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Review of Enrollment in APS Pre-Kindergarten Programs and Academic Performance during the Middle School Years

Prepared for Arlington Public Schools

In this report, we examine the ongoing performance of a cohort of students who participated in pre-kindergarten programs within the Arlington Public Schools (APS). These programs include Montessori, Virginia Preschool Initiative, Special Education, and Dual Enrolled Special Education. Included in this report is a comparison with students who did not participate in such programs. Performance measures include a variety of assessments conducted between sixth and eighth grade, such as the Degrees of Reading Power (DRP) Program, the Standards of Learning (SOL), and the Stanford Achievement Test Series (Stanford 10). We also include a secondary analysis that describes differences in World Languages course enrollment in middle school.

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Overview

Executive Summary

This report serves as a companion document to a report entitled "Longitudinal Analysis of Performance of Students in APS Prekindergarten Programs" created by Hanover Research for the Arlington Public Schools (APS) in June 2008. In that report we provided an analysis of the impact of participation in APS pre-kindergarten programs on future academic performance during grades K-5. We provided a preliminary investigation of the differences in academic performance between participants and non-participants in APS Pre-K programs. Our analysis also highlighted differences in performance among participants of the various APS Pre-K programs.

In this report, we replicate the analysis of subsequent academic performance described in the 2008 report, focusing on the subsequent performance of the same group of pre-kindergarten students in grades six through eight. Performance measures include the Degrees of Reading Power (DRP) Program, Standards of Learning (SOL), and the Stanford Achievement Test Series (Stanford 10). We also include an examination of enrollment in World Languages during middle school. We describe differences in academic performance in several ways. For example, in the first section, we examine the data based on seven categories:

- Full Cohort - All Students
- APS Pre-K Attendees
- No APS Pre-K
- Montessori
- Virginia Preschool Initiative (VPI)
- Special Education
- Dual Enrolled Special Education

In addition, we examine the performance of middle schools students according to their economically disadvantaged (ED) status. This analysis is performed in order to isolate the interaction of ED status and APS pre-kindergarten participation on academic performance. For similar reasons we also disaggregate the academic performance of students according to whether they were classified as having Limited English Proficiency (LEP).

In this report we confirm the following trends, first identified in 2008:

- APS Pre-K students score lower, on a variety of tests, than students who did not attend an APS Pre-K program.
- APS Montessori students outperform VPI students.
- ED APS Pre-K students score higher than ED non-participants.
- LEP APS Pre-K students outperform LEP non-participants.
- LEP Montessori students score higher than LEP VPI students.

It is important to note that throughout this report we frequently refer to "APS Pre-K participants" and "non-participants." While these "non-participants" did not attend an APS Pre-kindergarten program, they likely attended other programs.

For each category, we calculate sample means and standard deviations for students' scores on a number of assessments.[1] This provides a basis for comparison between groups. We are then able to determine how students who participated in an APS Pre-K program compared to students who did not enroll in an APS Pre-K program on each performance measure. This allows us to answer questions related to specific programs such as: Did individuals who participated in the VPI receive higher scores on their sixth grade DRP than students in the Montessori program?

By examining the data in this manner, we are also able to determine whether the effects of APS Pre-K program participation appear to diminish over time. Comparing student scores on a number of assessments conducted at different points throughout their educational experiences allows us to see if average scores between APS Pre-K program participants and non-participants begin to even out at a certain point.

When calculating average scores, we used all available testing data, including SOL scores marked as "excluded in calculating accreditation ratings." We did this in order to provide the most complete picture of APS Pre-K participant and non-participant academic performance. In our commentary, we focus our discussion on comparisons between groups for which there are at least 10 members in each.

In subsequent sections, we break down the data based on Economically Disadvantaged (ED) and Limited English Proficiency (LEP) status. This enables us to control for some factors that may influence student performance beyond participation or non-participation in an APS Pre-K program.

[1] Due to the large amount of data, we provide an Excel file accompanying the report which includes all of the sample means and standard deviations for each performance measure included in the raw data. In the body of this report we describe major trends, illustrated with a selection of assessment scores.

