

**2012-2013 Advisory Committee on Instruction
MATHEMATICS ADVISORY COMMITTEE
ANNUAL REPORT**

MEMORANDUM

DATE: March 22, 2013
TO: Arlington School Board
FROM: ACI Mathematics Advisory Committee
SUBJECT: Annual Report

COMMITTEE MEMBERS: Rance Cleaveland, Beth Doyle, Ron Fecso, Michael Gold, Mark Hill, Selene Ko, Luanne Lohr, Mark Nadel, Ali Protik, Dan Rosenbaum, Denise Sughrue (chair), Tannia Talento, Sezer Ulku.

OBSERVERS: Lincoln Swaine-Moore, John Sullivan

STAFF LIAISON: Margaret Chung, Mathematics Supervisor

ACI LIAISON: Betsy Morse

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. 2013 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 sets forth the topics the MAC has been pondering and discussing, 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 everyone. Apart from any current educational trends or fads, citizens with a basic fluency in mathematics and data analysis are better able to inform

themselves and understand where their interests lie in our increasingly technical world, where investment information, polling/survey data, performance metrics and other forms of quantitative argumentation are routinely used both to enlighten and to obfuscate. Such fluency is becoming an increasingly important skill in a large range of jobs and in everyday life.

2. 2012 Recommendations Update

In its 2012 report, the MAC made three recommendations. Each is reviewed here, along with its current status.

2.1. Recommendation #1: Devote More Time to Mathematics Instruction in APS Middle Schools.

Background

In current APS middle-school scheduling, an average of 45 minutes per day, or 225 minutes per week, is devoted to Mathematics instruction. This schedule has been in effect for a number of years at this point, during which time APS performance on Mathematics Standards of Learning (SOL) tests, while generally above state levels, has been noticeably less so for middle school students than for elementary school students (relative to the state average for each respective age group). It must also be noted that the APS middle schools that have failed to achieve Adequate Yearly Progress as defined by the No Child Left Behind Act often have difficulties because of their mathematics performance.

The MAC recommended in its 2012 Annual Report that APS allocate at least one (1) hour per day for Mathematics instruction for each grade level in its middle schools.

Status of Recommendation and Rationale

While the recommendation has not been applied across the board to date, an additional period of Math (45 minutes) has been provided to struggling students through Math 6, 7, 8 and Algebra 1 Strategies courses. "Strategies" is an elective course for students who need additional support for success in grade level Mathematics. Such instruction is offered daily to targeted students who have been identified as being at risk for passing the SOL test. Students in the Strategies course will build background knowledge, experience more conceptual approaches to the content and develop the core course content more thoroughly. The status of the Strategies courses is that they are currently being offered at all 5 middle schools. The effectiveness of this approach will need to be reviewed via participation rates for those students who most need the extra help and test data. Since the 2012-13 school year will be the second year with the new SOL

Math test, APS will have data this year to see to what extent students who did not pass the SOL test during the 2011-2012 school year pass this year.

Notwithstanding the introduction of the “Strategies” courses, which affects a small percentage of middle school students, the MAC still believes that it remains advisable for all middle school students to receive additional Math instruction, e.g., increase the time devoted to Mathematics instruction from 45 to 60 minutes per day on average (irrespective of whether block scheduling is adopted by the county). The increasing need for Mathematics fluency affects all students, not just those who may require additional tutelage through the Strategies courses. The MAC is also exploring the strategy of incorporating Math into other subject areas (see Section 3 herein).

2.2. Recommendation #2: Ensure Presence of a Full-Time Math Coach in Every APS Elementary School.

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, the APS Math Office 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.

The addition of the Math Coaches has proven popular with classroom teachers and principals; in addition, SOL achievement in the 3rd, 4th and 5th grades has improved markedly after the two-year start-up period that academic research generally indicates is the amount of time needed for the effect of coaches to be felt.¹ Within APS, from the 2007-08 (the last year before the allocation of coaches to all schools) to 2010-11 school years, the pass rates improved county-

¹ Patricia F. Campbell, Nathaniel N. Malkus. “The Impact of Elementary Mathematics Coaches on Student Achievement.” *The Elementary School Journal*, Vol. 111, No. 3 (March 2011), pp. 430-454.

This study is especially noteworthy because of its focus on Virginia SOL performance at the elementary-school level. The researchers are based at the University of Maryland.

wide, while the advanced pass rates for these grade levels skyrocketed. The full data (through 2010-11) can be found in Appendix C of the MAC's 2012 Annual Report.²

Nevertheless, the new Math standards will have a significant impact on elementary-school Math curricula as well as those in middle-schools, as topics have been shifted down into lower grades in order to accommodate the progression to 8th-grade Algebra I. Such a shift will drive the need for further Math coaching assistance.

Status of Recommendation and Rationale

The state has recommended a Math specialist be provided for every 1,000 students in elementary school. Currently, all elementary schools within APS have a "half-time" Math coach and all nine Title 1 schools (i.e., those schools where a substantial number of kids require free or reduced price lunches) have 1 full-time Math Coach assigned³.

