

**2014-2015 Advisory Committee on Instruction  
MATHEMATICS ADVISORY COMMITTEE  
ANNUAL REPORT**

MEMORANDUM

**DATE:** February 4, 2015  
**TO:** Arlington School Board  
**FROM:** ACI Mathematics Advisory Committee  
**SUBJECT:** Annual Report

**COMMITTEE MEMBERS:** Amy Beaumont, Stan Degler, Ron Fecso, Mark Hill (co-chair), Selene Ko, Luanne Lohr, Mark Nadel, Ali Protik (co-chair), Judy Rudman, Dan Rosenbaum, Mona Siddiqui, John Sullivan, Nathan Zee.

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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 County School Board.

Like other ACI committees, the MAC issues “recommendation” and “non-recommendation” reports in alternating years. 2015 is a non-recommendation year for the MAC; thus, this document contains no proposals for specific actions for the ACI and the School Board to consider. Instead, it reflects on the recommendations made in last year’s report and sets forth the topics the MAC has been considering 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. A basic fluency in mathematics and data analysis is an important skill not only in a large range of jobs but also in everyday life. Apart from any current educational trends or fads, in an increasingly technical world, it has become

crucial for citizens to attain such fluency to understand investment information, polling/survey data, performance metrics and other forms of quantitative argumentation.<sup>1</sup>

## **2. 2013-14 Recommendations Update**

In its 2013-14 Report (November 2013), the MAC made four recommendations. Each is reviewed here, along with its current status.

### **2.1. Recommendation #1: Gather Information on, and Study the Feasibility of, the “Flipped Classroom” Approach at the Secondary-Level and Assess Its Impact on Student Learning.**

#### **Background**

The MAC believes that it is worth examining the potential effectiveness of the flipped classroom approach. This view has resonated with both APS staff members and the Board since this Recommendation was made in the MAC’s 2013-14 Report (November 2013). Among other benefits, it may be an innovative way to shrink the achievement gap between disadvantaged and non-disadvantaged students within APS as this approach may mitigate the impact of the lack of academic support disadvantaged students might be able to receive outside of school. Of course, the effectiveness of this approach depends on whether those students have the necessary equipment and connectivity to watch the lesson presentations either at home, at an accessible library, or at school either during a homeroom period or through an extended day program. Such access could be ensured through APS-supplied devices, at least to those students who are in need. Moreover, the success of any flipped classroom approach depends on the ability of the teacher to tailor the approach to the needs of the students. If executed successfully, the flipped classroom approach could provide teachers with more opportunities to work with students individually or in small groups during class and thus provide more support and enrichment as needed. The ability to provide greater differentiation in the classroom would support the APS Strategic Plan goal of challenging and engaging all students. Furthermore, recorded lessons would permit students, as well as parents, to replay concepts they have difficulty understanding.

The MAC believes that the flipped classroom approach may hold promise for all APS students, including those who are struggling in mathematics, but believes

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<sup>1</sup> As an example of the importance of math fluency on students’ ability to function in the world beyond K-12 schooling, a recent report from the Harvard Business School found that “students required by states to take additional math courses practiced better credit management than other students ... and were better able to avoid both home foreclosure and credit-card delinquency.” This study also found that math, not personal-financial education at the primary and secondary school levels, was the driver behind such financial aptitude betterment. Charlie Wells, “The Smart Way to Teach Children About Money,” *The Wall Street Journal*, February 2, 2015.

that data and analyses are required to evaluate and confirm this belief. The data may be in the form of both quantitative and qualitative information.

In its 2013-14 Report (November 2013), the MAC recommended that APS evaluate the effectiveness of the flipped classroom approach in two stages:

- First Stage: APS administers a feasibility study to ascertain whether there is the appropriate level of (1) student access, (2) instructional resources and (3) overall APS community desire to accommodate a scaling up of the flipped classroom approach within APS at the secondary-level.
- Second Stage: if the feasibility study shows potential benefits of scaling up flipped classroom instruction within APS, then APS conducts an evaluation on the effectiveness of the flipped classroom approach.

The MAC recommended that the feasibility study in the First Stage be based on surveys of (1) APS teachers who are using this approach, (2) their students, (3) the parents of their students, and (4) principals in the schools where the flipped-classroom approach has been used.

Only if deemed feasible, the MAC recommended that APS move into the Second Stage and carefully evaluate the effects of the flipped classroom approach on student test scores and learning through a formal impact assessment.<sup>2</sup>

The MAC also recommended that APS use an independent evaluator for assessing the impacts of flipped classroom instruction during the Second Stage. However, if APS decides to perform the assessment internally, several members of the MAC have experience with impact assessment and can assist APS in formulating and implementing an impact assessment of the flipped classroom approach.

