

**2017-2018 Advisory Council on Instruction  
MATHEMATICS ADVISORY COMMITTEE  
MEMORANDUM**

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**TO:** The School Board of Arlington Public Schools

**FROM:** ACI Mathematics Advisory Committee **DATE:** 12/13/2017

**SUBJECT:** Annual Report, 2017-18

**COMMITTEE MEMBERS:** Amy Beaumont, Ron Fecso, Mark Hill (chair),  
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**STAFF LIAISON:** Shannan Ellis, Mathematics Supervisor

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## 1. INTRODUCTION

This report presents the Mathematics Advisory Committee's (MAC's) recommendations for continually improving the teaching and learning of Math in Arlington Public Schools (APS). These recommendations are intended to address the School Board's strategic plan 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 two specific recommendations for the Advisory Council of Instruction (ACI) and the School Board to consider this school year:

- 1) Ensure employment of a full-time Math Coach at every elementary school; and
- 2) Apply Selective Algebra I Acceleration.

Before setting forth our recommendations, 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. The MAC also acknowledges the challenges APS faces regarding budgetary constraints and understands the advantages of working collaboratively with other ACI advisory committees. We, therefore, welcome any opportunities for discussions regarding our recommendations.

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## **2. 2017-18 RECOMMENDATIONS**

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

### **2.1 Recommendation #1: 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 effectively implement the APS math curricula and assist them in designing approaches to improve student achievement and instruction. As APS continues to grow their professional learning communities, the Math Coaches play an instrumental role. They strategically work alongside teams of teachers to help them design differentiated instruction for a wide range learners. Math Coaches work collaboratively with teachers in interpreting data to determine appropriate instructional responses. The coach helps teachers design long-range and short-range plans to meet the needs of students throughout our data driven school system.

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.

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 has continually recommended, since its 2011-2012 Annual Report, that all APS elementary schools have a Full-Time Math Coach. As of this school year, 2017-18, only 11 of the 23 APS elementary schools had Full-Time Math Coaches (the eleven (11) schools are comprised of all Title 1 schools, i.e., those schools where a substantial number of students receive free or reduced price lunches, plus two non-Title 1 schools).

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-

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up period that academic research generally indicates is the amount of time needed for the effect of coaches to be felt.<sup>1</sup>

### **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 long-standing recommendations 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) plus two other schools have an additional half-time Math Coach. While it may seem, on its face, that the Title 1 schools are where more support is needed to help students to achieve 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 coaching support provided to teachers.

The new Math standards are having 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 Algebra I by the 7<sup>th</sup> or 8<sup>th</sup>-grade. Such a shift will drive the need for further math coaching support at the elementary school-level.

### **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 several years. Projections show that the APS Elementary School populations will be over 40% greater by 2020 compared to the time (2008) when the School Board approved funding for half-time Math Coaches in all APS Elementary Schools.<sup>2</sup>

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<sup>1</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>2</sup> Student population for APS Elementary Schools was 10,166 in 2008; such population is projected to increase to 14,459 by 2020. ([https://www.apsva.us/wp-content/uploads/2015/04/Capacity\\_Utilization\\_FallProjections17-26\\_Final\\_Web.pdf](https://www.apsva.us/wp-content/uploads/2015/04/Capacity_Utilization_FallProjections17-26_Final_Web.pdf))

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## **Budget Impact**

Currently, 12 APS elementary schools have only a 0.5-FTE Math Coach. Increasing these schools' Math Coach resource to a full FTE will require an additional 6 FTEs of new hires. Assuming a \$90,130 planning factor for an FTE, this recommendation will require \$540,780 of additional funding to implement during the 2018-19 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 to a full FTE. In such case, the funding required during the 2018-2019 school year would be \$180,260.

## **2.2 Recommendation #2: Apply Selective Algebra I Acceleration**

### **Background**

The debate over Algebra I acceleration concerns two issues: i) strongly encouraging, if not requiring all students to take Algebra I by 8<sup>th</sup> grade and ii) encouraging strong math students to take Algebra I in 7<sup>th</sup> grade or earlier. While the latter appears to be leading students to thrive, policymakers are realizing that the former may not be appropriate for all students. APS should adjust its approach accordingly. Placing students in math courses that match their skills need is the best way to boost math proficiency and reduce the achievement gap.