Key Findings

Comparison with the 2008 Report

- Results from this report continue the trend identified in the 2008 report in which APS Pre-K students scored lower on a variety of assessments than students who did not participate in APS Pre-K programs.
- As in the 2008 report, APS Montessori students outperformed VPI students on most assessments.
- Aligned with 2008 results, students who were dual enrolled in special education had higher scores than students who were enrolled only in special education.
- As was seen in the 2008 report, economically disadvantaged students who participated in APS Pre-K programs tended to score higher on assessment tests than economically disadvantaged students who had not participated in APS Pre-K programs.
- Reversing the trend from the 2008 report, ED VPI program participants frequently had higher scores than ED Montessori participants.
- LEP students who participated in APS Pre-K programs outperformed LEP non-participants, a trend first observed in the 2008 report.
- Montessori LEP students received higher scores than VPI LEP students in both the 2008 and 2011 reports.

Full APS Middle School Cohort

- The middle school cohort contained 1,229 middle school students, including 142 who attended an APS Pre-K program. Retention among the original 392 APS Pre-K students was 36.2 percent.
- In general, APS Pre-K participants' assessment scores were lower than the scores of APS Pre-K non-participants.
- Participants in APS Pre-K programs had lower mean scores than APS Pre-K non-participants on both the fall and the spring DRP tests. The same pattern was evident for students requiring remediation.
- APS Pre-K non-participants scored higher than APS Pre-K students in middle school SOL tests, with the exception of three eighth grade tests.
- A total of 654 students within the middle school cohort took at least one advanced math class (as evidenced by SOL tests) during grades 6-8. Of these, 576 (88.1 percent) did not attend an APS Pre-K program while 78 (11.9 percent) did.

- For each grade, a slightly greater percentage of APS Pre-K participants than APS Pre-K non-participants enrolled in advanced math courses.
- A higher percentage of APS Pre-K students began world language instruction in grades six and eight in comparison to grade seven. A greater percentage of APS Pre-K non-participants began taking these courses in grade seven.
- APS Pre-K participants and non-participants performed at fairly similar levels on the Stanford 10 tests. The difference between these two groups on each of the tests described was 5 points or less.

Specific APS Pre-kindergarten Programs

Montessori versus VPI

- With respect to mean scores, with few exceptions, Montessori students outperformed VPI students on all assessments, including DRP, SOL and Stanford 10 tests, from sixth through eighth grade.
- Students in the Montessori and VPI programs had comparable SOL passing rates. For some tests, Montessori students passed at greater rates than VPI, while on other tests, this was reversed.
- Forty-four of the 79 APS Montessori students (55.7 percent) took at least one advanced math class during grades six to eight. This compares with 17 of 27 APS VPI students (63.0 percent) who took at least one advanced class. Both groups were most likely to enroll in these classes in eighth grade.
- Approximately 82.9 percent of Montessori APS Pre-K students took at least one world languages course in middle school. This compares with the 77.8 percent of APS VPI students. Students in both groups were most likely to enroll in these courses during seventh grade.
- APS Montessori students outperformed APS VPI students in each subject area of the Stanford 10 tests.

Special Education versus Dual Enrolled Special Education

- In middle school, dual enrolled students scored higher than special education students on almost all assessments including DRP, SOL and Stanford 10 tests.
- Approximately 95 percent of dual enrolled students took at least one world languages course in middle school. This compares with 47.4 percent of special education students.
- Dual enrolled students outperformed special education students on each of the four Stanford 10 tests.

Economically Disadvantaged Students

- ED students who had participated in APS Pre-K programs outperformed ED APS Pre-K non-participants on many middle school assessments described in this report.
- Seventh grade ED students who had enrolled in an APS Pre-K program scored 5 to 32 points higher on average in each SOL test for which there were 10 or more students in each group.
- Of the 402 ED APS Pre-K non-participant students, 101 (25.1 percent) enrolled in at least one advanced math course during middle school (as evidenced by SOL tests). Of the 74 ED APS Pre-K students, 31 (41.9 percent) enrolled in at least one advanced math course.
- Of the 402 ED APS Pre-K non-participant students, 227 (56.5 percent) enrolled in a world languages course. Of the 74 ED APS Pre-K students, 54 (73 percent) enrolled in a world language course.
- ED students who had participated in an APS Pre-K program outscored APS Pre-K non-participants by three to five points in every test described in the table below.
- Economically disadvantaged students in the VPI program outscored Montessori students on almost all DRP, SOL and Stanford 10 tests.

