



AVON GROVE SCHOOL DISTRICT



Mathematics Task Force Curriculum Review Final Report 2006-2007

**Mathematics Task Force
April 26, 2007**

AVON GROVE SCHOOL DISTRICT

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I. The Policy Environment Influencing the Mathematics Task Force's Work

The last review of the Avon Grove Mathematics Program occurred during the 2000-2001 school year. Since that time, there have been significant changes in the policies governing schools. Some of those policy changes that had a direct influence on the work of the Mathematics Task Force are outlined below.

Pennsylvania's adoption of the Academic Standards for Mathematics that spell out in general terms what mathematics students should know and be able to do as a result of their K-12 education. To make more clear what students need to learn, the Pennsylvania Department of Education (PDE) developed "assessment anchors" that defined more explicitly what knowledge and skills would be assessed by the Pennsylvania System of School Assessment (PSSA) initially in grades 5, 8, and 11; however, in response to requirements of the federal law, No Child Left Behind (NCLB), Pennsylvania now administers assessments of mathematics and reading in every grade between grade 3 and 8, as well as in grade 11.

To help districts and schools interpret the performance of their students on the PSSA, the commonwealth has established performance standards (cut scores) that classify student performance as "advanced," "proficient," "basic," or "below basic." In addition, in response to NCLB's goal that all students graduate high school proficient or advanced in mathematics, as well as its requirement that states create a series of minimum achievement targets that demonstrate how the state will achieve that goal by 2014, Pennsylvania developed the following minimum achievement targets for mathematics:

- 2002-2004: a minimum of **35%** of all students will demonstrate proficiency
- 2005-2007: a minimum of **45%** of all students will demonstrate proficiency
- 2008-2010: a minimum of **56%** of all students will demonstrate proficiency
- 2011: a minimum of **67%** of all students will demonstrate proficiency
- 2012: a minimum of **78%** of all students will demonstrate proficiency
- 2013: a minimum of **89%** of all students will demonstrate proficiency
- 2014: a minimum of **100%** of all students will demonstrate proficiency.

These targets also apply to students that belong to any of the following subgroups: (a) economically disadvantaged students, (b) students from major racial and ethnic groups, (c) students with limited English proficiency, and (d) students with disabilities. (Note: The federal law identifies these four subgroups as the students with which America's schools and districts have been least successful.)

Also, in response to NCLB and as part of its accountability system, Pennsylvania annually identifies schools and districts that do not meet the minimum achievement targets as "in need of school improvement". Under the accountability system, there are increased consequences for schools and districts the longer that they fail to achieve these minimum achievement targets.

To help school and district staffs engage in ongoing school improvement, PDE has developed a number of tools. Tools that were utilized by the Task Force included:

- *e-Metric.* e-Metric is a Web-based tool that staff can use to generate analyses of PSSA data.
- *Getting Results.* Getting Results is a framework to guide improvement planning that suggests the following steps: (a) the analysis of student achievement, (b) the identification of possible causes/explanations for strengths and weaknesses in achievement, (c) the identification of strategies/changes in practice that will maintain strengths and address weaknesses, (d) the development of a work plan for implementing those strategies, and (e) the development of a plan for gathering evidence about the extent to which the work plan is implemented, the changes made in practice, and the intended improvement in student achievement.
- *A standards-aligned instructional system.* Pennsylvania created a vision of what schools and districts need to develop if they are to achieve Pennsylvania’s goal of each student graduating proficient in the core subjects and ready for college and career, regardless of background, “condition” or “circumstance”. Pennsylvania described a “standards-aligned instructional system” as composed, at minimum, of the following six components: (a) clear standards, (b) fair assessments, (c) a standards-aligned curriculum, (d) standards-aligned instruction, (e) supportive instructional materials and resources, and (f) interventions (safety nets) for students not making adequate progress.
- *Resources for interventions.* In addition to resources provided by the federal government to provide interventions that help students not making adequate progress (e.g., funds for supplementary educational services under Title I of NCLB; the 21st Century Program), Pennsylvania now provides state funds for such interventions under the following three programs: the Classroom Plus Program, the Educational Assistance Program, and PA Accountability Block Grants.
- *Response to Intervention (RtI).* The strengthening of the interventions component of a standards-aligned instructional system has been part of the efforts of both federal and state governments to make special education law, policy, and practice aligned with the standards-based educational system envisioned under NCLB. The reauthorized special education law, IDEA 2004, specifically encourages states, districts, and schools to transform general, remedial, and special education into a well integrated system of instruction and interventions. This system is focused on helping all students achieve academic standards and uses data from students’ responses to instruction and interventions to determine the best way to match instruction and interventions to student needs.

II. The Purpose of the Mathematics Task Force and the Organization of the Work

The review of Avon Grove School District's Mathematics Program had two general goals:

- to ensure that the District Mathematics Program is of high rigor and prepares students for the world of work and postsecondary experiences; and
- to ensure that there is alignment among the written, taught, and tested curricula.

The work of the Task Force was organized in three phases.

- Phase I – Review of Academic Achievement: In November and December 2006, the Task Force would review current achievement data to identify strengths and weaknesses in student performance.
- Phase II - Current Instructional Programs and Practices: In January and February 2007, the Task Force would seek to identify possible explanations for weaknesses in student achievement. In particular, it would seek to determine whether students had the “opportunity to learn” the knowledge and skills, given the written, assessed, and taught curricula.
- Phase III – Student and Parent Perspectives on Mathematics Program and Instruction: In March 2007, the Task Force would survey students and parents to obtain their perspectives on the mathematics program and on current practices.

In April 2007, the Task Force would submit a report to the Board of Education, summarizing its findings and proposing plans for work that needs to be implemented to strengthen the mathematics program and improve student achievement.

(Appendix A provides the dates on which the Task Force met and a brief summary of the work that was undertaken on those days.)

III. Results of Analysis of Student Achievement Data

The Task Force primarily used 2006 PSSA data for its analysis of student achievement in mathematics. Specifically, Avon Grove Intermediate School had PSSA data for each of its grades (3 through 6), and Fred S. Engle Middle School had PSSA data for grades 7 and 8. Avon Grove High School had PSSA data for grade 11. Penn London Elementary School did not have PSSA data for their grades (K-2), though it did use PSSA data from grade 3. Penn London did have data from the Terra Nova that was administered to grade 2 students in May 2006.

The analysis of PSSA data was carried out in three steps. First, the distribution of student performance on the entire assessment was reviewed (Table 1). Second, the distribution of student performance by the five reporting categories was reviewed: (a) number and operations, (b) measurement, (c) geometry, (d) algebraic concepts, and (e) data analysis and probability (Table 2). Finally, the distribution of the performance of student subgroups was reviewed (Tables 3 – 6). The Task Force’s general conclusions from these reviews are summarized in this section of the report.

Analysis by Grade of the Distribution of Student Performance on the 2006 PSSA for Mathematics

Table 1 summarizes by grade the distribution of student performance on the 2006 PSSA in mathematics. In general, from grade 3 to grade 8, between 78% and 87% of the students are performing at proficient or advanced levels. On the Grade 11 PSSA, the percent of students performing at proficient or advanced levels decreases to 67%.