Each of the 22 APS elementary schools is assigned a 0.5 FTE coach from the district's operating budget. The nine (9) Title 1 schools are assigned an additional 0.5 FTE coach paid for by Title 1 funds. These schools are where more support is needed to help students to achieve Mathematics understanding at the same levels as non-Title 1 schools. It is difficult to measure the direct impact that having a full-time coach versus a half-time coach has at this juncture since it is at our Title 1 sites only that full-time coaches have been assigned. Comparing pass rates between Title 1 schools and non-Title 1 schools would not equitably measure the impact of having full-time vs. half-time coaches. However, comparisons to the **changes in pass rates** of Title 1 versus non-Title 1 schools could serve as a useful indicator of improvement. In addition, APS could make comparisons of a discrete set of student characteristics across both Title 1 and non-Title 1 schools.

The results of a teacher survey on Math discourse from the beginning of the school year and at the end of the school year will be used by some of APS Math Coaches to measure the extent the teachers whom they have coached have grown in their practice of Math discourse.

² Note that with the 2011-12 Math SOL being substantially different than prior years, the results from such year, which showed both lower pass and advanced pass rates than prior years, may be incomparable to prior years. It should be also noted that APS elementary Math SOL performance increased relative to the state levels during 2011-12.

³ Five (5) underperforming sites had been given an additional 0.5 FTE through a School Improvement Grant (SIG). Those Title 1 sites therefore had 1.5 Math Coaches. The SIG funds have been cut for next year (a consequence of the federal sequestration) so now all Title 1 schools will have just 1.0 FTE.

Notwithstanding the above statements regarding full-time Math Coaches at Title 1 schools only, the MAC continues to stand by its 2012 Recommendation that a full-time Math Coach should be ascribed to each APS elementary school. The increasing need for Mathematics fluency affects all students, not just those who attend Title 1 schools.

2.3. Recommendation #3: Require Licensure in Mathematics, as well as training/experience in second-language instruction, for Mathematics Instructors for Secondary-Level Students Enrolled in ESOL/HILT Programs.

Background

APS students who are English-Language Learners (ELLs) currently receive instruction through ESOL/HILT that is designed both to accommodate these pupils' developing English skills and also to give them the necessary academic content knowledge in order to be eventually mainstreamed with their peer group. Such programs serve an important purpose, especially in Arlington County, where 1/3 of the student body consists of ELLs. Because of the specialized and technical nature of Mathematics, teachers in these programs who are not licensed in Mathematics often struggle with material for secondary-level students, who need to learn subjects such as Algebra I, Geometry and Trigonometry. There had been no requirement that secondary-level Mathematics teachers in these programs be licensed in Mathematics instruction, and at least two secondary schools currently lack licensed Math teachers to instruct their ELL students in the subject.

Status of Recommendation and Rationale

All HILT level 2 Math courses in middle school, Math Foundations (taught at high school level) and Pre-Algebra courses are taught by Math certified teachers who are either dually certified in ESOL/HILT or have received training in Sheltered Instruction Observation Protocol (SIOP). However, not all teachers who teach Math to ESOL/HILT students are secondary-level Math certified. There are only two teachers at the middle school level who teach newly arrived ESOL/HILT students Mathematics (i.e., HILT level 1) who are not Math certified. All teachers who teach Mathematics to ESOL/HILT students within the three high schools, HB Woodlawn and 3 out of the 5 middle schools are Math certified.

Ongoing Mathematics support is provided to all secondary-level teachers of ESOL/HILT students through site-based job embedded professional development provided by the ESOL/HILT Math specialist.

As next steps, APS needs to ensure licensure for those teachers teaching Math to ESOL/HILT students at all levels.

3. Topics Under Study

During its monthly meetings in the 2012-2013 academic year, the MAC has studied several topics in particular that may serve as the basis for future recommendations. The APS district goals (e.g., challenge and engage all students, eliminate the achievement gaps) are at the forefront of the MAC's deliberation on such topics. Each topic is discussed below.

Metrics/Data Analysis

Practically all of the recommendations in this report are at least partially based on data analysis. However, this analysis is based upon evidence from aggregate data that can be difficult to interpret because of changes in the SOLs, changes in the number of students taking advanced Mathematics courses, changes in the characteristics of students, and more. In other cases, there are questions that the MAC would like to ask, but cannot be answered with aggregate data.

These limitations of the data analysis affect not only the work of the MAC but also likely affect the work of almost all of the APS advisory committees. These limitations likely also affect analyses that influence decisions made by APS staff and the School Board. Richer data analysis of APS longitudinal micro-level data for students or classrooms or schools would not definitively answer important questions, but it almost surely could provide stronger evidence about what is working and what is not. Such analysis would allow APS staff and the School Board to test, learn, and adapt in many areas where current data limited them to educated guesses. Issues related to Mathematics that could be addressed with such data analysis include the following:

- What is the effect of Math Coaches in APS elementary schools? What is the effect of full-time vs. part-time Math Coaches? How do the coaches affect low-performing students? How do the coaches affect high-performing students?
- What is the effect of taking advance Mathematics courses in middle school? Does the effect vary by student characteristics, such as previous grades or SOL scores? A careful analysis of longitudinal student-level data could reveal "rules of thumb" that schools could use to better place students in appropriate Mathematics courses.