Limited English Proficient Students

- Overall, LEP students who participated in an APS Pre-K program outperformed students who did not participate in APS Pre-K on all middle school assessments described in this report.
- LEP students who attended an APS Pre-K program scored higher than APS Pre-K non-participants on all seventh and eighth grade tests for which there were 10 or more students in each group. However, sixth grade SOL scores were an exception; non-participant scores were higher.
- Of the 61 APS Pre-K students who were also designated as LEP, 29 (47.5 percent) enrolled in at least one advanced math course during middle school (as evidenced by SOL tests). Of the 353 APS Pre-K non-participants, 108 (30.6 percent) enrolled in at least one advanced math course.
- Of the 353 LEP non-participant students, 216 (61.2 percent) enrolled in a world languages course. Of the 61 APS Pre-K students, 46 (75.4 percent) enrolled in a world languages course.
- LEP students who participated in an APS Pre-K program outscored non-participants in all four Stanford 10 tests.

- Montessori LEP students received higher scores than VPI LEP students on almost every middle school assessment in the sample.

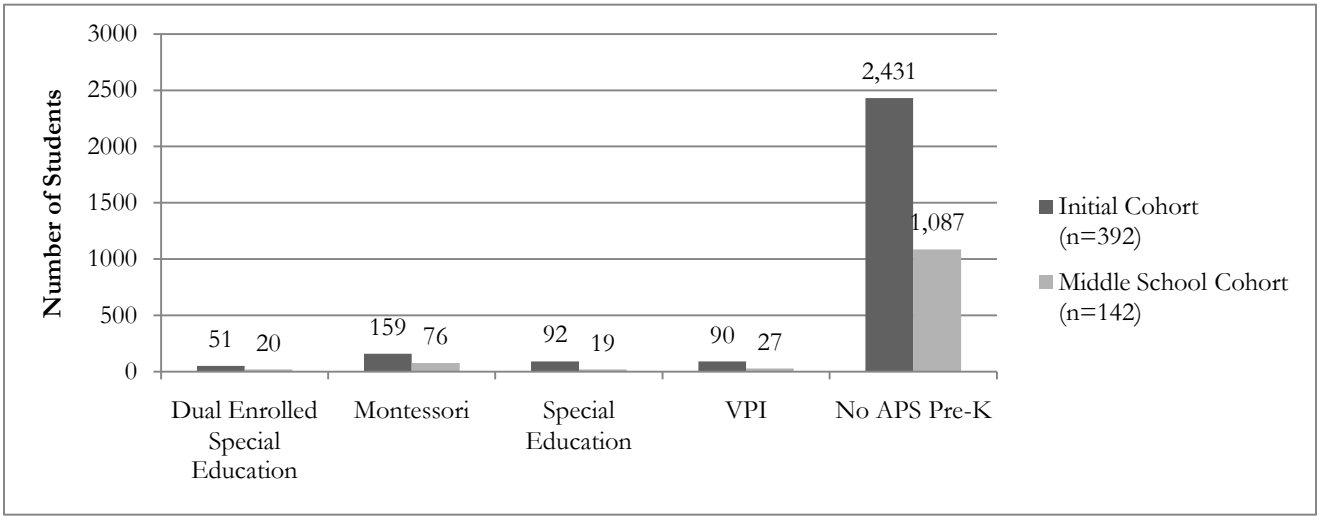
Scope and Methods of the Report

The data file provided by Arlington Public Schools included student demographic and academic assessment data gathered between 2000-2001 and 2009-2010. Variables present in the file included: APS program attendance, race, gender, and a variety of other demographic characteristics such as grade level, school, economic disadvantage (ED) status, disability status, and Limited English Proficiency (LEP) status. Also present were various middle school academic performance variables associated with the DRP program, SOLs, and the Stanford 10, and the names and course numbers associated with enrollment in world languages course work. The database included the initial cohort of 392 students who were examined in the 2008 report, as well as students who entered APS after kindergarten (including both those who left before sixth grade and those who were still enrolled in APS in middle school). There were a total of 2,834 students for whom at least one year of data were available in the database. Eleven of these students whose pre-kindergarten program was listed as "retained in kindergarten" were excluded from this analysis at the direction of APS (leaving 2,823 students in the data set).

The table below presents an overview of the retention rates of the initial APS Pre-K cohort and the entire sample into the middle school years. As this table demonstrates, **an average of 36.2 percent of students who attended an APS pre-kindergarten program went on to enroll in an APS middle school. Approximately 44.7 percent of students who did not attend an APS Pre-K program went on to attend at least one APS middle school grade**.