The MAC has begun a review of Algebra I acceleration in APS. APS currently has a very high share, of its 8<sup>th</sup> graders taking Advanced Math (Algebra I and above); enrollment peaked at 82% in 2015-16, before edging down slightly to 77% in 2016-17. There are signs that some students are struggling in Regular 8<sup>th</sup> grade Algebra I based on end-of-year course grades. APS middle school students in Intensified Algebra I (including those enrolled as 7<sup>th</sup> graders) appear to be doing well based on the same metric. The MAC would like to take a broader look at the issue by examining how accelerated students are doing not just in Algebra I but also in Algebra II and looking to see how SOL scores might best be used in determining the potential for success in Algebra I at the various grade levels. Such examination could be optimally conducted if the MAC could meet with the appropriate APS personnel that can provide access to such data.

In the Appendix, we provide background material on recent trends in Algebra I acceleration, both nationally and within APS.

### **Recommendation and Rationale**

#### **Regular 8<sup>th</sup> Grade Algebra I**

- **Encourage Math 8 as an alternative to Algebra I for Middle School students not likely to thrive in Algebra I**

Year-end grades suggest that a subset of APS students is having difficulty keeping up with 8<sup>th</sup> grade Regular Algebra I. In addition to being discouraged in Algebra I, they have also missed

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an additional year of instruction in critical pre-Algebra skills that are likely to have more application to every day life than Algebra I. As such, we recommend that APS adopt more stringent eligibility criteria for Algebra I in 8<sup>th</sup> grade to ensure that students that do enroll stand a good chance of succeeding at a level that would encourage taking further math and to allow other students the opportunity to solidify their base which will better prepare them to succeed in Algebra I in 9<sup>th</sup> grade.

- **Publish a list of skills that must be acquired each year in order to be ready for Algebra I in 8<sup>th</sup> grade**

The goal of 8<sup>th</sup> grade Algebra I is a good one so long as a strong math base is in place first. APS should publish a list of the skills that students need to master for each grade to be on track for 8<sup>th</sup> grade Algebra I and highlight it to parents and students. In this way, gaps can be spotted and addressed early on and students are not left disappointed in 8<sup>th</sup> grade when they realize they are unable to take Algebra I until high school.

#### **Intensified Algebra I**

- **Maintain Option for APS students to take Algebra I in 7<sup>th</sup> grade**

Intensified Algebra and the current placement approach seem to be working well, with students appearing comfortable with the material presented. We recommend maintaining the option to allow students with strong math backgrounds the option of taking Intensified Algebra I in 7<sup>th</sup> grade.

- **Ensure APS students that take Algebra I in 7<sup>th</sup> grade have covered all prior math curriculum and publish the compacted curriculum**

While APS allows qualified students to accelerate and take Algebra I in 7<sup>th</sup> grade, APS has generally waited until 6<sup>th</sup> grade to begin the acceleration. Previously, this meant that accelerated students would skip some parts of the grade 6-8 curriculum. As part of the 2016 standards, APS is now compacting its math curriculum for accelerated students so that no content is skipped. We applaud APS on this approach and encourage it to extend math compaction deeper into elementary school to ensure a more gradual compaction path. We also encourage APS to publish its yearly compacted math curriculum so there is consistency across schools and so students and parents can see clearly what skills are being accelerated into each year.

#### **Additional Related Thoughts**

- **Expand flexible math groups in elementary schools to ensure “just right” instruction for all students**

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Consider expanding flexible math groupings beginning in 3<sup>rd</sup> grade as is currently done in Fairfax County, which can also facilitate earlier compaction of the math curriculum.<sup>3</sup> APS's 1:1 Digital Learning Initiative stresses the importance of targeting instruction to a student's particular needs to give them the strongest academic base possible. The same philosophy can extend to classroom structure as well. A teacher with a class of students who is learning the same material can better deliver "just right" instruction. This would help all students – it gives teachers more leeway to support struggling students and to challenge stronger students. As there is only a fixed amount of planning time, it is more efficient to have each teacher devote their time to making one well-developed lesson plan rather than asking each teacher to split their planning time among multiple, lesser-developed lesson plans targeted at different instructional levels within the same class.