### **Status of Recommendation and Rationale**

According to an APS staff update, APS has gathered some preliminary data points<sup>3</sup> on the creation, implementation, and assessment of flipped classroom lessons and is currently gathering anecdotal data and providing professional development to teachers around technological and pedagogical practices. The

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<sup>2</sup> In a formal and rigorous impact assessment, average test scores of a group of students experiencing flipped classroom instruction would be compared with the average test scores of a similar group of students who are not experiencing such an instructional approach. While these two groups would be randomly assigned in an ideal scenario, randomization would not be feasible in the APS context because some teachers have already chosen (non-randomly) to use flipped classroom instruction. Instead, APS could create a comparison group (classrooms where flipped classroom instruction is not used) using data on student pre-test scores and demographic characteristics, which APS already has available.

<sup>3</sup> The information gathered to date is qualitative, i.e., which teachers are trying the flipped classroom approach, which grade levels/courses are exploring it, content of videos created, etc.

MAC strongly urges that this Recommendation continue to be acted upon as it represents an innovative approach for instructional method and has minimal budget impact.

## **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. The Math Coaches' primary role is to provide on-site, direct support to teachers by helping them develop their math curricula and assist them in designing approaches to improve student achievement and instruction. Research has shown that professional development is most effective when it is ongoing and job-embedded and having Math Coaches present in each school ensures that new teaching techniques and math materials are incorporated rapidly into each APS classroom. This is particularly important as new textbooks are introduced and SOL math standards evolve.

Under the formula approved by the School Board in 2008, each elementary 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 full-time equivalents (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 supported 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 mathematics instruction. The MAC recommended in its 2011-2012 Annual Report (and reaffirmed this recommendation in its 2013-2014 Report) that all APS elementary schools have a Full-Time Math Coach; as of this school year, 2014-15, only 9 (all Title 1 schools, i.e., those schools where a substantial number of students receive free or reduced price lunches) had Full-Time Math Coaches.

The addition of the Math Coaches has been embraced by classroom teachers and principals and Math SOL achievement in the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> 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.<sup>4</sup> Within APS, from the 2007-08 (the last year before the allocation of Math Coaches to all schools) to 2010-11 school years, the pass rates improved county-wide, while the advanced pass rates for these grade levels showed substantial improvement (e.g., with APS SOL scores increasing 13 percentage points vs. 4 percentage points for all of VA in the 3<sup>rd</sup> grade; for 5<sup>th</sup> graders, APS improved 14 percentage points vs. 5 percentage points for the state).

See Table Below:

**Advanced Pass Rates (in %) – Math SOL: APS and Virginia**

	2007-08 APS	2010-11 APS	2007-08 VA	2010-11 VA
3 <sup>rd</sup> Grade	56	69	51	55
4 <sup>th</sup> Grade	46	65	42	55
5 <sup>th</sup> Grade	60	74	52	57

Such pass rates for the Math SOL also showed marked improvement when compared to English-Reading SOL advanced pass rates (which basically remained stagnant or decreased) over the same period.

**Advanced Pass Rates (in %) – English Reading SOL: APS and Virginia**

	2007-08 APS	2010-11 APS	2007-08 VA	2010-11 VA
3 <sup>rd</sup> Grade	48	50	39	41
4 <sup>th</sup> Grade	53	49	47	42
5 <sup>th</sup> Grade	49	49	42	40

**Substantial APS Elementary School Population Increases**

A strong factor supporting this recommendation is that the number of students within APS Elementary Schools has grown substantially over the past 5 years (about 25%). In addition, projections show that the APS Elementary School population over the next 5 years will reach a level that is over 40% greater than when the School Board approved funding for half-time Math Coaches in all APS Elementary Schools.<sup>5</sup>

**“Reading Specialists” Comparison**

<sup>4</sup> 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 using schools where math coaches were randomly assigned. The researchers are based at the University of Maryland.

<sup>5</sup> Student population for APS Elementary Schools increased from 10,166 in 2008 to 12,793 in 2013; such population is projected to increase to 14,383 by 2018.

<http://www.apsva.us/cms/lib2/VA01000586/Centricity/Domain/110/Capacity%20Analysis%202012-11-20%20no%20dual%20enrolled.pdf> and <http://www.apsva.us/site/Default.aspx?PageID=1110>

Within the APS Elementary Schools, reading specialists are assigned to schools at 1.0 FTE and 1.5 FTE for those schools with a population of less than 500, and greater than 500, respectively. Given the importance of mathematics instruction, it would seem imperative for APS to provide 1.0 FTE Math Coach for all APS Elementary Schools. Note that all APS Elementary Schools, except one (1), currently have over 500 students.