Retention in Middle School Cohort			
Program	**Entire Sample**	**Middle School Cohort**	**Percent Retention**
Dual Enrolled Special Education	51	20	39.2%
Montessori	159	76	47.8%
Special Education	92	19	20.7%
VPI	90	27	30.0%
All APS Pre-K Programs	392	142	36.2%
No APS Pre-K	2,431	1,087	44.7%
Total	**2,823**	**1,229**	**43.5%**

Enrollment in APS Pre-Kindergarten Programs: Initial Cohort versus Middle School Cohort



As our focus is on middle school academic performance, we limit our analysis to the cohort of students who were enrolled at APS during sixth, seventh or eighth grade and for whom we have a valid score on at least one performance test. In this report, we refer to this narrower cohort as the "Middle School Cohort."

We examine the performance of middle schools students on various tests according to their participation in APS Pre-K programs and their status as economically disadvantaged (ED). This analysis is performed in order to isolate the interaction of ED status and APS pre-kindergarten participation on academic performance. For similar reasons we also disaggregate students' academic performance according to whether they were classified as having Limited English Proficiency (LEP).

Measures of Academic Performance

Student scores were provided for a variety of assessments, including the Degrees of Reading Power (DRP) Program, Standards of Learning (SOL), and the Stanford Achievement Test Series, Tenth Edition (Stanford10).

Degrees of Reading Power (DRP) Program

The DRP by Questar Assessment, Inc., measures how well students understand the meaning of text.[2] The data sample contains DRP data for APS sixth graders for both the fall and the spring. An analysis of raw scores is presented, as is a DRP identification of whether a student was identified for remediation.

Standards of Learning (SOL)

The SOLs are a set of academic standards which are measured through annual SOL tests and assessments.[3] The data sample contains SOL data for APS sixth, seventh and eighth graders in subject areas such as Math, Reading, History, Science, Writing and World Geography. An analysis of both scale scores and an identification of enrollment in advanced math courses are presented in this report.[4,5] We give primary attention to Math and Reading SOLs.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

The Stanford 10, by Pearson Education, Inc. is a test of content typically taught in schools across the United States. The purpose of this assessment is to compare the performance of students to a representative national sample of students.[6] The data sample contains Stanford 10 data for sixth graders and includes subject areas such as reading, math, language, spelling, science and social science. Normal Curve Equivalent (NCE) Scores for the Stanford 10 are analyzed in this report.[7] While a stratification of all Stanford 10 subtests/scores are included in the Appendix, we

[2] Degrees of Reading Power (DRP) Program. http://www.questarai.com/Products/DRPProgram/Pages/default.aspx. (Accessed on 10 June 2011)
[3] Testing & Standards of Learning (SOL). http://www.doe.virginia.gov/testing/index.shtml. (Accessed on 10 June 2011)
[4] There are five possible performance levels: Pass Advanced, Pass Proficient, Fail, Fail Basic, and Fail Below Basic.
[5] "Student performance is graded on a scale of 0-600 with 400 representing the minimum level of acceptable proficiency and 500 representing advanced proficiency." SOL Test Scoring & Performance Reports. http://www.doe.virginia.gov/testing/scoring/index.shtml. (Accessed on 13 June 2011)
[6] Arlington Public Schools. Stanford 10 Achievement Test. http://www.apsva.us/Page/1125 (Accessed on 21 July 2011)
[7] Normal Curve Equivalent scores allow for comparison from one subtest to another. NCE scores of 1, 50 and 99 correspond to percentile ranks of 1, 50 and 99. The NCE is a modification of the standard score or z-score, which measures how many standard deviations above or below the mean a given score is.

focus on Reading Total, Language (Writing), Math Total, Science, and Social Science NCE scores in the main body of this report.

The table below summarizes the assessments that are described in this report.

Assessment by Testing Type, Area and Grade				
Assessment		**Grade**		
Testing Type	Area	Sixth	Seventh	Eighth
DRP	Fall	X		
	Spring	X		
SOL	Math[8]	X	X	X
	Algebra I	X	X	X
	Algebra II		X	X
	Geometry		X	X
	Reading	X	X	X
	Writing			X
	History		X	
	World Geography			X
Stanford 10	Word Study	X		
	Vocabulary	X		
	Reading Comprehension	X		
	Reading Total[9]	X		
	Math Problem Solving	X		
	Math Procedures	X		
	Math Total[10]	X		
	Prewriting	X		
	Composing	X		
	Editing	X		
	Language[11]	X		
	Spelling	X		
	Science	X		
	Social Science	X		
	Partial[12]	X		
	Total	X		

[8] Note that starting in middle school, students may take higher Math SOL tests depending on which math class they are enrolled. For example, sixth graders may take either sixth, seventh or eighth grade Math SOLs.
[9] Word Study, Vocabulary and Reading Comprehension are included in the Reading Total Score
[10] Math Problem Solving and Math Procedures are included in the Math Total score.
[11] Pre-writing, Composing and Editing are included in the Language Scores
[12] The Partial Battery score is based on the combined scores for Total Reading, Total Math and Language.