### **Budget Impact**

The MAC sees little, if any, budgetary impact due to this Recommendation.

### **3. Comment on past Recommendation: Continue to provide support, mentoring, and resources to teachers interested in using the "Flipped Classroom" approach.**

The MAC applauds the efforts of APS in supporting the flipped classroom initiative (which the MAC has touted since its 2013-14 Recommendation report) and urges APS continue providing teachers the autonomy to decide how to effectively deliver the material that they are required to teach and support them as needed. The flipped classroom helps support the personalized learning initiative.

The MAC believes that APS should support, if not encourage, teachers to experiment with using a flipped classroom approach to teaching math: using class time for the problem solving that was traditionally viewed as homework, while asking students to spend time at home learning new material via video lessons. After all, teachers of social studies, English, and science, typically ask students to learn new material at home by reading a chapter or more, thereby freeing more classroom time for group activities, like discussions or labs.

As math teachers become more comfortable creating or selecting online video lessons for their students, we urge APS to continue to (1) identify math teachers who are using flipped classrooms, so others interested can either consult them or access a centralized database that serves as a repository for flipped classroom learnings; (2) use existing professional development (PD) funds to help any

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<sup>3</sup> Fairfax County Public Schools Mathematics Curriculum Study, Final Report, September 2014, FCPS Office of Program Evaluation.

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teachers interested in initiating or improving a flipped classroom approach to obtain appropriate PD; and (3) ask math coaches to share material so that APS can help flipped classroom teachers identify the most engaging video material available for each topic of the Virginia math SOLs.

#### **4. Other Topics Under Study**

During the 2017-2018 academic year, the MAC will continue to conduct further study into several topics that may serve as the basis for future recommendations. The APS School Board current strategic plan goals and priorities are at the forefront of the MAC's deliberation on such topics. One topic is discussed below.

#### **Develop "Students Tutoring Students" Approach at the Secondary Level / Peer 2 Peer**

One-on-one, student-to-student - peer tutoring of math – has long existed at the APS high schools, but rarely at middle or elementary schools. APS math teachers should consider encouraging the stronger math students in middle and elementary school to tutor weaker classmates in math, if there is sufficient interest. Teachers should also encourage those top students to create video clips to illustrate difficult SOL topics for their classmates by incorporating humor, music, special effects, and, where possible, games. Such approach would resemble the existing APS SMASH program (<http://www.smashcontest.org/>) but not be limited to examples tied to sports. There could be an annual county-wide competition for the best math games and the best could be posted on a district website, available to all APS students. Students could be encouraged to build videos around whatever events (sporting or other), celebrities, products, music, or stories were "hot" or trending,

#### **Appendix**

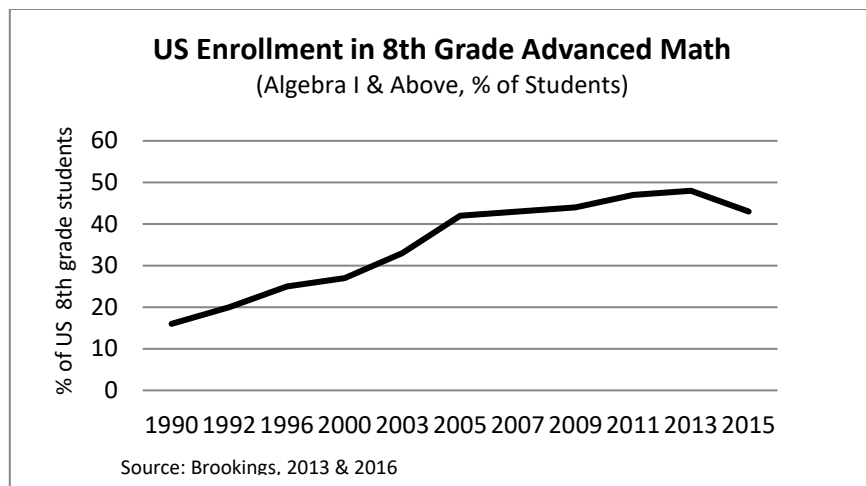
##### **Background on Algebra I Acceleration in Middle School (2015-16 data)**