Table 1: Distribution by Student Performance on the 2006 PSSA in Mathematics

Grade Tested	Number of Students	% Proficient/Advanced	% Advanced	% Proficient	% Basic	% Below Basic
Grade 3	374	(321) 87%	(227) 60%	(94) 25%	(32) 9%	(21) 6%
Grade 4	399	(353) 88%	(233) 58%	(120) 30%	(26) 7%	(20) 5%
Grade 5	389	(309) 79%	(208) 54%	(101) 26%	(55) 14%	(25) 6%
Grade 6	405	(355) 87%	(257) 64%	(98) 25%	(26) 6%	(24) 6%
Summary for AGIS	1567	(1338) 85%	(925) 59%	(413) 26%	(139) 9%	(90) 4%
Grade 7	455	(389) 85%	(300) 66%	(89) 20%	(28) 6%	(38) 8%
Grade 8	432	(337) 78%	(255) 59%	(82) 19%	(53) 12%	(42) 10%
Summary for FSEMS	887	(726) 82%	(555) 63%	(171) 19%	(81) 9%	(80) 9%
Grade 11	404	(272) 67%	(160) 40%	(112) 28%	(53) 13%	(79) 20%
District Total	2858	(2336) 82%	(1640) 57%	(696) 24%	(273) 10%	(249) 9%

Analysis by Grade of Distribution of Student Performance on the 2006 PSSA for Each of the Five Reporting Categories

Table 2 presents by grade the percentage of students performing at proficient or higher levels with respect to each of the reporting categories

- With respect to the numbers and operations part of the 2006 PSSA, it is important to know that the proportion of PSSA items allocated to this category declines across the grades. To be specific, on the grades 3, 4, and 5 PSSA, between 40% and 50% of the assessment addresses this reporting category, while between grades 6 and 11 that percentage drops from approximately 30% on the grade 6 assessment to approximately 15% on the grade 11 assessment. Table 2 shows the percent of students performing at the proficient or advanced levels varies from a low of 70% in grade 5 to a high of 81% at grade 7. Again, the percent of students in grade 11 performing at the proficient or advanced range decreases significantly to 54%. Numbers and operations was the lowest reporting category for grades 4, 5, and 11.
- With respect to the measurement part of the 2006 PSSA, the proportion of PSSA items allocated to this category is between 12% and 15% across the grades. Table 2 shows the percentage of children performing at the proficient or advanced levels varies from a low of 70% in grade 8 to a high of 84% in grades 4 and 6. Again, the percent of students in grade 11 performing at the proficient or advanced range decreases to the lowest percent across the grade levels at 65%.
- With respect to the geometry part of the 2006 PSSA, the proportion of PSSA items allocated to this category is between 12% and 21% across the grades. Table 2 shows the percent of students performing at the proficient or advanced levels varies from a high of 93% to a low of 71% with the lowest percent being in grade 11. Geometry was the highest reporting category for grades 4, 5, 7, 8, and 11.
- With respect to the algebraic concepts part of the 2006 PSSA, the proportion of PSSA items allocated to this category increases across the grades. To be specific, on the grades 3, 4, and 5 PSSA, between 12% of the assessment addresses this reporting category, while between grades 6 and 11, that percentage increases from approximately 15% to 20% on the grade 6 assessment to approximately 36% to 42% on the grade 11 assessment. Table 2 shows the percent of students performing at the proficient or advanced levels varies from a high of 88% in grade 4 to a low of 62% in grade 11. Algebraic concepts was the lowest reporting category in grades 6 and 7.

- With respect to the data analysis and probability part of the 2006 PSSA, the proportion of PSSA items allocated to this category is also between 12% and 20% across the grades. Table 2 shows the percent of students performing at the proficient or advanced levels varies from a high of 81% in grade 4 to a low of 67% in grade 5. Data analysis and probability was one of the two highest reporting categories for grade 11.

Table 2: Number and Percentages by Grade of Students Performing at Proficient or Advanced Levels in Each of the Five Reporting Categories for the 2006 PSSA in Mathematics

Grade Tested	Number of Students	Numbers & Operations	Measurement	Geometry	Algebraic Concepts	Data Analysis & Probability
Grade 4	399	(304) 76%	(335) 84%	(372) 93%	(351) 88%	(324) 81%
Grade 5	389	(272) 70%	(286) 73%	(307) 79%	(289) 75%	(312) 67%
Grade 6	405	(331) 82%	(339) 84%	(324) 80%	(302) 74%	(312) 77%
Grade 7	455	(368) 81%	(354) 78%	(390) 86%	(354) 78%	(375) 83%
Grade 8	432	(243) 80%	(301) 70%	(359) 88%	(307) 72%	(339) 78%
Grade 11	404	(215) 54%	(260) 65%	(287) 71%	(250) 62%	(285) 71%

Analysis by Grade of Distribution of Student Performance on the 2006 PSSA by Student Subgroup

Each of four tables present a comparison by grade of the performance of the students considered members of one of the NCLB subgroups to the performance of students not considered members of those subgroups.

Table 3 compares by grade the number and percentages of students performing at proficient and higher levels on the 2006 PSSA who are considered to have “disabilities”, to the number and percentages of students who are not considered to have “disabilities.” Table 3 shows that districtwide, only 51% of the students who have “disabilities” are performing at the proficient or advanced levels in mathematics, while 87% of the students without disabilities are performing at the proficient or advanced levels. The percent of students with disabilities performing at the proficient or advanced levels decreases as students move through grades 3 through 11.

Table 3: Comparison of Performance on the 2006 PSSA in Mathematics of Students Who Have and Do Not Have "Disabilities"

Grade Tested	Number of Students	# and % of Students without Disabilities	# and % of Students with Disabilities	# and % of Students without Disabilities Performing at Proficient or Advanced Levels	# and % of Students with Disabilities Performing at Proficient or Advanced Levels
Grade 3	(374)	(327) 87%	(47) 13%	(286) 87%	(35) 74%
Grade 4	(399)	(341) 85%	(58) 15%	(311) 91%	(42) 72%
Grade 5	(389)	(339) 87%	(50) 13%	(284) 84%	(25) 50%
Grade 6	(405)	(345) 85%	(60) 15%	(317) 92%	(38) 63%
Summary for AGIS	(1567)	(1352) 86%	(215) 14%	(1198) 89%	(140) 65%
Grade 7	(455)	(398) 87%	(57) 13%	(363) 91%	(26) 46%
Grade 8	(432)	(354) 82%	(64) 18%	(314) 85%	(123) 36%
Summary for FSEMS	(887)	(752) 85%	(121) 17%	(677) 88%	(49) 41%
Grade 11	(404)	(342) 85%	(62) 15%	(260) 76%	(12) 19%
District Total	(2858)	(2446) 86%	(398) 14%	(2135) 87%	(201) 51%

Table 4 compares by grade the number and percentages of students performing at proficient and higher levels on the 2006 PSSA who are considered to be “English Language Learners” to the number and percentages of students who are not considered “English Language Learners.” Table 4 shows that district-wide only 28% of the ELL students in the district are performing at the proficient or advanced levels in mathematics. This percentage remains relatively consistent across the grade levels with the exceptions of grades 4 and 7 where between 44% and 42% of the students are performing at the proficient or advanced levels.

Table 4: Comparison of Performance on the 2006 PSSA in Mathematics of Students Who Are and Are Not English Language Learners

Grade Tested	Number of Students	# and % of Non-ELL Students	# and % of ELL Students	# and % of Non-ELL Students Performing at Proficient or Advanced Levels	# and % of ELL Students Performing at Proficient or Advanced Levels
Grade 3	(374)	(351) 94%	(23) 6%	(316) 90%	(5) 22%
Grade 4	(399)	(383) 96%	(16) 4%	(346) 90%	(7) 44%
Grade 5	(389)	(371) 95%	(18) 5%	(215) 82%	(4) 22%
Grade 6	(405)	(395) 98%	(10) 2%	(353) 89%	(4) 20%
Summary for AGI	(1567)	(1500) 96%	(67) 4%	(1320) 88%	(18) 27%
Grade 7	(455)	(436) 96%	(19) 4%	(381) 87%	(8) 42%
Grade 8	(432)	(423) 98%	(9) 2%	(35) 79%	(2) 22%
Summary for FSEMS	(887)	(859) 97%	(28) 3%	(719) 83%	(10) 36%
Grade 11	(404)	(393) 97%	(11) 3%	(270) 69%	(2) 18%
District Total	(2858)	(2752) 96%	(106) 4%	(2306) 84%	(30) 28%

Table 5 compares by grade the number and percentages of students performing at proficient and higher levels on the 2006 PSSA who are considered “economically disadvantaged” to the number and percentages of students who are not considered “economically disadvantaged.” Table 5 shows that district-wide only 53% of the students identified as economically disadvantaged are performing at the proficient or advanced levels. This percentage fluctuates across the grade levels between 43% and 69% with the exception of grade 11 where only 22% of the economically disadvantaged students are performing at the proficient or advanced levels.