### **Status of Recommendation and Rationale**

The MAC continues to stand by its Recommendation (as set forth in both the 2011-12 and 2013-14 MAC Reports) 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.

Currently, all elementary schools within APS have at least a “half-time” Math Coach while all nine Title 1 schools have an additional half-time Math Coach assigned. While it may seem, on its face, that the Title 1 schools are where more support is needed to help students achieve mathematics understanding at the same levels as non-Title 1 schools, there is a substantial number of teachers and students in every APS elementary school that could benefit from additional Math Coaching assistance, which would help (1) reduce the achievement gap and (2) challenge and engage all students, within a school.

The new math standards have had a significant impact on elementary and middle school math curricula, as topics have been pushed down into lower grades in order to accommodate the progression to 8<sup>th</sup>-grade Algebra I. Such a shift will drive the need for further Math Coaching assistance at the elementary school-level.

### **2.3. Recommendation #3: Continue to Devote More Time to Mathematics Instruction in APS Middle Schools.**

#### **Background**

In the drive to close the “achievement gap”, APS should focus on increasing the math instructional time for those who really need it. “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 build background knowledge by previewing key mathematical concepts and vocabulary, experience more conceptual approaches to the content and receive more thorough instruction in the core course content. The Strategies courses are currently being offered at all five (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 the resulting test data. In addition to Strategies, Swanson Middle School has introduced a program for its

6<sup>th</sup> graders that enables those students requiring extra help with math to receive instruction during Homeroom time (i.e., 20 minutes). Coupled with their math class during the 1<sup>st</sup> period, taught by the same teacher, these students receive 65 minutes of daily math instruction.

The MAC recommended in its 2013-14 Report (November 2013) that APS should provide greater awareness to middle school students of the instructional opportunities set forth above.

### **Status of Recommendation and Rationale**

The increasing need for mathematics fluency affects all students, but in the interest of eliminating the achievement gap within APS, resources should be directed toward those who may require additional tutelage through programs such as Strategies. Perhaps additional exploration is warranted to further another Board goal (to challenge and engage all students) by reaching out to students beyond those who need additional support (i.e., those that desire to be challenged). The MAC is also exploring the strategy of incorporating math into other subject areas (see Section 3 herein) as a means of increasing the time devoted to mathematics in APS middle schools. In addition, APS should track and monitor the effectiveness of programs such as Strategies and the Swanson initiative. About 500 APS middle school students are availing themselves of such programs, representing about 10% of the middle school population.

### **2.4. Recommendation #4: Require Licensure in Mathematics, as well as training/experience in second-language instruction, for All Mathematics Instructors for Secondary-Level Students Enrolled in ESOL/HILT Programs.**

#### **Background**

APS students who are English Learners (ELs) currently receive instruction through the ESOL/HILT program 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 ELs. 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. At the time of the MAC's 2013-14 Report (November 2013), there was just one middle school within APS that still needed math certification for teacher(s) instructing ESOL/HILT students in mathematics.

### **Status of Recommendation and Rationale**

As next steps, APS needs to ensure that all teachers who provide Math instruction to ELs be certified in mathematics and have the requisite experience and training in providing English instruction to ELs. APS could reassign the ESOL/HILT math course to an already math certified APS teacher (who will also have had the requisite Sheltered Instruction Observation Protocol (SIOP) training) within the middle school in question.

### **3. Topics Under Study**

During its monthly meetings in the 2014-2015 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.

#### **Integrating Math Into Other Subjects**

One of the topics being considered by the MAC is the development of a K-12 STEM (science, technology, engineering, math) model by developing a STEM program (including instructional training), e.g., through the Career Center, as well as partnerships with universities/industries requiring STEM education and training.

The MAC is also exploring ways to make the study of math relevant to the real world, i.e., broaden student learning to cover the relationship between math and art, design, dance, music and other areas. The MAC has also reached out to the Gifted Services and Science Advisory Committees to explore collaborative efforts on this front in the near future.

#### **Increasing Transparency of Math Teaching Methods in Communications with Parents**

MAC sees the value of keeping parents informed of the math instructional methods being adopted and applied within APS schools, especially at the elementary school level. We are exploring methods of communications and would expect that some semblance of uniformity across schools be adopted in such communications processes.

#### **Tutoring Approach--Students Tutoring Students**

There may be a way to introduce a peer-tutoring approach which enables students to tutor fellow students, in a way that would not supplant teachers' and students' standard teaching/learning experience during the standard school day,



but augments it. The student-on-student teaching model will provide opportunities for advanced math students to use and challenge their math skills to teach and help their peers who may be struggling in math. The MAC is aware of certain peer-tutoring programs such as one at Yorktown H.S. where students tutor peers in a math lab.