items into two orthogonal factors (Table A-1). The two factors in combination explained 64.3% of the variance of the six observation indicators of Critical Thinking and both had eigenvalues greater than one.

The first rotated factor (eigenvalue = 1.98) accounted for 32.99% of total variance and had high loadings on the following three indicators: "Teacher asks students questions that focus on problem solving strategies and reasoning," "Teacher models thinking process for developing strategies and discovering relationships," "Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing)."

The second factor (eigenvalue = 1.88) explained an additional 31.35% variance and had high loadings for: "Teacher uses real world applications of mathematical concepts," "Teacher presents or demonstrates multiple strategies to students," and "Teacher helps students make connections to prior knowledge." The alpha reliability estimates for both factors are acceptable in the field (.70 for factor 1 and .65 for factor 2) and reported in Table A-1. The scores for the two factors were saved in the data set for the purpose of multiple regression analysis.

Table A-1
Factor Pattern Matrix for Critical Thinking and Questioning Indicators

Indicator	Factor 1 Reliability (Cronbach's Alpha = 0.70)	Factor 2 Reliability (Cronbach's Alpha = 0.65)
1. Teacher asks students questions that focus on problem solving strategies and reasoning.	**0.811**	-0.6
2. Teacher models thinking process for developing strategies and discovering relationships.	**0.753**	0.402
3. Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing).	**0.737**	0.245
4. Teacher uses "real world" applications of mathematical concepts.	-0.044	**0.795**
5. Teacher presents or demonstrates multiple strategies to students.	0.222	**0.731**
6. Teacher helps students make connections to prior knowledge.	0.401	**0.700**

Differentiation, variety, learning styles. The principal component procedures revealed a three factor solution which explained 83.09% of the total variance of the five observation indicators (Table A-2).

The first factor had an eigenvalue of 1.65 and explained the largest proportion of the total variance (32.95%). This factor had similar and high loadings (.897 and .889, respectively) for "Teacher provides differentiated activities, formats, or outcomes, for different groups of students," and "Teacher varies activities, formats, or outcomes to support individual students' learning."

The second factor (eigenvalue = 1.30) accounted for an additional 25.95% of the total variance and had a very high loading (.946) for the following indicator: "Teacher uses a variety of materials and modalities to teach the lesson to the whole class (manipulatives, drawings, paper-and-pencil problem solving, using computers, using books, discussion)." This factor had a moderate loading (.56) for the indicator "Teacher encourages students to try a variety of materials and methods to solve problems or generate responses."

The third factor (eigenvalue = 1.21 explained 24.20% of total variation and had the highest loading (.916) for "Teacher gives students opportunities to make choices about tasks, products, processes, or content." The third factor had a similar loading (.55) as factor 2 for "Teacher encourages students to try a variety of materials and methods to solve problems or generate responses," suggesting the lack of a clear structure for this indicator.

The scores for the three factors were saved in the data set for the purpose of multiple regression analysis. The alpha reliability is relatively high for the first factor (.790) and moderate for the third factor (.525). The internal consistency or the reliability coefficient for factor 2 could not be calculated, since it only had a high loading for one indicator.

Table A-2
Factor Pattern Matrix for Differentiation, Variety, Learning Styles Indicators

Indicators	Factor 1 Reliability (Cronbach's Alpha = 0.790)	Factor 2	Factor 3 Reliability (Cronbach's Alpha = 0.525)
1. Teacher provides differentiated activities, formats, or outcomes, for different groups of students.	**0.897**	-0.086	0.246
2. Teacher varies activities, formats, or outcomes to support individual students' learning.	**0.889**	0.272	0.046
3. Teacher uses a variety of materials and modalities to teach the lesson to the whole class (manipulatives, drawings, paper-and-pencil problem solving, using computers, using books, discussion).	0.057	**0.946**	0.073
4. Teacher encourages students to try a variety of materials and methods to solve problems or generate responses.	0.166	0.562	**0.551**
5. Teacher gives students opportunities to make choices about tasks, products, processes, or content.	0.152	0.077	**0.916**

Formative assessment. A three factor model was produced from the six observation indicators that were employed in the Math 7 classrooms to measure the use of formative assessment (Table A-3).

The first factor (eigenvalue = 2.04) accounted for the highest portion of variation (33.97%) and had loadings for four of the six indicators, ranging from .85 to .55. These indicators were: "Teacher asks direct questions to check for understanding and listening to students' responses," "Visual walk-around and check of homework or work at students' desks," "Every pupil responds/dipsticking/thumbs up," and "Calls students to front of class to solve a problem." The Cronbach's alpha for the four indicators of formative assessment was moderate (alpha = .65).