Table 5: Comparison of Performance on the 2006 PSSA in Mathematics of Students Who Are and Are Not Economically Disadvantaged

Grade Tested	Number of Students	# and % of Students Who are Not Economically Disadvantaged	# and % of Students Who Are Economically Disadvantaged	# and % of Non-Economically Disadvantaged Students Performing at Proficient or Advanced Levels	# and % of Economically Disadvantaged Students Performing at Proficient or Advanced Levels
Grade 3	(374)	(318) 85%	(56) 15%	(292) 92%	(29) 52%
Grade 4	(399)	(331) 83%	(68) 17%	(306) 92%	(47) 69%
Grade 5	(389)	(328) 84%	(61) 16%	(283) 86%	(26) 43%
Grade 6	(405)	(354) 87%	(51) 13%	(324) 92%	(31) 61%
Summary for AGIS	(1567)	(1331) 85%	(236) 15%	(1205) 91%	(133) 56%
Grade 7	(455)	(392) 86%	(63) 14%	(350) 89%	(39) 62%
Grade 8	(432)	(375) 87%	(57) 13%	(308) 82%	(29) 51%
Summary for FSEMS	(887)	(767) 86%	(120) 14%	(658) 86%	(68) 57%
Grade 11	(404)	(364) 90%	(40) 10%	(263) 72%	(9) 22%
District Total	(2858)	(2462) 86%	(396) 14%	(2126) 86%	(210) 53%

Table 6 compares by grade the number and percentages of students performing at proficient and higher levels on the 2006 PSSA who are considered to be members of “major racial and ethnic groups” to the numbers and percentages of students who are not considered to be members of “major racial and ethnic groups.” Table 6 shows that district-wide only 56% of the students from the “major racial and ethnic groups” are performing at the proficient or advanced levels in mathematics.

Table 6: Comparison of Performance on the 2006 PSSA in Mathematics of Students Who Are Members and Who Are Not Members of Major Racial Groups

Grade Tested	Number of Students	# and % of Students Who are Not Members of Major Racial Groups	# and % of Students Who Are Members of Major Racial Groups	# and % of Students Not From Major Racial Groups Who Are Performing at Proficient or Advanced Levels	# and % of Students From Major Racial Groups Who Are Performing at Proficient or Advanced Levels
Grade 3	(374)	(307) 82%	(67) 18%	(279) 91%	(42) 63%
Grade 4	(399)	(318) 80%	(81) 20%	(293) 92%	(60) 74%
Grade 5	(389)	(319) 82%	(70) 18%	(276) 87%	(33) 47%
Grade 6	(405)	(346) 85%	(59) 15%	(318) 92%	(37) 63%
Summary for AGIS	(1567)	(1290) 82%	(277) 18%	(1166) 90%	(172) 62%
Grade 7	(455)	(380) 84%	(75) 16%	(348) 92%	(41) 51%
Grade 8	(432)	(363) 84%	(69) 16%	(302) 83%	(35) 51%
Summary for FSEMS	(887)	(743) 84%	(144) 16%	(650) 87%	(76) 53%
Grade 11	(404)	(344) 85%	(60) 15%	(249) 73%	(23) 38%
District Total	(2858)	(2377) 83%	(481) 17%	(2065) 87%	(271) 56%

Analyses Conducted by Schools

The above analyses provide a general picture of strengths and weaknesses in student performance. Each school team on the Task Force was able to begin to probe more deeply the meaning of PSSA data.

Some schools also used data from 4Sight formative assessments to identify at more specific levels the strengths and weaknesses in student performance; these assessments are aligned to the PSSA, but are administered three to five times a year in grades 3 through 8 and 11 to provide teachers information on the progress that individual students are making with respect to specific assessment anchors/eligible content. Some schools also examined data from common assessments that students took in specific courses. In general, these assessments either came as part of a school's instructional program, or had been developed by teachers for particular mathematics courses.

In addition, school teams compared and contrasted the performance of students by course and class. Some schools actually identified individual students within a grade that exhibited similar patterns of performance.

IV. Exploration of Possible Explanations/Root Causes for Weaknesses in Student Performance

Having identified weaknesses in student performance, school teams brainstormed possible explanations/reasons why students would not be able to demonstrate proficiency with respect to particular content, and then, to set priorities as to which explanations needed to be addressed first.

Curriculum-Related Explanations

The first set of explanations identified had to do with the district's/school's mathematics curriculum – that is, the extent to which the content that was not being learned by some students was actually addressed by the district's (a) written curriculum, (b) assessed curriculum, and (c) taught curriculum.

Written Curriculum

The written curriculum is primarily found in two documents: (a) Planned Course Outlines (PCO) and (b) Pacing Guides. Based on the review of these documents for their grades, school teams determined, to various degrees, that:

- some of the eligible content set forth in the Pennsylvania standards/assessment anchors was not described explicitly in the current PCOs;
- existing Pacing Guides did not describe when the content was to be taught nor did they provide estimates as to what time should be allocated to the teaching of that content; and
- Pacing Guides did not exist for some courses.

Assessed Curriculum

What students needed to learn can be clarified by the assessments that are used to determine the extent to which students are learning particular content. True to that understanding, Pennsylvania assessment anchors not only define the content that can be assessed on the PSSA, but also provide examples of types of items that can be used to assess the learning of that content. School teams reviewed the extent to which there were assessments that staff were using to track student learning of the content that was not being demonstrated on the PSSA. School teams found gaps in current available assessments (e.g., those provided by 4Sight, those coming with a particular instructional program, those common assessments that had been developed by the teachers who taught particular courses); they also found variations in the extent to which teachers administered those assessments, analyzed the data resulting from those assessments, and used the analysis to inform their instruction.

Taught Curriculum

The fact that there is a written curriculum and even an assessed curriculum does not necessarily mean that the curriculum is taught. School teams initially reviewed instructional textbooks and other materials to determine whether they adequately addressed the content that some students

were not able to demonstrate on the PSSA. In some cases, those teams concluded that current instructional materials were inadequate.

One school team also surveyed all teachers, asking them individually to note for each item of “eligible content” that would be addressed on the PSSA whether that content had been: (a) taught and assessed before PSSA,” (b) “taught, but not assessed before PSSA,” (c) “taught after PSSA,” or (d) not taught or assessed it this year.” That team determined that there was a great deal of variation in the teachers’ responses to these items, suggesting that the taught curriculum varied by teacher/classroom.

Another school team surveyed their teachers and students about the extent specific learning activities and resources were used – specifically, (a) “use of hands on materials (e.g., calculators, counting blocks, rulers, protractors, geometric solids, etc.),” (b) “opportunities to practice (i.e., centers, problems from the book, games, computers, etc.) and to get explanations for problems they may have difficulty understanding,” (c) “opportunities to work alone and with others to explore and solve problems.” This team determined that there was a great deal of variation in teachers’ responses and between teachers’ and students’ responses, suggesting that instructional activities varied by teacher/classroom.

Learning-Related Explanations

Several school teams surveyed their students about how they did homework and studied for tests. Given the variation in student responses, these teams concluded that a significant number of students had not been taught explicitly how one needs to do homework if one is to learn from it, and similarly how best to study for a test.