Traditionally, most students took Algebra I in 9<sup>th</sup> grade, while strong math students took it in 8<sup>th</sup> grade. Beginning in the 1980s, however, efforts were made to expand the number of students taking 8<sup>th</sup> grade Algebra I; the share of US 8<sup>th</sup> graders taking advanced math (Algebra I & above) soared from 16% in 1990 to 48% in 2013 before easing back in 2014-15. <sup>4</sup>

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<sup>4</sup> Loveless, Tom, "The Algebra Imperative: Assessing Algebra in a National and International Context", Brown Center on Education Policy at Brookings, September 2013.

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### What were the results of the sharp increase in US 8<sup>th</sup> grade Algebra I enrollment?

- The results were mixed; the number of students passing Algebra I rose but the number of students getting discouraged/dropping out also rose because their math base was not strong enough. Of the students in the bottom 10% of the National Assessment of Educational Progress (NAEP) in 2005, roughly 30% were still placed in Algebra I or above despite having math skills at 3<sup>rd</sup> grade or below.<sup>5</sup>
- Despite hopes that 8<sup>th</sup> grade Algebra I enrollment would be a gateway to higher math, not all of the newly enrolled 8<sup>th</sup> grade Algebra I grade students continued on to geometry.<sup>6</sup>

Many now believe that the negative effects of universal 8<sup>th</sup> grade Algebra I outweigh the benefits. Common Core emphasizes general 8<sup>th</sup> grade math over Algebra I for most students, prompting the share of students taking advanced math in 8<sup>th</sup> grade to trend lower recently. Of note, after adopting Common Core, the share of California students taking advanced math in 8<sup>th</sup> grade fell from 73% in 2013 to 45% in 2015.<sup>7</sup>

### APS Middle School Algebra I

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<sup>5</sup> Ibid.

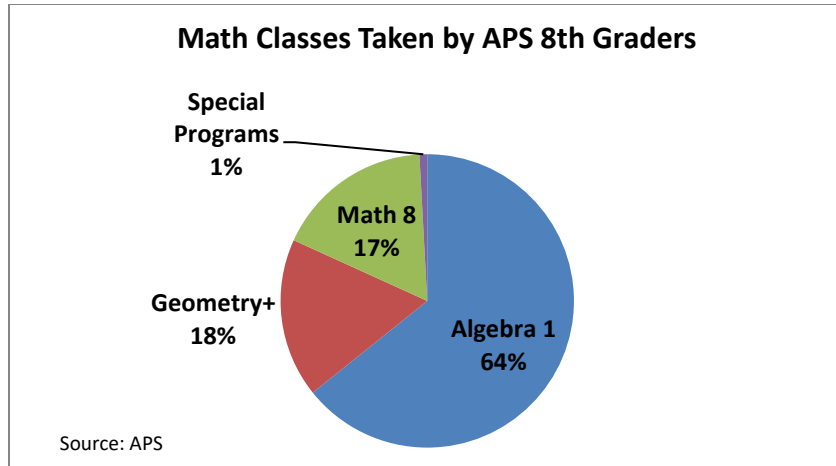
<sup>6</sup> Liang, Jian-Hua, Paul Heckman, Jamal Abedi, “What do the California Standards Test Results Reveal About the Movement Toward Eight-Grade Algebra for All?”; *Education Evaluation and Policy Analysis*, 34(3):328-343, September 2012.

<sup>7</sup> “The 2016 Brown Center Report on American Education: How Well Are American Students Learning?” Brookings Institution, March 2016.