The second (eigenvalue = 1.10) and the third factor (eigenvalue = 1.09) together accounted for an additional 36.6% (about 18% each) of the total variation. The second factor had a high loading (.91) for "Listen to students discussing in pairs or groups," and the third factor had a similar loading (.87) for the indicator "Asking student to clarify thinking or justify response aloud." The three factors were saved in the data file for further analysis. The second and third factors had loadings for only one indicator; therefore, Cronbach's alpha could not be calculated for these factors.

Table A-3
Factor Pattern Matrix for Formative Assessment Indicators

Indicator	Factor 1 Reliability (Cronbach's Alpha= 0.65)	Factor 2	Factor 3
1. Asking direct questions to check for understanding and listening to students' responses.	**0.85**	-0.04	0.18
2. Visual walk-around and check of homework or work at students' desks (for content, not just that students did something).	**0.73**	0.33	-0.05
3. Every pupil responds/dipsticking/thumbs up.	**0.63**	-0.13	-0.15
4. Calls students to front of class to solve a problem.	**0.55**	-0.37	-0.54
5. Listen to students discussing in pairs or groups.	0.02	**0.91**	-0.01
6. Asking student to clarify thinking or justify response aloud (critical thinking).	0.3	-0.08	**0.87**

Technology. Four indicators constituted the measurement system for use of technology in Math 7 classrooms. Two factors were extracted from the four indicators (Table A-4).

The first factor had an eigenvalue of 2.17 and accounted for 54.13% of the total variance of the four indicators. This factor had high loadings for the following three indicators: “Teacher uses a Smart View (display) calculator with Promethean board or overhead projector as a tool for understanding concepts,” “Teacher has students use calculators as tools for understanding concepts (not just for checking work),” and “Teacher uses internet tools to enhance instruction (e.g., taking students to a problem solving web site, showing a video streamed from the internet).” The Cronbach's alpha for the three indicators was in a moderate/high range.

The second factor (eigenvalue = 1.08) accounted for 26.93% of the variability of the four indicators. Therefore, the cumulative variability explained after the second factor was extracted was 81.06%. Only one indicator, “Teacher uses Promethean board interactively so that students participate (e.g., problem for students to come up and solve, students drag or uncover correct answers, board used for interactive game,” had a high loading (.96) for this factor. Therefore a Cronbach's alpha cannot be computed for this factor.

Table A-4
Factor Pattern Matrix for Teacher Use of Technology

Indicator	Factor 1 Reliability (Cronbach’s Alpha= 0.69)	Factor 2
1. Teacher uses a Smart View (display) calculator with Promethean board or overhead projector as a tool for understanding concepts.	**0.89**	-0.10
2. Teacher has students use calculators as tools for understanding concepts (NOT just for checking work).	**0.81**	0.37
3. Teacher uses internet tools to enhance instruction (e.g., taking students to a problem solving web site, showing a video streamed from the internet).	**0.81**	0.24
4. Teacher uses Promethean board interactively so that students participate (e.g., problem for students to come up and solve, students drag or uncover correct answers, board used for interactive game).	-0.04	**0.96**

Appendix B

Data Collection Materials

- Observation Protocol
- Lesson Log

Observation Protocol Math 7
Fall 2010

LOGISTICS

Observer:	MIDDLE SCHOOL:
Teacher Name: Other adult in room? Who?	
Room Number:	Date of observation:
	[ ] Time One (Oct/Nov) [ ] Time Two (Nov/Dec)
Number of students in this section (see schedule from OASIS): Number of Students Today:	Class period number: ________ From ____:___ to ______:____
Unit and Lesson Taught (if known from e-mails):	Length of period: ____________
NOTE ESSENTIAL QUESTION(S) IF USED:	
How did the teacher communicate the mastery objective or goal of the lesson to students? [ ] written [ ] oral [ ] both **Objective/SWBAT:**	

SUMMARY DESCRIPTION OF LESSON

Sample problems from warm up here:
Sample problems from focus lesson here:

ELEMENTS OF CLASSROOM ARRANGEMENT – BEGINNING OF CLASS

(diagram room here as needed)	Circle all that apply: 1 Promethean Board 2 Computers for student use 3 Desks/tables arranged in rows facing teacher 4 Desks/tables arranged in clusters for group work or activities 5 Math activity centers 6 Other (note below)
Notes here:	
If teacher rearranged students or furniture DURING the lesson, please describe here:	

LESSON COMPONENTS

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

TEACHER USE OF TECHNOLOGY

Indicators of Practice		Number of Times Observed (circle)	Describe How Used:
1	Teacher uses Promethean Board **interactively** so that students participate (e.g., problem for students to come up and solve, students drag or uncover correct answers, Board used for interactive game)	**0 1 2 3 4 5 6+**	
2	Teacher uses a Smart View (display) calculator with Promethean Board or overhead projector **as a tool for understanding concepts**	**0 1 2 3 4 5 6+**	***Note: This was included in the original protocol but was later determined to be not relevant for Math 7, as graphing calculator is not used in Math 7.***
3	Teacher has students use calculators **as tools for understanding concepts** (NOT just for checking work)	**0 1 2 3 4 5 6+**	
4	Teacher uses Internet tools to enhance instruction (e.g., taking students to a problem-solving website, showing a video streamed from the Internet)	**0 1 2 3 4 5 6+**	

INSTRUCTIONAL PRACTICES

Please note evidence of instructional practices.