Explanations Related to Individual Student Differences

Every teacher is aware that students differ in (a) the knowledge and skills they bring to new learning tasks, (b) the time they need to learn specific content well, and (c) the ways in which they learn best. The challenge for teachers is how to differentiate their learning activities and instructional supports, so that every student has an appropriate opportunity to learn the desired content.

Every teacher is also aware that some students have learning problems that are sufficiently complex and cannot be successfully addressed in the regular class setting and/or within available class time. For such students, supplementary instruction is required that can be delivered during the school day or in after-school, weekend, or summer programs.

Finally, every teacher is also aware that s/he can have a small number of students who are far behind grade level and who need a comprehensive curriculum that helps them to accelerate their learning.

The data on the performance of the subgroups suggested the need for a district-wide strategy for providing the supplementary educational activities that would significantly increase the level performance of those students.

V. School Site Recommendations and Work Plans

Each school team has developed work plans to address the explanations in ways that promise to improve student achievement with respect to specific PA Assessment Anchors. This section summarizes those plans.

Penn London Elementary School's Proposed Work Plan

Achievement problems/challenges and related improvement goals

A significant number of Penn London students are not able to demonstrate:

- fluency in basic math operations at the level that is the goal of the school;
- fluency in numeral writing that is a prerequisite skill for demonstrating fluency on timed tests requiring written responses; and
- mastery of the prerequisite skills needed to be proficient in the eligible content, specifically by the at-risk population.

Penn London team's goal is to increase the number and percentage of its students who can demonstrate such skills and understandings.

Explanations for the problems/challenges and proposed changes in practice

The Penn London team identified the following possible explanations for current student performance:

- many students do not have the opportunity to engage in the kinds of frequent practice needed to do the basic math operation at a high level of fluency;
- many students have not had the kind of instruction and practice opportunities to develop fluency in numeral writing needed to perform well on timed basic math fact tests;
- many students have not received explicit instruction on how to demonstrate the conceptual understanding that they have developed in paper and pencil activities; and
- at-risk students require more intensive instruction in prerequisite skills and grade appropriate skills and require more time to achieve mastery of these skills.

The team's plan is to ensure that students have those practice opportunities and that they receive the needed instruction.

Specific activities to implement the proposed changes in practice

1. To ensure that students have multiple opportunities throughout the day to practice basic addition and subtraction facts, Penn London staff will: (a) schedule math fact practice multiple times a day, (b) recruit and train parent, community volunteers, and paraprofessionals to help implement the Mastery Math Facts program and related *Investigations* activities during the school day, and (c) during its Math Night, demonstrate and inform parents about the kinds of practice opportunities they could provide their children at home.

The teachers will provide explicit strategy instruction related to the learning of basic addition and subtraction facts. To do this well, the staff will: (a) clarify the vocabulary that will be used in presenting the strategies, (b) relate the strategies explicitly to the Mastery Math Facts program, (c) model the use of the strategies as part of their instruction, (d) involve their students in guided practice on the use of the strategies, and (e) provide helpful feedback to students whenever they use specific strategies.

2. To help students develop fluency in numeral writing, the Penn London team will: (a) obtain guidance from the Intermediate Unit Occupational Therapy staff with respect to strategies that can help their young students develop such skills, (b) train its teachers in how to implement the Mastery Math Numerals program with their students, and (c) provide additional assistance to the teachers as they pilot that program.
3. To help students learn how to demonstrate knowledge in multiple formats, including paper and pencil tasks, Penn London staff will teach students how to communicate their understanding of math concepts through the use of a “think aloud” process. Specifically, teachers will: (a) model the process, (b) involve students in guided practice of the use of the process, and (c) provide students feedback on their actual use of the process.

Teachers will also explicitly teach students how to demonstrate their conceptual knowledge in multiple formats – for example, performances, paper and pencil tasks and projects, etc. Specifically, teachers will (a) develop examples of multiple response formats, (b) model and display responses to such formats, (c) revise assessments to reflect both performance and paper-pencil type tasks, and (d) provide students opportunities to practice doing such tasks.

4. To narrow the achievement gap for at-risk students, Penn London staff will reduce the number of deficit prerequisite skills, thereby enabling students to progress on grade appropriate skills. Specifically, teachers will (a) identify essential skills at each grade level, (b) develop activities to support essential skills, (c) identify opportunities for

repeated practice in the pacing guides, and (c) provide additional, small group, intensive instruction and remediation.

Types of resources needed

- Stipends for professional development time for training and curriculum development
- Mathematics Coach
- Mastering Mathematics Numerals Program
- Paraprofessional Support (2 per grade)
- Allocation of funds (state/district) to support a pilot full day Kindergarten Program
 - 4 classes of 12-15 students per class
 - 2 full time teachers
 - Space for additional classes
 - Equipment to furnish 2 classrooms
 - Instructional materials

Avon Grove Intermediate School's Proposed Work Plan

Achievement problems/challenges and related improvement goals

As a result of its analysis of PSSA and other data, AGI has identified with respect to each of the five PSSA reporting categories specific knowledge and skills on which it would like to improve student performance.

Explanations for the problems/challenges and proposed changes in practice

AGI identified four principal explanations for the problems identified:

- The current written and assessed curricula have gaps and ambiguities that need to be addressed if teachers are to have clear directions and supportive resources to teach a curriculum well-aligned to the Pennsylvania mathematics standards and assessment anchors.
- There is not a systematic program within each grade level to provide individual and small groups of students the additional time and instructional support that they need to master specific math concepts and skills.
- There is considerable variability in teacher knowledge and skills to teach AGI's challenging mathematics program, primarily due to significant numbers of relatively new teachers (60% of AGI classroom teachers have been in the district less than three years) and the lack of an ongoing professional development program to ensure that teachers have the knowledge and skills required by the program.
- The steady growth in size of AGI classes is constraining teachers' abilities to plan and implement differentiated instruction in ways that ensure that all students get the kinds

of support within the regular classroom and mathematics periods that enables them to make progress.

Specific activities to implement the proposed changes in practice

1. To address the gaps and ambiguities in the written and assessed curricula, AGI proposes to update Planned Course Outlines and the Pacing Guides, revise common assessments, and identify and acquire supplementary instructional materials needed.
2. Create remediation and enrichment workshops for mathematics that will meet for one half-hour daily.
3. Create and implement a professional development program that strengthens teachers' knowledge and skill at (a) using revised Planned Course Outlines and Pacing Guides to inform their instructional plans, (b) implementing *Investigations* and *Connected Math* programs with their students, (c) designing and implementing "inquiry-based learning," and (d) analyzing and interpreting data from assessments that helps them plan instruction for all students, including the differentiation of their instruction, and specific remediation and enrichment activities for students that need them.

Types of resources needed

- Stipends for professional development for training and curriculum development
- Supplemental instructional materials for intervention and enrichment
- Paraprofessional support to provide remediation and enrichment
- Mathematics Coach (2)

Fred S. Engle Middle School's Proposed Work Plan

Achievement problems/challenges and related improvement goals

- As a result of its analysis of PSSA and 4Sight data, the Fred S. Engle (FSE) team determined that there was too much variability in student performance with respect to the eligible content summarized under the five PSSA reporting categories.
- The team, adopted an improvement goal that sets forth their desire to make steady improvement in the numbers of students that improve their levels of performance with respect to each of the five PSSA reporting categories over an academic year (e.g., students currently performing at the "below basic" level begin to perform at the "basic" level, students performing at the "basic" level begin to perform at the "proficient" level, and students performing at the "proficient" level begin to perform at the "advanced" level).