Issues that do not necessarily pertain to Mathematics and are broader across the entire APS educational landscape include the following:

- The lotteries for schools such as Arlington Traditional School and HB Woodlawn would allow for analysis that could identify the effect of these

- schools on student performance relative to their alternative choices. That could inform decisions on whether or not to expand such options.
- Are there differences in schools or teachers in improving the performance of students after accounting for the characteristics of students? Are there schools or teachers who are particularly successful (or unsuccessful) with particular types of students? Are there lessons that can be learned from those patterns that could be used to improve instruction?

This is just a sampling of the types of questions that could be addressed with analyses of longitudinal micro-level data. Actual APS decision-makers likely could add hundreds of other important questions.

The MAC has been able to reach out to APS staff to assess their capacity to do this type of analysis. APS staff is in the process of an extensive effort to integrate the various data systems that APS has used over the years. Such data integration is the first step for any kind of analysis. APS staff is also building an interface that will provide decision-makers much greater access to simple data analyses. Such access is likely to change the way in which decision-makers integrate data into their decisions. It is also likely to whet the appetite for deeper analysis of the types of issues described above.

It appears that while APS is building a database that would support the type of analysis described above, it does not appear that it employs analysts with experience working with complex micro-level data. The MAC is in the unique position that several of its members are employed as expert data analysts who have helped complex organizations make better use of their data. Because of confidentiality protections for student record data, it likely would not be appropriate for the MAC to directly work with student data. But there may be other ways in which MAC members could help increase the capacity of APS staff to do richer data analysis. MAC members have experience building such capacity (often at minimal cost) in organizations that share many commonalities with APS.

Integrating Math Into Other Subjects

Some of the topics being considered by the MAC include developing a K-12 STEM (science, technology, engineering, math) model using “backwards design” by developing partnerships with universities/industries requiring STEM education and training, tracking the job market, i.e., on what attributes are employers focused with respect to prospective employees entering the workforce from undergraduate/graduate school, and the role that Math has in technology and other fields currently and its expected role in the future. Such focus ties into the APS and Virginia state initiatives to prepare all students for college and career readiness.

While initiatives have been underway to integrate Math with some other subjects, e.g., through STEM, the MAC is also exploring ways to make Math relevant to the real world, i.e., broaden the use of Math from just the STEM concepts base to art, design, dance, music, etc.

Rich Tasks

The MAC has discussed the effort to increase the learning done through implementation of rich tasks (i.e., committing to sustained exploration of topics) across the county. This year is a pilot year and rich tasks are being deployed at the high school and middle school levels. In elementary school, the Math Coaches have been trained and they will train their teachers. Job embedded professional development has been provided to K-8 teachers throughout this year through the work of Math Coaches. For the high school and middle school teachers, they have been in countywide meetings to learn the rich task techniques. There is also time being spent with school administrators to ensure they understand the quality instruction underpinned by the application of the rich tasks being piloted. Another opportunity would be to better leverage the Continental Math League as a rich task focused on different problem solving techniques. In addition, provision of SIOP training to all Math teachers may serve to bolster the effectiveness of Math instruction to ELL students.

Best Practices

The MAC is looking at Best Practices, both those within APS and beyond. A next step is to explore ways of ascertaining Best Practices, such as invite selected APS Math teachers to describe their “best practices” of instruction or review selected “best practices” from nationwide aggregation source (i.e., clearinghouse/filtering concept—where certain practices have been applied and shown to have worked via independent evaluators). Furthermore, the MAC will explore how to spread Best Practices most effectively throughout APS.

“Flipped Classroom” Model Exploration

In order to challenge our students and strive to eliminate the achievement gaps within APS, the MAC is looking at ways for teachers to be trained to provide differentiated instruction. The “Flipped Classroom” model sets forth a scenario “flipped” from the normal instructional method (i.e., teacher lectures in class, students perform homework that night at home) where students would review lectures at night, most likely from a link to an APSVA website and do “homework” in the classroom the following day, individually as well as work in teams. A challenge that would need to be addressed is that 30% of Arlington students are within the pool of free and reduced lunch students (economically disadvantaged) and thus may likely not have Internet access from home. A successful “Flipped

Classroom” program must ensure that such students are able to have the means to access the assigned lectures outside of the classroom. The MAC is planning to explore whether any “Flipped Classroom” models might serve as examples that APS could draw upon for enhancing the delivery of Mathematics instruction.

The discussions within the MAC on the topics above are targeted to dovetail to supporting the Strategic Goals as established by APS School Board.