World Languages Coursework

The final area of analysis includes a description of differences in enrollment in world languages in middle school. These languages include Arabic, Chinese, French, Spanish, German, and Latin. We describe whether or not students took a world language during middle school and when this instruction began.

Full APS Cohort

As mentioned above, information regarding 1,229 students in the middle school cohort, 142 of whom attended an APS Pre-K program, was provided by APS for this report. Of the entire middle school cohort, 52.3 percent were reported as male and 47.7 percent as female. In terms of racial and ethnic composition of the group, 49.0 percent were white, 25.3 percent Hispanic, 13.9 percent black, and 11.2 percent Asian.

We begin our analysis by comparing the scores of APS Pre-K participants with students who had not participated in an APS Pre-K program.

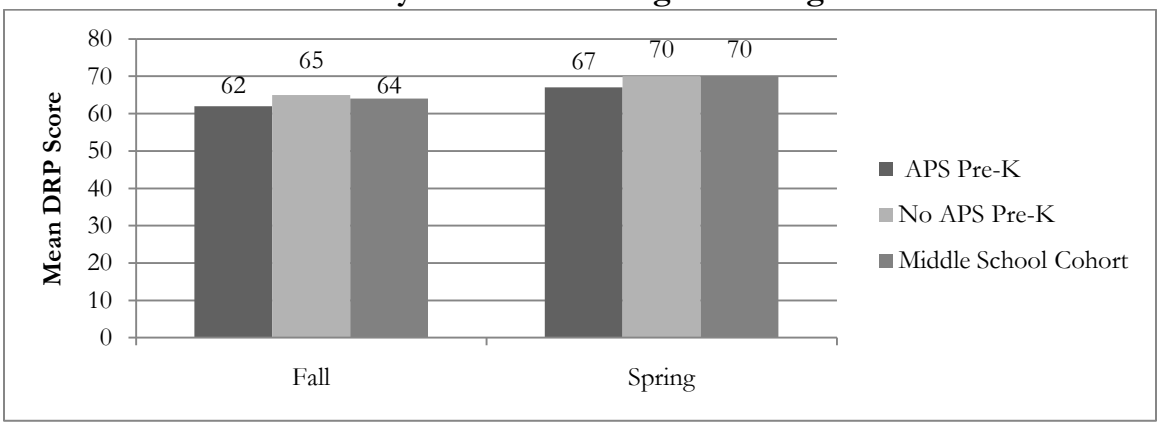
Degrees of Reading Power (DRP) Program

In this section we present an analysis of DRP raw scores and remedial designations by attendance at an APS pre-kindergarten program. Recall that the analysis of DRP scores was limited to sixth grade. For sixth grade, the instructional level of the average student is 56 (p=0.75) where p is the P-value or percent of comprehension. As shown in the table below, it is clear that participants of APS Pre-K programs had lower mean scores than non-participants on both the fall and the spring DRP.

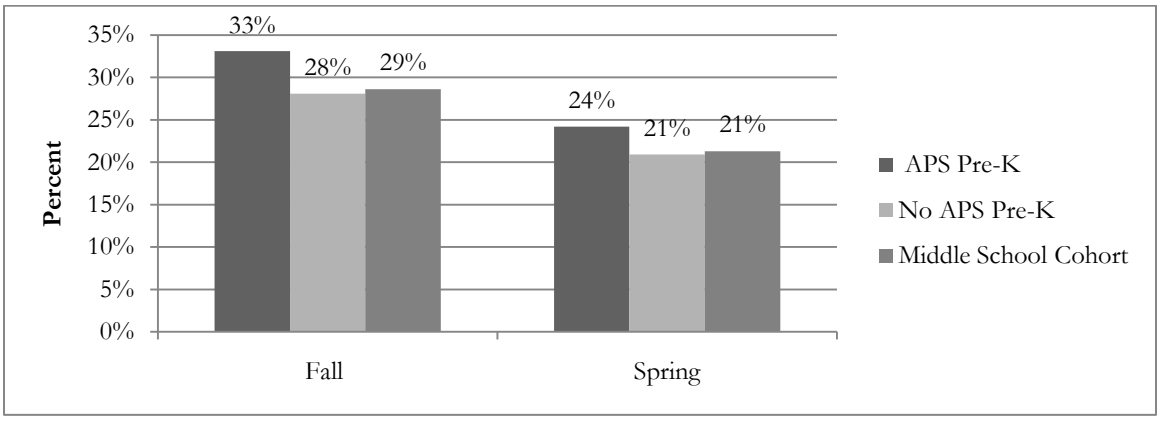
The same pattern exists for students requiring remediation. In the fall, 33.1 percent of APS Pre-K participants needed remediation, compared to 28.1 percent of non-participants. The difference was slightly less pronounced in the spring with 24.2 of APS Pre-K participants recommended for remediation while 20.9 percent of non-participants received this recommendation.