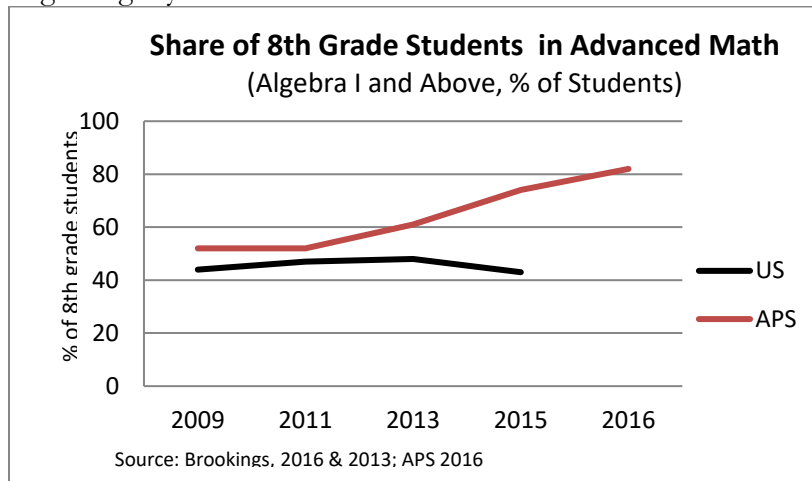


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APS never mandated 8<sup>th</sup> grade Algebra I for all students, however, it still has a very large share of its 8<sup>th</sup> graders taking advanced math -- 82% took Algebra I or above in 2015-16, nearly double the national share.



Given income and education levels, one would expect Northern Virginia to have a higher share of 8<sup>th</sup> grade advanced math pupils than the US as a whole. However, much of the rise in APS's share of advanced 8<sup>th</sup> grade math students happened in the last three years, when the national share topped out and edged slightly lower.

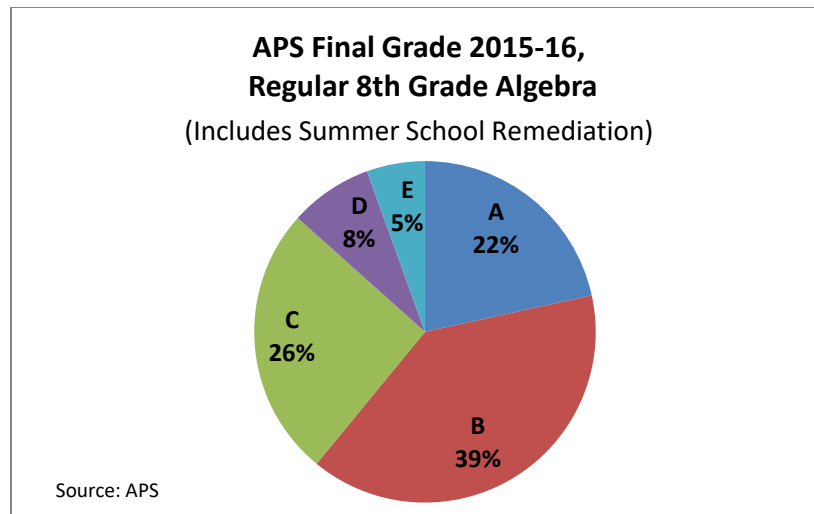


APS offers two middle school Algebra I courses – Regular and Intensified. The latter covers the curriculum for Regular Algebra I in greater depth and also covers additional topics that provide a bridge to Geometry & Algebra II. Students must have strong math skills to enroll in Intensified Algebra I. As of the 2015-2016 school-year, 46% of APS MS Algebra I students took Regular Algebra I and 54% took Intensified Algebra I.

### Regular 8<sup>th</sup> Grade Algebra I

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Higher levels of Algebra I enrollment have meant that more APS MS students are taking and passing Algebra I. However, a subset of Regular 8<sup>th</sup> grade Algebra I students appear to have struggled with acceleration. In the 2015-16 school year, 13% of students taking Regular Algebra I (85 students) received a grade of D or E even after summer remediation is included. Nearly 40% received a grade of C, D, or E (248 students.)



The share receiving Cs, Ds, & Es has declined from two years ago as APS made additional efforts to i) mesh its Algebra I curriculum with the SOLs and exclude topics traditionally covered in Algebra II; ii) provide more remediation for struggling students; and iii) increase class discussion of difficult concepts.

