2013-2014 Advisory Council on Instruction

MATHEMATICS ADVISORY COMMITTEE
ANNUAL REPORT

MEMORANDUM

DATE: November 30, 2013

TO: Arlington School Board

FROM: ACI Mathematics Advisory Committee

SUBJECT: Annual Report

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1. Introduction

This report presents the Mathematics Advisory Committee's (MAC's) recommendations on improving the state of Math instruction in Arlington Public Schools (APS). These recommendations are intended to address the School Board's goal of eliminating the achievement gap within APS and reflects the MAC's advocacy of the importance of challenging and engaging all students in learning meaningful and applications-oriented Mathematics. The MAC has four (4) specific recommendations for the Advisory Council of Instruction (ACI) and the School Board to consider this school year:

1) Gather information on, study the feasibility of, and assess the effectiveness of, the flipped classroom approach;
2) Ensure employment of a full-time Math Coach at every elementary school;
3) Devote more time for those students requiring Mathematics assistance at the middle school level;
4) Ensure the licensure of all Math instructors for secondary level students enrolled in ESOL/HILT programs.

The MAC would also like to note the importance of obtaining and analyzing relevant data in determining whether, and to what extent, a certain instructional approach is effective in increasing APS student proficiency in Mathematics. Due to existing limitations on access to data, the MAC has only been able to base what limited analysis it could perform on evidence from aggregate data, as micro-level data currently isn't available. During the last school year, APS staff has been 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 and the MAC would like to commend this effort by APS. As APS develops the capacity to analyze micro-level data, the MAC expects to be able to provide recommendations based on more sophisticated analysis in the future.

2. 2013-14 Recommendations

This section presents the MAC's recommendations, and accompanying rationale for each, for this reporting cycle.

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

A new approach to the use of classroom time, the "flipped classroom," has been gaining nationwide attention.[1] The concept is to allow students to work on problems (traditional "homework") during class time, when teachers and classmates are most available to help. That time to work would be made possible because teachers would have made pre-recorded presentations of lessons available for students to watch outside the classroom--either at home, in libraries, or other places—before the class session. At least six (6) APS teachers have already incorporated elements of the flipped classroom approach into their teaching method.[2]

[1] *See* "When Schools Do Flips," N.Y. Times, Oct. 13, 2013, Sun, Review at 12 9 (http://opinionator.blogs.nytimes.com/2013/10/09/turning-education-upside-down/); See also http://opinionator.blogs.nytimes.com/2013/10/23/in-flipped-classrooms-a-method-for-mastery; http://www.washingtonpost.com/blogs/answer-sheet/post/flipping-classrooms-does-it-make-sense/2012/06/06/gJQAk50vJV_blog.html. The Flipped Learning Network, an online professional community for educators using this approach, was established in 2012 and the Annual Flipped Conference enters its 6th year in 2013.

[2] Note that none of the APS teachers that incorporate elements of the flipped classroom approach in their instructional method has adopted a "pure" flipped classroom teaching method. But for purposes of this report, we are treating even the hybrid, or "blended" methods as part of the flipped classroom approach.

The MAC believes that it is worth examining the potential effectiveness of the flipped classroom approach. 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. If the students have such access, the flipped classroom approach would 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. Furthermore, recorded lessons would permit students, as well as parents, to replay concepts they have difficulty understanding.

Empirical research to support the effectiveness of the flipped classroom approach is scarce.[3] Also, the factors related to the potential success and/or failure of this approach have not been extensively studied. Thus, the effectiveness of this approach in different contexts and on a large scale is still unclear. However, based on the current available research, the MAC believes that the flipped classroom approach may hold promise for all APS students, including those who are struggling in Mathematics, but believes that data and analyses are required to evaluate and confirm this belief.

Recommendation and Rationale

The MAC recommends 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 recommends 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. Student and parent surveys can be conducted online through a set of structured questionnaires, but the MAC recommends semi-structured interviews for teachers and administrators so that

[3] http://flippedlearning.org/Page/63

they have opportunities to provide details as necessary. The goal of each of these surveys is briefly discussed below:

Teacher Survey: This survey will ask teachers to describe the flipped classroom approach they are using, give reasons why they used a particular approach, their evaluation of its effect on students' motivation, classroom engagement, attendance, and test scores.

Student Survey: This survey will ask students about their experience with flipped classrooms, specifically whether it allows them more interaction time with the teacher and their peers in the classroom, whether they find the additional time it allows them to work on homework or in small groups, or individually with teachers, makes learning easier or more fun, and whether they feel they have adequate access to lesson materials outside the classroom.

Parent Survey: This survey will ask parents about their perception about the flipped classroom approach. Parents will be asked if they like the approach in general, if the in-home lessons help them understand/brush-up on the topics so that they can help the students better, whether watching/reading lessons at home is feasible given the students' other commitments, and whether they have more or fewer opportunities to engage in student learning. Parents will also be asked if they have appropriate internet access at home and a dedicated device for the students to access lesson materials.