Indicators of Practice		Number of Times Observed (circle)	Notes/Description/ How Used:
Critical Thinking and Questioning			
1	Teacher models thinking process for developing strategies and discovering relationships	**0 1 2 3 4 5 6+**	
2	Teacher presents or demonstrates multiple strategies to students	**0 1 2 3 4 5 6+**	
3	Teacher helps students make connections to prior knowledge	**0 1 2 3 4 5 6+**	
4	Teacher uses "real world" applications of mathematical concepts	**0 1 2 3 4 5 6+**	
5	Teacher asks students questions that focus on problem-solving strategies and reasoning	**0 1 2 3 4 5 6+**	
6	Teacher reinforces students' use of the language of mathematics (vocabulary, speaking and writing)	**0 1 2 3 4 5 6+**	
Discourse and Group Work			
1	Teacher facilitates student discussions about mathematical concepts and processes	**Yes No evidence**	
2	Teacher has students discuss in groups or pairs ("turn to a partner" or "think pair share")	**Yes No evidence**	
3	Teacher has students work in small groups or pairs to solve problems	**Yes No evidence**	
Classroom Structures That Support Learning			
1	Class ground rules or expectations are posted	**Yes No evidence**	
2	Students appear to know what to do when they come into the room (e.g., find their seat, pick up work at front table) or when they form groups (e.g., find partners, move into groups)	**Yes No evidence**	
3	Students can get textbooks, calculators, ActiVotes, etc. without teacher's help	**Yes No evidence**	
4	Students can drop off completed work and get copies of homework or make-up work without teacher's help	**Yes No evidence**	

DIFFERENTIATION, VARIETY, LEARNING STYLES

Please note evidence of differentiation and supporting different learning styles.

Indicators of Practice		Number of Times Observed (circle)	Notes/Description/ How Used:
1	Teacher provides **differentiated** activities, formats, or outcomes, for different **groups** of students	**0 1 2 3 4 5 6+**	
2	Teacher varies activities, formats, or outcomes to support **individual** students' learning	**0 1 2 3 4 5 6+**	
3	Teacher uses a **variety** of materials and modalities to teach the lesson to the whole class (manipulatives, drawings, paper-and-pencil problem solving, using computers, using books, discussion)	**0 1 2 3 4 5 6+**	
4	Teacher encourages students to try a variety of materials and methods to solve problems or generate responses	**0 1 2 3 4 5 6+**	
5	Teacher gives students opportunities to **make choices** about tasks, products, processes, or content.	**0 1 2 3 4 5 6+**	
6	Teacher has students use strategies or seek resources **other than getting information from the teacher** to solve problems or generate responses	**0 1 2 3 4 5 6+**	

FORMATIVE ASSESSMENT

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

Indicator of Practice		Number of Times Observed (circle)	Notes/Description/ How Used:
1	Visual walk-around and check of homework or work at students' desks (for **content**, not just that students did something)	**0 1 2 3 4 5 6+**	
2	Calls students to front of class to solve a problem	**0 1 2 3 4 5 6+**	
3	**Listens** to students discussing in pairs or groups	**0 1 2 3 4 5 6+**	
4	Every pupil responds/ dipsticking/ thumbs up	**0 1 2 3 4 5 6+**	
5	Asking direct questions to check for understanding and listening to students' responses	**0 1 2 3 4 5 6+**	
6	Asking student to clarify thinking or justify response aloud (critical thinking)	**0 1 2 3 4 5 6+**	
7	Asking questions at a **variety** of levels (recall, comprehension, inference)	**Yes No evidence**	
8	Exit card/Summarizer (get copy)	**Yes No evidence**	

Other evidence that teacher uses formative assessment (describe):

OBSERVER:
Label handouts and Lesson Log from teacher with name of school, teacher, and class period and paper clip to completed observation protocol.

Office of Shared Accountability
Math 7 for Grade 7
Lesson Log

Please complete this log for the four lessons prior to the observed lesson, and give a completed copy to the OSA observer on the day of the visit. Thank you.

Observation date:	
Teacher:	
Middle School:	
Class Period:	

Unit and Lesson	Date of Lesson	Main Topic(s) Today	Materials, Activities and Strategies