Explanations for the problems/challenges and proposed changes in practice

- The FSE team concluded from its teacher surveys that teachers were not teaching in a consistent and rigorous way all of the eligible content that was described in Pennsylvania mathematics standards and assessment anchors for 7th and 8th grade mathematics. In trying to understand possible reasons for the variability in what is being taught, it became clear that the written curriculum for the three levels of courses offered in each middle school grade (e.g., Planned Course Outlines) did not include all of the eligible content, that there were no pacing guides to help teachers allocate class time most effectively, that there were no common course assessments that would clarify for teachers what students really needed to know and be able to do, and that there were significant gaps in the current textbooks and other instructional materials with respect to specific eligible content. The FSE team decided that they first needed to address these possible reasons of inconsistent instruction with respect to the eligible content.

Specific activities to implement the proposed changes in practice

The FSE team proposed the following six-part plan to ensure more consistent instruction with respect to the eligible content for grades 7 and 8.

1. Revise the Planned Course Outlines for each of the six courses to ensure that irrespective of the level of difficulty of the course that students take, the grade level eligible content will be addressed. Consistent with this goal, there will no longer be a general math, rather it will be both renamed and redesigned as a Basic Pre-Algebra course.
2. Create Pacing Guides for each course, designed to help teachers allocate time to eligible content in a consistent manner.
3. Based on the revised Planned Course Outlines, determine the extent to which some courses may need new textbooks and/or supplementary materials to adequately address the eligible content.
4. Create common assessments that clarify for teachers what students must know and learn to do, track student progress in acquiring the eligible content and achieving specific standards, and help teachers to determine which students may need additional help to learn additional content.
5. Provide professional development and in-class assistance that will help teachers use the revised Planned Course Outline, new Pacing Guides, new common assessments, and new instructional materials to plan and provide their students consistent instruction with respect to all of the eligible content that 7th and 8th grade students need to learn.
6. Plan for possible revisions to the above based upon feedback from teachers and evidence provided on the common assessments and the 2007 PSSA in mathematics.

Types of resources needed:

- Stipends for professional development for training and curriculum development
- Mathematics Coach
- Grade 7 Supplanted Mathematics Course Instructional Materials/Textbooks
- Grade 7 General Mathematics Course Textbooks
- Grade 8 Intro to Pre Algebra Textbooks

Avon Grove High School's Proposed Work Plan

Achievement problems/challenges and related improvement goals

The high school team chose to address two achievement problems of quite different scope.

- The first achievement problem addresses eligible content with respect to measurement on which students have performed consistently low over the last few years – namely, students are unable to calculate or analyze various relationships and properties of geometric figures presented on the Grade 11 PSSA. The intent of the High School team is to take steps that ensure that grade 11 students can perform at a proficient or higher level with respect to this eligible content on the PSSA.
- The second achievement problem addresses the fact that a substantial number of students (approximately 30%) are not able to demonstrate the knowledge and skills described by the assessment anchors for the grade 11 PSSA. In general, these students enroll as 9th grade students in below grade level courses, because they enter high school without having demonstrated the prerequisite skills for grade level courses. The intent of the high school team is to take steps that ensure that no 9th grade student can enroll in a course that does not address the eligible content, thereby increasing the numbers of students who can perform at a proficient level or higher on the grade 11 PSSA.

Explanations for the problems/challenges and proposed changes in practice

Though the first two achievement problems are different in scope, the High School team believes that the primary reason for students not being able to demonstrate specific eligible content is that they were not taught the content.

- With respect to the measurement problem, the team designates Geometry teachers as accountable for teaching the targeted eligible content – that is, providing explicit instruction in the use of the appropriate methods for calculating perimeter, area, volume, surface area, etc. Additionally, both teachers and students will use data from common assessments to determine the strengths and weaknesses in their learning and in the teaching. Students and teachers will work collaboratively to decide what instruction and what practices are needed to address identified weaknesses in student performance.

- With respect to the significant number of students not receiving instruction in eligible content, starting in the fall, all high school courses will address the appropriate eligible

content for their grade level. Not only will the content be taught, but common assessments will also be used to help teachers and students track student progress in learning the content and in planning how they will work together to address weaknesses in learning identified through those assessments.

Specific activities to implement the proposed changes in practice

The specific activities that will be undertaken to ensure that eligible content is taught include:

1. Revise the Planned Course Outlines, so that they include the eligible content, and develop Pacing Guides that help teachers to cover that content before the grade 11 PSSA.
2. Develop common assessments needed to monitor student progress and inform future instruction and support.
3. Provide teachers with the supplementary instructional materials needed to help them teach and to help their students to learn the eligible content.
4. Ensure that the teachers responsible for teaching the eligible content receive professional development that helps them to understand:
 - a. the revised PCOs and their implications for instruction;
 - b. the purpose, structure, and use of the Pacing Guide;
 - c. how to use the new supplementary instructional materials; and
 - d. how to administer the common assessments, and involve students in the process of using data from the assessments to inform both the teaching they receive and their activities to learn the content.
5. Implement support programs for all students performing below grade level.

Types of resources needed:

- Stipends for professional development for training and curriculum development
- Mathematics Coach
- HS Mathematics Seminar Textbooks (Phase I)
- HS Basic Geometry Textbooks (Phase I)
- HS Geometry Textbooks (Phase I)
- HS Honors Geometry Textbooks (Phase I)
- HS Basic Algebra II (Phase I)

- HS Trig/PreCalculus (Phase II)
- HS Calculus & AP Calculus (Phase III)
- HS AP Statistics (Phase III)

- Full time teacher to support Mathematics Seminar

[Note: The high school team proposed a third achievement problem that needs to be addressed – namely, that a substantial number of students do not graduate high school with the mathematical skills that they will need to be successful in a demanding post-secondary program. In presenting this problem, the high school team stated its belief that it could steadily increase the numbers of students who graduate high school with the mathematics knowledge and skills that they need to be successful in a demanding post-secondary program.

District leadership believes that the high school team has highlighted a potentially very serious problem that needs to be addressed. Solving this problem will require a collaborate effort of both middle school and high school staff, District leadership, the Board of Education, and parent representatives. Therefore, it is included as #4 in Section VI of this Report.]

VI. Districtwide Recommendations to Improve the Effectiveness of the Avon Grove Mathematics Program

The Mathematics Task Force accomplished its purpose to determine how the district's schools could increase the alignment of the written, assessed, and taught curricula with each other and the alignment of those curricula to the knowledge and skills described by Pennsylvania, thereby improving students' opportunity to learn critical content. Over the course of its work, other strategies were identified that could improve Avon Grove's students' performance in mathematics. Here are four strategies that the Mathematics Task Force recommends the District to pursue.

1. **Ensure highly effective standards-aligned instruction occurs in every mathematics class** by making provision for the Mathematics Task Force to develop a multi-year professional development program that ensures that instruction in all classrooms is standards-aligned and increasingly effective.

Rationale: As reflected in the School Work Plans, most of the proposed efforts are for revising the curriculum (i.e., Planned Course Outlines, Pacing Guides) so that they address the Pennsylvania Mathematics Standards and Assessment Anchors and as a result, can be used to increase the alignment among the written curriculum, the assessed curriculum, and the taught curriculum.

During the work of the Task Force, there were beginning conversations about different ways of looking at instruction and about what makes "instruction" a critical component of an effective standards-based educational system.

Recommendation: The Task Force recommends that some time should be set aside in the coming school year to investigate this topic and determine whether a possible important focus of a district-wide professional development activity should be: *What does standards-aligned instruction look like in the classroom, and what knowledge and skills do teachers need to plan and provide such instruction in their classrooms?*

Resources needed to implement this recommendation:

- Stipends for professional development planning/development/training
 - Mathematics Coaches to implement professional development
 - Allocation for funds for consultants and NCTM trainers
2. **Provide a system of supplementary educational interventions,** that is, develop a district-wide approach to providing supplementary educational interventions for students needing additional instruction and supports beyond what can be provided through the regular program.