Principal Survey: This survey can be administered to all principals in APS (but with primary focus to those at the secondary-level) to gather information on principals' understanding of the flipped classroom approach, reasons they may or may not encourage the use of this approach, and potential challenges.

The surveys would provide valuable information on the feasibility of employing flipped classroom instruction and its potential effects on student learning in APS. Only if deemed feasible, the MAC recommends 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.[4]

Examining scores of students in flipped classrooms will likely be challenging because motivated teachers are more likely to use this instructional approach and students of motivated teachers tend to do well. Thus, it may be difficult to

[4] 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.

separate out the effects of teacher motivation from the instructional approach. In addition, comparing student test scores of the same teachers before and after they used flipped-classroom instruction could be problematic because it is likely that different cohorts of students will be compared.[5]

The MAC recommends 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.

Budget Impact

The cost of the recommended feasibility study in the First Stage has two components: (1) the cost of the surveys; and (2) the cost of analyzing data from the surveys. Developing the contents of the 4 surveys can take up to 2-3 weeks of full time effort from one APS staff member and about a week to pre-test and fine tune. The staff member will have to monitor the progress of, and any issues with, the online surveys (parents and students), and conduct in-person surveys for the semi-structured interviews with the teachers and principals. This effort could take up to another 2-3 weeks of full time effort. Analyzing data from the surveys and writing a short report could take up to 5-6 weeks. Thus the cost of the First Stage is equivalent to employing a staff member with appropriate capabilities for about 2.5-3 months in a full-time capacity.

If APS employs an independent evaluator to perform the formal evaluation of the flipped classroom approach (i.e., the Second Stage), the cost can range between $125,000 and $150,000. The evaluator will analyze student- and classroom-level data from several years to formulate a comparison group and examine impacts on test scores. Since student- and classroom-level data is already available from APS, the evaluator will not have to collect, on his or her own, data on test-scores, classroom assignments, and student demographic characteristics. If APS decides that it has the appropriate capacity to conduct this evaluation internally, it will require shifting resources from elsewhere since several staff members will have to devote significant time to complete this task. The evaluation may require about 3-4 months of full time level of effort from at least two (2) APS staff members with the appropriate capabilities to conduct this evaluation.

Staff Response:

APS staff supports this overall recommendation.

[5] Thus, it will not be clear whether differences in test scores, if any, among these two groups of students are due to the effects of different cohorts or the different instructional approaches.

Versions of the "Flipped Classroom" and "Blended Learning" models are currently being explored by several APS middle and high school teachers. Gathering data on the teachers' use of different implementation models and its effectiveness on student learning will inform next steps on further development of the model and its use. Students' and parents' responses will provide valuable data on the levels of access to the online lessons and videos at home and to what extent the model is a useful and effective learning tool for all participating students and parents. The principals' response will provide important baseline information on supports needed at the school level. In addition, the math office will review current research regarding effective blended classroom models.

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 MAC recommended in its 2011-2012 Annual Report that all APS elementary schools have a Full-Time Math Coach; as of the end of the 2012-13 school year, only 9 (all Title 1 schools) had Full-Time Math Coaches.

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.[6] 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 skyrocketed. See Table Below:

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

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

Recommendation and Rationale

The MAC recommends that every APS Elementary School be allocated at least one Full-Time Math Coach.

The MAC continues to stand by its February 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.

Currently, all elementary schools within APS have at least a "half-time" Math Coach while all nine Title 1 schools (i.e., those schools where a substantial number of kids require free or reduced price lunches) 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 to achieve Mathematics understanding at the same levels as non-Title 1 schools, there is a substantial number of students in each APS Elementary School that could benefit from additional Math Coaching assistance.

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 pushed 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 at the elementary school-level.

Substantial APS Elementary School Population Increases

[6] 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.

A strong factor supporting this recommendation is that the number of students within APS Elementary Schools has grown substantially over the past 5 years, since about the time the School Board approved funding for half-time Math Coaches across all APS Elementary Schools. Since then, the APS Elementary School population has increased 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.[7]

"Reading Specialist" Comparison

Both reading and Mathematics are core subjects where students in their formative learning years can only gain by having additional instructional assistance accorded to them. Within the APS Elementary Schools, reading skills 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 five (5), currently have over 500 students. Each of the five (5) schools that do not exceed 500 in population already has a1.0 FTE Math Coach.

Budget Impact

Currently, 13 APS Elementary Schools have a 0.5-FTE Math Coach. Increasing these schools' Math Coach resource to a full FTE will require an additional 6.5 FTEs of new hires. Assuming a $90,130 planning factor for an FTE, this recommendation will require $585,845 of funding to implement during the 2014-15 school year. Or, in a less costly alternative given APS budgetary constraints, increase the Math Coaching complement in, say, four (4) of those non-Title 1 APS Elementary Schools that are consistently showing lower Math SOL scores (those lower than some of the Title 1 schools) to a full FTE. In such case, the funding required during the 2014-2015 school year would be $180,260.

