

**2010-2011 Advisory Committee on Instruction
MATHEMATICS ADVISORY COMMITTEE
ANNUAL REPORT**

MEMORANDUM

DATE: March 9, 2011

TO: Arlington School Board

FROM: ACI Mathematics Advisory Committee

SUBJECT: End-of-Year Report

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1. Introduction

The Mathematics Advisory Committee (MAC) provides input and advice to policymakers and Arlington Public Schools (APS) administrators on the state of the mathematics program in APS. The MAC reports to the Advisory Council on Instruction (ACI), and through the ACI to the Arlington School Board.

Like other ACI advisory committees, the MAC issues “recommendation” and “non-recommendation” reports on alternating years. 2011 is a non-recommendation year for the MAC; thus, this document contains no proposals for specific actions for the ACI to consider. Instead, it reflects on the recommendations made in last year’s report and discusses topics the committee has been pondering and which may form the basis for future recommendations.

Before launching into this discussion, however, and at the risk of sounding repetitive from previous years’ reports, the MAC wishes to re-emphasize its deeply held belief in the importance of basic mathematical knowledge for all people. Apart from any current educational trends or fads, citizens with a basic fluency in mathematical thinking are better able to inform themselves and understand where their interests lie in our increasingly technical world, where investment information, polling data, survey results and other forms of quantitative argumentation are routinely used both to enlighten and to obfuscate.

2. 2010 Recommendations Update

In its 2010 report the MAC made two recommendations. Each is reviewed here, along with its current status.

2.1. Recommendation #1: Retain Math Coaches in APS Elementary Schools.

Background

In 2008 the Arlington School Board approved funding in the FY09 APS budget to provide Math Coaches for every APS elementary school. Under the formula approved by the School Board, each such school would receive a minimum half-time person whose responsibilities would include helping classroom teachers improve their pedagogy and content knowledge in mathematics. The MAC had recommended this action in its 2008 report, and the ACI had ranked it highly that year. Since many APS elementary schools at that time already had Math Coaches, this action by the School Board added funds equivalent to 4.5 FTEs to the APS budget.

In the 2008-09 school year, Staff moved aggressively to implement the Math Coach program in all elementary schools. By January of 2009 all APS elementary schools were covered by Math Coaches at the 0.5 FTE level or higher, and the system as a whole had 14.5 FTE specialists working with principals and classroom teachers to enhance mathematical instruction. In 2010-11 the number of Math Coach FTEs stands at 15.

Status of Recommendation

This recommendation was ranked very highly by the ACI in spring 2010 (2nd of 16 total recommendations across all recommending Advisory Committees), and the School Board subsequently preserved all Math-Coach positions. The MAC applauds this outcome and feels it is in the best interests of Arlington school children.

The APS elementary-school mathematics program is in a state of change, for a number of reasons. Locally, the APS has targeted substantially increasing the number of 8th-graders who take Algebra I; meeting this goal is requiring revision of lower-grade math curricula to include topics from higher grades to prepare 8th-graders for algebra. This pressure to move more advanced mathematical topics from middle school into the elementary schools is also the result of revisions to the Virginia 5th-grade Math SOL, which will include formerly 6th-grade topics such as linear equations in the syllabus for the grade 5 math SOL exam beginning in 2012. It should be noted that currently, these topics are taught by specialized math teachers in middle schools; ensuring that 5th-grade teachers are well-

prepared for the new content (and 4th-grade teachers for the current 5th-grade subjects they will be expected to teach to their charges) is a major challenge for APS that Math Coaches are ideally positioned to help address. Finally, at a national level the standards that schools must meet to ensure Adequate Yearly Progress (AYP) for their students in Mathematics are rising every year by 4%. In 2009, for Arlington elementary schools to meet their AYP targets, 79% of students in each designated No Child Left Behind group had to achieve a grade of Proficient on their Math SOL. In 2010 this figure rose to 83%, while in 2011 it will be 87%.

Studies in Virginia and elsewhere suggest the beneficial impact of Math Coaches. One NSF-funded study headed by Prof. Patricia Campbell at the University of Maryland studied five Virginia school districts and compared student achievement in schools that had such specialists and those that do not. The findings, reported at the 2009 annual meeting of the National Council of Teachers of Mathematics held in Washington and quoted from the study's website¹, include the following.