Rationale: Another critical component of a standards-aligned education system addresses the question: *What do we do when a student is not making adequate progress toward learning the knowledge and skills described by specific academic standards?* We know how a non-standards-based educational system answers that question: *“Accept that lack of progress as a fact of life and proceed to cover the content that you need.” “Give the student an “F.” “Make the student repeat the course/the grade.” “Refer the student to Special Education”.*

We know those answers do not reflect a standards-based system that wants every student to be successful in learning the knowledge and skills described by Pennsylvania’s academic standards. In the context of a standards-aligned educational system, the answers are different: *“Do something different.” “Ask for help from colleagues, parents and even the student to figure out how best to help the student to learn and to make progress.” “Turn to research for clues as to what practices might work.” “Whatever, do not ignore the problem; do not give up on trying to identify an intervention that will help the student make progress.”*

Consistent with these answers is *Response to Intervention*, the practice of using data about how the student responds to specific educational interventions to inform the design of future interventions – a practice encouraged in the reauthorized Special Education law, IDEA 2004.

Recommendation: To design an effective system of interventions to help students who are not making adequate progress requires a collaborative effort of regular education, remedial education, and special education leadership and staff. The Mathematics Task Force recommends that such an effort be initiated with appropriate external assistance from possibly an Intermediate Unit, PaTTON, and/or a school district that has designed an effective system of educational interventions.

Resources needed to implement this recommendation:

- Stipends for professional development training and curriculum work
- Allocation of funds for consultants, conferences, and other professional development activities
- Special Education Instructional Coach/ELL Instructional Coach
- Allocation of funds for instructional materials/resources to provide intervention to students
- Teachers and paraprofessionals to provide the support and interventions

3. **Address more effectively the needs of ELL students.**

Rationale: It was clear to the Mathematics Task Force that there is a need to improve the mathematics performance of ELL students (See Section III, Table 4). In response, the Task Force was shared information about the district’s effort to (1) put in place strategies that will strengthen how all schools work with ELL students and their families, and (2) provide all teachers with the knowledge and skills to plan lessons that take into account the English language skills of the students in their classes. The Task Force concluded that for this year, it

did not have time to address the problem of ELL mathematics performance well; however, that it should highlight this need in its report.

Recommendation: The Task Force recommends that as the district determines the mix of strategies that it will utilize to improve ELL students' achievement, it will ensure that those strategies address the professional development that teachers of mathematics at all levels will need to be more effective with the ELL students in their classes.

Resources needed to implement this recommendation:

- Stipends for professional development training and curriculum work
- Allocation of funds for consultants, conferences, and other professional development activities
- ELL Instructional Coach
- Allocation of funds for instructional materials/resources to provide support for ELL students
- Teachers and paraprofessionals to provide the support and interventions

4. Increase the number of students who graduate with the mathematical knowledge and skills that they will need to be successful in demanding postsecondary educational programs and careers.

Rationale: As was noted in the end of the previous section, the high school team identified the problem that significant numbers of students are graduating high school without the mathematical knowledge and skills needed to be successful in postsecondary schooling. The identification of this problem recognizes: (a) Pennsylvania standards and assessment anchors describe what all students need to know and be able to do by March of their junior year, but (b) what students need to know and be able to do to succeed in post-secondary schooling is reflected best by the mathematical knowledge and skills taught in the most advanced courses that the high school offers and which are taken only by small numbers of students.

The Task Force read a longitudinal study of a school district's effort to increase the numbers of students, including students from less advantaged circumstances, taking and successfully completing advanced mathematics courses in high school (see Appendix D for an article summarizing the results of the study). This study described the effort as involving the following major strategies: (a) the development of an accelerated three-year course sequence (grades 6 through 8) that all students took and that ensured that most students learned the knowledge and skills associated with Algebra I by the time they left grade 8, (b) providing alternate-day support classes, known as mathematics workshops, to help struggling students succeed in the accelerated program, (c) having both accelerated and workshop classes taught by all mathematics teachers, and (d) establishing common preparation periods for the math teachers. The study followed several cohorts of students for six years. The study showed that the numbers of students taking higher level courses in high school increased significantly, that the number of students from less advantaged circumstances taking such courses also increased, and that there was a decline in the numbers of students that stopped

taking mathematics course during their high school years. From the perspective of the Task Force, this study suggested that a district like Avon Grove could increase the number of students that are successfully completing advanced mathematics courses.

Recommendation: The Task Force recommends that a work group be formed to address this problem and that through its work, it considers:

- identifying explicitly what are the mathematical knowledge and skills that Avon Grove students should ideally acquire, in order to be successful in demanding post-secondary schooling;
- determining currently how many students it is graduating with such knowledge and skills;
- exploring ways of creating course sequences that would enable many students to acquire such knowledge and skills;
- exploring ways of ensuring that the supplementary educational supports are available to help students whenever they find themselves not mastering critical knowledge and skills being taught in math classes;
- identifying the kinds of educational planning that students and their parents need to undertake with the support of school staff during their secondary years (grades 6 through 12), in order to create goals for their immediate educational program, while at the same time, keeping their options open as to what educational futures they might achieve; and
- determining how policies governing graduation and course requirements might need to evolve to be supportive of this effort.

Resources needed to implement this recommendation:

- Stipends for professional development for curriculum and committee work
- Allocation of funds for staffing/textbooks/instructional materials that will be necessary based upon the recommendations of the committee to be formed.

Appendix A: Summary of Mathematics Task Force Meetings

Phase I: Academic Achievement

- **November 2, 2006**

The first meeting of the Mathematics Task Force focused on (a) an overview of the charge of the Task Force, (b) a review of resources and materials to assist the Task Force with the work, and (c) a review of the process for data analysis that would be utilized. The Task Force began the process of examining various achievement data sources to identify strengths and weaknesses that were apparent as a result of this analysis. Task Force members also began to probe for possible explanations/causes for the trends and patterns in student achievement that were becoming apparent. The school teams were charged with completing this process with their colleagues in their schools prior to the December meeting.

- **December 18, 2006**

The second meeting of the Mathematics Task Force focused on the reporting out by schools of the analyses of strengths and weaknesses in student learning and achievement related to the PA mathematics standards. The Task Force explored possible explanations for the causes of the trends and patterns in student achievement that were becoming evident. Possible explanations explored included students opportunity to learn, specifically (a) curriculum explanations, (b) learning theory explanations, and (c) quality of instruction explanations. Additional explanations examined student-related issues such as (a) prerequisites explanations, (b) response to intervention explanations, and (c) time explanations. School teams were charged with completing this process of exploring causes/explanations for the data trends and patterns prior to the January meeting.

Phase II: Instructional Practices & Programs

- **January 8, 2007**

The third meeting of the Mathematics Task Force focused on a review of the explanations for the trends and patterns of student mathematics achievement across the schools and District. The committee then began to probe into the opportunity to learn explanations. The Task Force began the process of analyzing the written curriculum in relationship to the achievement data. The written curriculum included the Planned Course Outlines, the Pacing Guides, and the instructional materials and resources. School teams were charged with carrying out this review of the written curriculum back in their schools prior to the February meeting.

- **February 8, 2007**

The fourth meeting of the Mathematics Task Force focused on gathering data regarding the written and tested curriculum across the District as related to achievement data. The Task Force began to explore strategies for investigating the taught curriculum. School teams began the process of identify strategies that they would pilot in their schools for assessing the taught curriculum (e.g., teacher surveys, student surveys, focus groups, walk

throughs, etc.). School teams were charged with the development and implementation of their survey instruments prior to the March meeting. Several members of the Task Force visited the Penn Delco School District to explore their process for conducting walkthroughs as a means of monitoring the taught curriculum.