STAFF RESPONSE:

APS staff supports providing a full time math coach at every elementary school in the district. Data supports that since the implementation of math coaches in the elementary schools, students' math achievement has increased. Math coaches are instrumental in helping teachers improve

[7] 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

their instruction by co-planning, modeling instruction, and co-reflecting on teachers' instructional practice. With the district's strategic goal to increase the number of students enrolled in Algebra 1 or above by 8th grade and the state's more rigorous SOL math tests, teachers will need targeted support in their math instruction to help students be successful as they grow in their understanding of mathematics. Math coaches also provide teachers with job-embedded professional development for teachers on content knowledge and pedagogy. Their collaboration with principals will be critical in the district's ongoing work on improving instruction to benefit all students so that the achievement gap will be eliminated.

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

Background

While the recommendation of two (2) years ago (February 2012) of increasing the average time spent on Math from 45 to 60 minutes 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. Perhaps it is best, at this juncture, i.e., in the drive to close the "achievement gap" for APS to focus on increasing the Math instructional time to 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 develop the core course content more thoroughly. The status of the Strategies courses is that they 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 test data. In addition to Strategies, Swanson Middle School has introduced a program for its 6th 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 1st period, taught by the same teacher, provides 65 minutes of daily Math instruction.

Recommendation and Rationale

The introduction of the "Strategies" courses and the program at Swanson, may currently affect a small percentage of middle school students, but the MAC believes that it is advisable for all middle school students requiring help to

receive additional Math instruction. Therefore, the MAC recommends that APS provides greater awareness to middle school students of such instructional opportunities. The increasing need for Mathematics fluency affects all students, but in the interest of eliminating the achievement gap within APS, resources should be focused on those who may require additional tutelage through programs such as Strategies. 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.

Budget Impact

There should be minimal budget impact in that the "Strategies" and Swanson initiatives are fully funded.

Staff Response:

APS staff supports this overall recommendation.

Math 6, 7, 8 and Algebra I Strategies courses provides identified students with the targeted instructional support that they need. The additional instructional time allows teachers to preview key concepts and vocabulary so that students who would otherwise struggle can now gain confidence to engage more fully in their grade-level math courses including Algebra I in 8th grade.

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-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 the time of the MAC's 2012-13 Report (March 2013), at least two secondary schools lacked licensed Math teachers to instruct their ELL students in the subject.

Recommendation and Rationale

This recommendation was made to the Board two years ago (February 2012), and as of March 2013, all teachers who taught Mathematics to ESOL/HILT students within the three high schools, HB Woodlawn and 3 out of the 5 middle schools were Math certified. There were only two teachers at the middle school level who taught newly arrived ESOL/HILT students Mathematics (i.e., HILT level 1) who were not Math certified.

Today, there is just one middle school within APS that needs Math certification for teacher(s) instructing ESOL/HILT students in Mathematics.

As next steps, APS needs to ensure that all teachers who provide Math instruction to ELLs be certified in Mathematics and have the requisite experience and training in providing sheltered English instruction to ELLs. 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.

Budget Impact

There should be minimal budget impact if APS reassigns an already Math certified APS teacher, with SIOP training, from within the APS middle school in question.

STAFF RESPONSE:

APS staff supports the requirement that all teachers instructing mathematics to secondary students enrolled in the ESOL HILT program be licensed in secondary mathematics and also be trained in Sheltered English Instruction or SIOP for the mainstream classroom. This combined background and training of teachers will help ensure that all ELL's in APS will receive targeted academic language support in math instruction. This will help ELL's to graduate on time and be prepared to pursue higher levels of education.

This year all K-8 math coaches and all the mathematics teachers at one of the middle and one of the high schools received training on Level 1 SIOP. In response to the Mathematics and ESOL HILT program evaluation recommendations, the two offices are collaborating to provide comprehensive SIOP training to all secondary teachers of mathematics.

3. Other Topics Under Study

During the 2013-2014 academic year, the MAC will build on the work it performed in 2012-2013 by further studying several topics that may serve as the basis for future recommendations. The APS district goals 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 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.

Rich Tasks

The MAC is also considering ways to increase the learning done through implementation of rich tasks (i.e., committing the instructors to sustained exploration of topics) across the county. Last year (2012-13) was a pilot year for rich tasks, and the MAC looks forward to examining the efforts of the elementary school Math Coaches to train K-8 teachers as well as the efforts of the high school and middle school teachers, to implement the rich task techniques they have learned through training that APS has provided.

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 inviting selected APS Math teachers to describe their "best practices" of instruction or reviewing 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). In addition, the MAC may study whether provision of Sheltered Instruction Observation Protocol (SIOP) training to all Math teachers may serve to bolster the effectiveness of Math instruction to English Language Learner (ELL) students. Furthermore, the MAC will explore how to spread Best Practices most effectively throughout APS.