Research findings to date indicate that overall, students in schools with mathematics specialists for 3 years have significantly higher scores on Virginia's high-stakes, state standardized achievement test for mathematics as compared to students in control schools (Grades 3, 4, and 5). This difference in achievement was not evident after the first year of placement of the specialists at any of these grades. In Grades 4 and 5 (but not in Grade 3), students in schools with elementary mathematics specialists had a statistically significant greater probability of achieving "advanced proficient" status than did students in the control schools. This increase was not evident until the second and third year of specialist placement.

The presentation was titled "Research findings about elementary school mathematics coaches and their impact on teachers and students' achievement"; a paper describing the research in more detail has been submitted to the *Elementary School Journal*. More information can be found on the study's website. The focus on "advanced proficiency" is appropriate in the context of increased emphasis on completion of Algebra I by the 8th grade.

An article in the spring 2009 issue of *The Journal of Mathematics and Science* notes the positive impact that principals perceive math coaches to have on classroom instruction. Titled "Mathematics Specialists Increasingly Appreciated and Sought," the authors report on the satisfaction expressed by principals interviewed in their study with math specialists at their schools.

Closer to home, the beneficial effects of math-coaching on student achievement can be found in the experience of Barrett Elementary's 2006 5th-grade class, all

¹ <http://www.education.umd.edu/EDCI/MathEd/Virginia.html>.

of whom passed the Virginia SOL that year after spending up to six years (depending on when they enrolled at Barrett) in a school with a Math Coach. These figures were elaborated on in the 2008 MAC report. Resources permitting, the MAC anticipates reviewing the impact of the Math Coach program by studying mathematic achievement data across the entire APS.

2.2. Recommendation #2: Implement Timeliness Targets for APS Responses to Data Requests.

Background

In its 2006 report the MAC recommended that APS adopt targets for students achieving “high-proficiency” scores on the 5th-grade Virginia SOL. The reasoning behind the recommendation was that the then-current Strategic Plan for APS contained no targets for mathematic achievement for grades below 8th; the target for 8th-grade was to increase the percentage of 8th-graders taking Algebra I. The committee felt that adopting a target for 5th-grade achievement would provide an early indicator as to whether the 8th-grade targets would be met. This recommendation was not adopted.

In subsequent committee discussions, the MAC decided that an empirical study assessing whether or not 5th-grade advanced-proficiency was a predictor of eventual Algebra I achievement would help determine whether or not the recommendation was supported. A data request was made, and subsequently fulfilled a number of months later. The resulting analysis performed by a MAC member who is a professional statistician was included as an appendix in the 2008 MAC report; it showed that better performance on the 5th-grade math SOL generally implies better (and earlier) performance in Algebra I.

This vignette illustrates both the benefits that a data-driven study provides as well as a frustration that the MAC has struggled with for several years. On the one hand, APS possesses data on student achievement that can be used to guide informed decision-making by the MAC, other ACI committees, and APS as a whole. On the other hand, the MAC experience is that it is very difficult to obtain this data in a timely fashion.

Status of Recommendation and Rationale

This recommendation also received significant support from the ACI, ranking 6th out of the 16 total recommendations the ACI considered. No action was taken by the School Board on this recommendation. However, the Superintendent has been working closely with the Math Office to develop a better system for making aggregate student performance data available for analysis, and this system, while still in its early stages of development, shows promise as a tool for conducting the statistical studies the MAC believes are essential for informed decision-making.

The MAC is still convinced that data and timely feedback are essential for school-board members, administrators, educators and evaluators. Without data, we fly blind. APS should be able to respond promptly to reasonable data requests, whether made by administrators, school board members or advisory committees. The MAC recognizes that such data must be handled sensitively, and in accordance with all relevant regulations concerning student confidentiality. The committee is also encouraged by the preliminary steps taken by the Superintendent. Nevertheless, it still believes that a systemic, county-wide data system encompassing all subjects and schools must be the eventual goal, and it expects to work toward this end in the future.

3. Topics Under Study

During its monthly meetings in the 2010-2011 academic year, the MAC has studied two topics in particular that may serve as the basis for future recommendations. Each is discussed below.

Acceleration Backfire

The term “acceleration backfire” refers to an over-acceleration of a student’s progress through the mathematics curriculum that leads to the student’s eventual abandonment of the accelerated path. The MAC’s concern over this subject was initially sparked by anecdotes involving students dropping out of advanced math courses in the 9th grade within APS; subsequently, news reports suggested that the phenomenon may be present in other school systems as well. Questions that the MAC has been discussing include the following.