Phase III: Student/Parent/Teacher Perspectives

- **March 22, 2007**

The final meeting of the Mathematics Task Force focused on sharing of the data schools collected related to the taught curriculum. The school teams began the process of defining their school recommendations and work plans based upon the work of the Task Force over the previous months.

Appendix B: Resource List for 2007-2008

	PENN LONDON	AGI	FEMS	AGHS	DISTRICT
STAFFING					
Mathematics Coach	X	X (2)	X	X	
Paraprofessional Support (2 per grade level)	X				
Teachers (2) - Full Time (K Pilot)	X				
Teacher HS Mathematics (Seminar)				X	
ELL Coach/Special Education Coach					X
MATERIALS/RESOURCES					
Mastering Math Numerals Program (K-2)	X				
Supplementary Instructional Materials		X		X	
TEXTBOOKS					
MS Grade 7 Supplanted Text			X		
MS Grade 7 General Math Text			X		
MS Grade 8 Basic PreAlgebra			X		
HS Math Seminar (Phase I)				X	
HS Honors Geometry (Phase I)				X	
HS Geometry (Phase I)				X	
HS Basic Geometry (Phase I)				X	
HS Basic Algebra II (Phase I)				X	
HS Algebra III/Trig (Phase I)				X	
HS Algebra II (Phase II)				X	
HS Trig/PreCalc (Phase II)				X	
HS Calculus & AP Calculus (Phase III)				X	
HS AP Statistics (Phase III)				X	
PROFESSIONAL DEVELOPMENT					
Stipends for PD/Curriculum Work (PCO/Pacing Guide/Common Assessments & Teacher Training)	X	X	X	X	X
Substitutes for PD/Curriculum Work (PCO/Pacing Guide/Common Assessments & Teacher Training)	X	X	X	X	X
Funding for Consultants/Workshops/Conferences/ect.					X
EQUIPMENT					
Furniture for 2 Pilot Full Day K Classrooms	X				
Laptops for Curriculum Work		X			

Appendix C: Implementation Timeline for 2007-2008

	FY 07-08	FY 08-09	FY 09-10
PENN LONDON			
Planned Course Outline Revisions	Completed by 9/07		
Pacing Guide Development	Completed by 9/07		
Professional Development Activities	August 2007 - June 2008	August 2008- June 2009	August 2009- June 2010
Revise Assessments	October 2007 February 2008 April 2008		
Planning Pilot Full Day K for Implementation in Fall of 2007 (funding source ABG)	Possible Implementation Fall 2007 (depending upon funding)		
AVON GROVE INTERMEDIATE			
Planned Course Outline Revisions	Completed by 9/07		
Pacing Guide Revisions	Completed by 9/07		
Development and Revision of Common Assessments	Completed by 9/07		
Development of Grade Level Materials List	Completed by 6/07		
Development Of Remediation/Enrichment Program	Completed by 8/07 Implement in 2007-2008		
Professional Development Activities	August 2007- June 2008	August 2008- June 2009	August 2009- June 2010
FRED S. ENGLE MIDDLE			
Planned Course Outline Revisions	Completed by 9/07		
Revise Course Descriptions	Completed by 7/07		
Development of Pacing Guides	Completed by 9/07		
Development of Common Assessments	Completed by 9/07		
Professional Development Activities	August 2007- June 2008	August 2008- June 2009	August 2009- June 2010
Secure new textbooks for 7th grade supplanted math, 7th grade general math, and grade 8 Intro to PreAlgebra	Completed by 9/07		
AVON GROVE HIGH SCHOOL			
Development of Math Seminar	Completed by 9/07 Implementation 9/07		

PCO Revisions Pacing Guide Development Development of Common Assessment Selection/Purchase of Textbooks & Supplementary Instructional Materials	Completed by 9/07 Phase I Math Seminar Geometry Courses Basic Algebra II Algebra III/Trig	Completed by 9/08 Phase II Algebra I & II Honors Algebra II Trig/Precalculus Honors Trig/Precalculus	Completed by 9/09 Phase III Basic Algebra Calculus AP Calculus AP Statistics All Other Courses
Professional Development Activities	August 2007- June 2008	August 2008- June 2009	August 2009- June 2010
DISTRICT			
Provide Support for the PCO, Pacing Guide, Common Assessment Work	Spring/Summer 2007		
Provide Support for the Selection of Textbooks & Supplementary Materials	Spring/Summer 2007		
Formation of a Committee to Address Recommendations regarding Secondary Education Issues outlined in Section VI (e.g. Graduation Requirements, Course Sequence, etc.)	Spring/Summer 2007 Graduation Requirements Course Sequence	Phased in Implementation Plan	Phased in Implementation Plan
Development of a Coordinated System of Interventions for Students	Phase I Implementation	Phase II Implementation	Phase III Implementation
Development of a Multi-Year Professional Development Plan for Mathematics	Phase I Implementation	Phase II Implementation	Phase III Implementation

Appendix D: Article: *Math Acceleration for All*

EDUCATIONAL LEADERSHIP

February 2004 | Volume 61 | Number 5

Improving Achievement in Math and Science

Math Acceleration for All

A middle school in New York eliminated tracked math classes, adopted a universal accelerated math program, and instituted heterogeneous grouping, with dramatic results.

Carol Corbett Burris, Jay P. Heubert, and Henry M. Levin



February 2004

Imagine that one school's organizational change resulted in more students taking advanced math courses in middle and high school and that these students demonstrated substantial gains in overall math achievement, including higher scores on Advanced Placement exams in calculus. Imagine further that the program produced these improvements for all groups of students—initial low achievers, initial high achievers, and students of different socioeconomic levels and racial backgrounds.

South Side Middle School, a diverse suburban school in the Rockville Centre School District in New York State, implemented such an organizational change in 1995 when it began to provide accelerated math instruction for all students. An analysis of six years of longitudinal data on what math courses these students subsequently took and their level of achievement in math has documented the program's extraordinary benefits (Burris, 2003). It also reveals how a community and a faculty committed to high standards for all can make that goal a reality.

II. The Importance of Advanced Math

Studying advanced math in high school has an enormous influence on whether or not a student subsequently enrolls in a four-year college and earns a bachelor's degree. Horn and Nunez (2000) report that students whose parents never attended college more than doubled their chances of enrolling in four-year colleges if they took high school math courses beyond Algebra 2. Similarly, a U.S. Department of Education study (Adelman, 1999) found that

taking advanced math in high school was more strongly associated with successful completion of college than any other factor, including high school grade point average and socioeconomic status.

Successful completion of college, in turn, correlates strongly with subsequent educational and employment opportunities (Murnane & Levy, 1996). In other words, studying advanced math in high school strongly correlates with future success.

III. Traditional Grouping Practices

If studying advanced math in high school produces such large benefits, why don't all students do it? Two inhibiting factors are tracking and the attitudes often associated with tracking. In the United States, the most proficient math students at lower grades usually advance to algebra in the 8th grade. These students usually continue taking other high-level math courses in high school, culminating with calculus in the 12th grade. For students who leave elementary school as low achievers in math, however, a two-year algebra course in high school is usually the end of math study, concluding a secondary sequence that typically begins with remedial pre-algebra courses.

Research suggests that such low-level instruction is not the best way to help all students—including initial low achievers—develop a deep understanding of mathematics. According to the National Research Council, low-track classes are "typically characterized by an exclusive focus on basic skills, low expectations, and the least-qualified teachers" (Heubert & Hauser, 1999, p. 282). Low-achieving students assigned to low-level courses fall further behind rather than acquiring increasingly high-level knowledge and skills. Tracking thus contributes to low math performance rather than addressing it (Kifer, 1993; McKnight, 1987; Oakes, Ormseth, Bell, & Camp, 1990). Low-track placements also reflect certain assumptions: that many students cannot learn beyond low levels, that good teachers are wasted on low achievers, and that high expectations will harm the self-esteem of low-achieving students.