	<b>% of MS Regular Algebra 1 Students Receiving a D or E</b>	<b>% of MS Regular Algebra 1 Students Receiving a C, D, or E</b>
<b>2015-16</b>	13%	39%
<b>2014-15</b>	16%	42%
<b>2013-14</b>	19%	47%

**Source: APS**

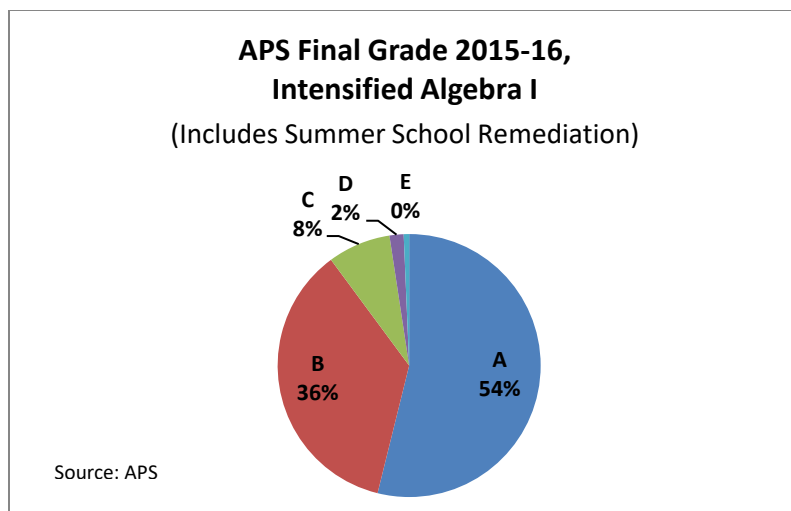
Even with recent improvements, however, it appears that a number of students in Regular 8<sup>th</sup> grade Algebra I are not thriving, and are unlikely to have a solid enough base in Algebra I to continue to higher level math.

### **Intensified Algebra I**

While some Regular Algebra I students have struggled as enrollment increased, Intensified Algebra I students appear to have done well overall even as enrollment rose -- 90% of Intensified Algebra I students received a grade of A or B in the 2015-16 school-year. This strong performance

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stems from the fact that admission to Intensified Algebra I is selective, with only stronger students permitted to enroll.



Of note, more than half of Intensified Algebra I students are 7<sup>th</sup> graders. This is consistent with the rising national trend of permitting strong 7<sup>th</sup> grade math students to take Algebra I. This provides an additional challenge for stronger math students and offers STEM students more space for additional math & science classes in high school. While only 5% of US students take Algebra I in or before 7<sup>th</sup> grade, the share is much higher for students in STEM schools, which often have competitive entrance exams.<sup>8</sup> Notably, 93% of the Thomas Jefferson HS for Science & Technology (TJHSST) Class of 2020 took Algebra I in 7<sup>th</sup> grade or earlier.<sup>9</sup>

The grade distribution for APS Intensified Algebra I suggests that the group of 7<sup>th</sup> graders now permitted to take it can handle the rigors of the APS accelerated math curriculum and thrive. Furthermore, an APS Math Office survey showed that nearly all of these accelerated students continued to take math throughout high school and did not “run out of courses to take”.<sup>10</sup>

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<sup>8</sup> “The 2013 Brown Center Report on American Education: How Well Are American Students Learning? Part III: Advanced Math in Eighth Grade”, Brookings Institution, March 2013.

<sup>9</sup> <http://www.fcag.org/documents/TJ+Class+of+2020+Math.pdf>

<sup>10</sup> The APS Math Office examined a cohort of students at Wakefield HS & Yorktown HS that took Algebra II/Trig in 9<sup>th</sup> grade to see whether they continued to take math through to 12<sup>th</sup> grade. For Wakefield, 100% of the accelerated students that remained within APS took Multivariable Calculus, Calculus AB, or AP Statistics in the 12<sup>th</sup> grade. For Yorktown, 97% took Multivariable Calculus, Calculus BC, or AP Statistics. W&L High School is not included because the IB program has differing math graduation requirements.

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