- To what extent is acceleration backfire a problem, versus evidence of natural attrition as students become older and their interests change?
- If acceleration backfire is indeed a problem, what policy / curricular remedies might be put in place to remedy it?

The rest of this section outlines the APS approach to math acceleration and summarizes some of the results of the MAC’s deliberations on this topic.

Currently, APS students have the option of accelerating their mathematics instruction in the 6th grade. Based on recommendations made by their former elementary schools, 5th-grade math SOL results, and a placement exam, a new 6th-grader may be placed in 6th-grade Math; 6th-grade Intensified Math, which covers the material in both 6th- and 7th-grade math courses; or 7th-grade Intensified Math, which includes 8th-grade math (pre-algebra) as well. Students in this last path may take Algebra I or Algebra I Intensified as 7th-graders; Geometry or Geometry Intensified as 8th-graders; and Algebra II or Algebra II Intensified as 9th- graders. If they continue on this path, such students eventually

take Calculus as high-school juniors and have the option of taking Multivariate Calculus (traditionally a sophomore-level course in college) as seniors.

The MAC became aware of several instances of students who enrolled in, and then dropped out of, Algebra II Intensified in the 9th grade after taking Geometry Intensified in their 8th-grade year. The stories were sufficiently varied that the committee became concerned that an underlying issue might require addressing. The Math Office conducted a small in-house evaluation in order to assess the extent of the phenomenon; it determined that the percentage of students who were dropping out of Algebra II Intensified was indeed concerning. Eligible students were found to be exiting the intensified math path dropping out of the Algebra II Intensified course, and not completing higher-level courses in the planned sequence at the expected rates. The MAC is debating what appropriate remedies might be for the problem, and whether there might be problems earlier in the advanced path that should also be investigated.

One theory about the source of the potential problem holds that there is a lack of standardization across APS middle schools in the teaching of intensified math courses, and that some students arrive in high school ill-prepared for the rigors of continued accelerated mathematics. To combat this problem, and also to ensure some uniformity in curriculum in middle-school mathematics, the APS Math Office has begun instituting common mid-term and end-of-year examinations for Algebra I, Geometry and Algebra II. The MAC believes this is a prudent measure, and will continue to monitor both the issue of acceleration backfire and the effects of curriculum standardization across schools on the problem.

More Time for Mathematics in Middle Schools

By “more time for mathematics” the MAC means significantly increasing the amount of instruction time devoted to mathematics in middle schools. Currently, APS middle schools devote 42 minutes on average per day to mathematics instruction. A majority of schools in Virginia devote substantially more than this figure to the subject, as a means of boosting achievement among all groups, meeting goals for enrollment in higher-level math classes, and narrowing the gaps among different student groups. The MAC has been discussing the following questions related to this phenomenon.

- Is 42 minutes of daily instruction in mathematics sufficient to ensure satisfactory levels of achievement across all student populations in Arlington schools, and to maintain competitiveness with peer systems?
- If not, how much more time should be devoted to mathematics on a daily basis, and what additional resources would be needed to ensure the effective delivery of this extra instruction?

Anecdotal evidence suggests that more than 70% of Virginia school districts now devote an average of 60-90 minutes per day to math instruction in middle school. Closer to home, a study comparing APS to 11 peer school systems in the state indicate that *every one of the other school* systems devotes at least 60 minutes, and a majority as much as 90 minutes, to mathematics every day. This move has been driven by two considerations: the need to improve middle-school SOL scores in math, and the Virginia Algebra Initiative, which is intended to raise the percentage of students who have completed Algebra I by the end of 8th grade. In Arlington, middle-schools have had trouble in recent years meeting Adequate Yearly Progress targets; underachievement on mathematics SOL exams is one of the culprits. These results stand in stark contrast to the generally positive SOL results obtained by APS elementary schools, where the aggressive deployment of Math Coaches and the offering of Math Academies appear to have bolstered both teacher effectiveness in mathematics and student achievement in the subject.

Given that AYP targets for acceptable levels of achievement increase every year, and given the difficulties experienced by APS middle schools in meeting these targets, the MAC believes that some intervention should be undertaken. Increasing the amount of mathematics instruction during an average middle-school day is one such option that the committee is seriously reviewing. Any such increase should of course be paired with mechanisms and curricular development to ensure that the extra time is used effectively. It must also be acknowledged that increasing instruction time just because other school systems are is not a justification in itself. At the same time, APS should not ignore this trend, and the problems APS middle schools have in meeting AYP goals should be taken seriously and addressed forthrightly.