But there is another way. Indeed, the current standards movement rests on the premise that virtually all students can reach high levels of achievement if they receive high-quality curriculum and instruction. Research on accelerating instruction supports the premise that an enriched, accelerated curriculum does more than a low-track, remedial curriculum to enhance the performance of low achievers and students who are at risk of failure (Bloom, Ham, Melton, & O'Brien, 2001; Levin, 1988; Peterson, 1989).

IV. Accelerated Math and Heterogeneous Grouping

New York State requires that middle schools provide an unspecified percentage of students with accelerated math instruction and that these students take the algebra-based New York State Regents exam, Sequential I Mathematics, in 8th grade. Most middle schools provide this instruction to approximately 20 percent of their students.

Believing that all middle school students would benefit from instruction in high-level, heterogeneously grouped classes, Rockville Centre Superintendent William H. Johnson and South Side Middle School Assistant Principal Delia Garrity developed a multiyear program to eliminate tracking in middle school math. Before initiating universal acceleration in math, the district had already worked since the late 1980s on dismantling tracking in English and social studies. In preparation for universal math acceleration, the district for several years gradually increased enrollments in accelerated math classes. Despite these increases, median scores on the Sequential I Mathematics Regents exam remained stable, a positive portent for universal acceleration.

Starting in 1995, all students entering 6th grade at South Side Middle School took accelerated math in heterogeneously grouped classes and prepared for taking the Regents exam when they reached 8th grade. Research found positive results for all student groups, even the initial high achievers who had previously studied advanced math in homogeneous, high-track classes.

South Side's middle school math teachers worked together to revise and condense the regular 6th and 7th grade math curriculum to prepare students for the accelerated algebra course usually reserved only for high achievers in 8th grade. Together, the teachers eliminated redundancies and streamlined content. The school supported struggling learners in three ways: It instituted special support classes that met every other day in addition to the regular class meetings; It required teachers, as part of their work contract, to provide after-school help four out of five days a week; and it offered general resource support, such as supplementary materials that teachers requested.

The reform took five years (1994–1998) to plan and implement. Along the way, some math teachers and parents expressed misgivings about universal acceleration and its effects on high achievers. The middle school administrators addressed these concerns by presenting data showing universal acceleration's positive effects, even for high achievers, and by actively promoting the district's strong public commitment to high standards for all. By

the year 2000, middle school math teachers confidently told visitors that they had no interest in returning to the previous tracked system. Accelerated math instruction has become an integral part of the culture of the school.

V. The Study

Evaluation of this reform (Burris, 2003) used longitudinal student achievement data from six student cohorts: the last three 6th grade cohorts at South Side Middle School that did not receive universal math acceleration and the first three 6th grade cohorts that received it. The evaluation used achievement and demographic data to examine the academic consequences of providing all students with a high-level, accelerated math curriculum.

The study first examined whether all students benefited from an accelerated algebra course in 8th grade, defining *benefit* as continued participation in the accelerated math program and enrollment in other advanced math courses in grades 9–12.

The study also looked at the effects of acceleration on specific subgroups: African American and Latino students; students from a low socioeconomic background; and initial low achievers, average achievers, and high achievers. Students' initial level of achievement was defined according to their 5th grade stanine scores on the Math Concepts subtest of the Iowa Tests of Basic Skills. The study also examined the effects of heterogeneous grouping on the performance of high achievers.

VI. Important Benefits for Each Group

By every measure, students benefited from studying accelerated math in heterogeneously grouped classes. The research documented a statistically significant increase in the percentages of all students who took math courses beyond Algebra 2 in high school. This benefit applied to every subgroup. Among students completing trigonometry before they graduated from high school, the percentage of students from low socioeconomic backgrounds increased from 32 to 67 percent; African American and Latino students increased from 46 to 67 percent; initial low achievers increased from 38 to 53 percent, average achievers from 81 to 91 percent, and even initial high achievers from 89 to 99 percent. The rates at which each group took precalculus and Advanced Placement calculus also increased.

Conversely, universal acceleration did not increase the percentages of students who did not take math courses or who took math courses below their grade levels; indeed, when compared with earlier cohorts, more students took

math courses at higher levels. The high standards did not discourage even the initial low achievers.

Universal math acceleration also helped close the achievement gap associated with poverty. For the trigonometry-based course (New York State Sequential III Mathematics), the advantage gained by members of the universal-acceleration cohort nearly wiped out the disadvantage associated with poverty. For example, students from a low socioeconomic background who participated in the accelerated program had approximately the same probability of completing Sequential III math (0.37) as did students of middle or high socioeconomic backgrounds who attended South Side before universal acceleration (0.38).

Likewise, universal acceleration narrowed the achievement gap associated with ethnicity. Being an African American or Latino student had been associated with lower odds of completing advanced math courses, but universal acceleration almost entirely offset these previously lower odds.

VII. Effects on High Achievers

A contentious issue in the tracking debate is whether the inclusion of all learners in heterogeneously grouped math classes diminishes the achievement levels of initial high achievers. Some studies find that high achievers learn less in heterogeneous groups (Kulik, 1992; Loveless, 1998), whereas others report no such achievement effects (Mosteller, Light, & Sachs, 1996).

Even if heterogeneous grouping were generally associated with diminished learning for high achievers, it is unclear whether the effect would be due to the grouping or to a less rigorous curriculum for lower-track classes (Lucas, 1999; Slavin, 1995). Some researchers (Oakes et al., 1990; Slavin & Braddock, 1993; Wheelock, 1992) assert that heterogeneous grouping will not impair the learning of high achievers if the top-track curriculum "becomes accessible to a broader range of students without watering it down" (Slavin & Braddock, 1993, p.15).

What happened, then, to the initial high achievers at South Side Middle School?

In fact, more of them—especially those who were African American or Latino—took trigonometry, precalculus, and Advanced Placement calculus courses in high school. For students of color in the highest initial-achievement categories, universal acceleration was the only factor that significantly contributed to the completion of a high school course in calculus.

Aside from taking more advanced classes, the math achievement of these students remained high. A careful comparison between high achievers in pre-acceleration and post-acceleration cohorts found that their mean scores on the Sequential I Regents Exam taken in 8th grade were statistically indistinguishable, and high achievers' scores of the post-acceleration cohorts on the Advanced Placement calculus exams were significantly higher.

Nor were initial high achievers the only ones whose Advanced Placement calculus scores improved after universal acceleration. The overall percentage of South Side High School students achieving scores of 3 or better on the Advanced Placement calculus exams increased as well, even as the percentage of students studying Advanced Placement calculus increased to more than 50 percent. In other words, high achievers are doing better, and more students have become high achievers. As long as the curriculum is rigorous, heterogeneous math classes can benefit all students.

VIII. Implications of the Study

Although nearly all Japanese students study algebra in the 8th grade, fewer than 25 percent of all U.S. 8th graders do so (Horn & Nunez, 2000). The percentages of African American and Latino students studying accelerated math are even lower: 13 percent and 12 percent, respectively (Shakrani, 1996). These low participation rates are troubling.

We can attribute this phenomenon partly to faulty assumptions about what portion of the student population can reach high achievement levels and partly to the questionable assumption that heterogeneous grouping inevitably waters down the curriculum so that high achievers learn less (Oakes et al., 1997).

Recent experience in the Rockville Centre School District challenges these assumptions. The inclusion of all learners did not undermine the performance of the high-achieving students, and all students received clear, long-term benefits. Rockville Centre's success demonstrates that universal acceleration can succeed in the United States, not just in Japan.

As we strive to educate all students to high standards, who gets what curriculum is a matter of great importance. We must not reserve accelerated courses in math and other subjects only for the most fortunate, but rather make these courses accessible and available to all. The potential long-term benefits for students and for society are enormous.

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