Degrees of Reading Power – Mean Scores and Remediation										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
APS Pre-K	136	61.56	13.67	45	33.1%	128	67.15	14.22	31	24.2%
No APS Pre-K	1,022	64.86	15.87	287	28.1%	969	69.94	15.13	203	20.9%
Middle School Cohort	**1,158**	**64.47**	**15.66**	**332**	**28.6%**	**1,097**	**69.61**	**15.05**	**234**	**21.3%**

Mean DRP Scores by APS Pre-Kindergarten Program Attendance



Percent of Students Identified for Remediation



Standards of Learning (SOL)

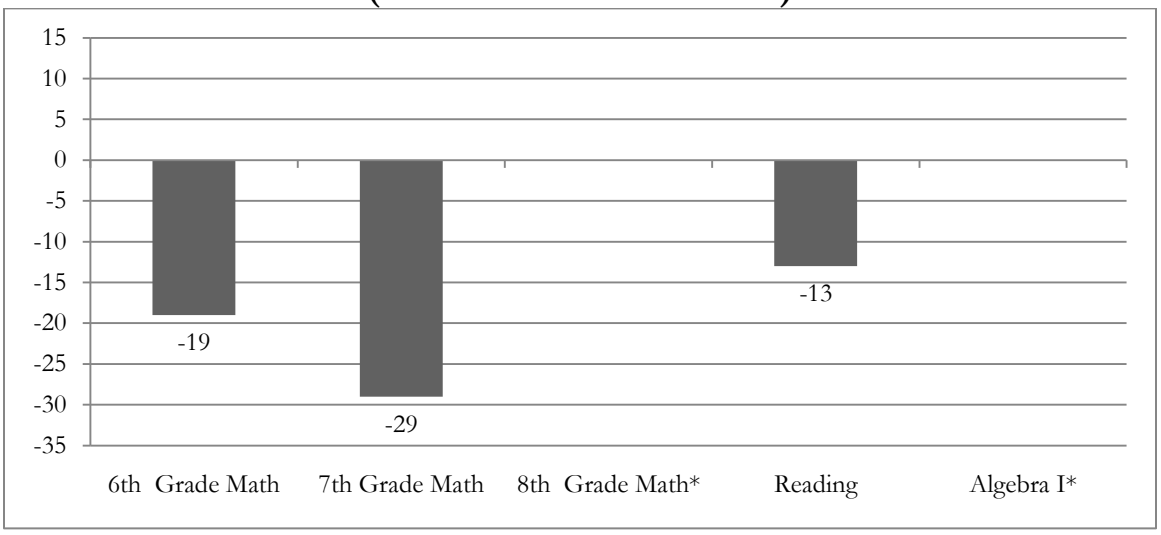
Mean Scale Scores

Looking at SOL test results, this trend continues to hold, as APS Pre-K participants tended to perform at lower levels than non-participants. The tables and figures on the following page provide average scores for SOL tests in grades six through eight. **For all SOL test results (except for three eighth grade tests), APS Pre-K participants were outscored by non-participants.**

In sixth grade, the difference between APS Pre-K and non-participants ranged from 13 points in Reading to 69 points in Eighth Grade Math. The three students who took Algebra I in sixth grade were non-participants.

Sixth Grade Standards of Learning – Mean Scores										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
APS Pre-K	76	384	54	496	6	509	136	477		
No APS Pre-K	625	403	328	525	59	578	977	490	3	572
Middle School Cohort	**701**	**401**	**382**	**521**	**65**	**572**	**1113**	**489**	**3**	**572**

Difference in Sixth Grade Standards of Learning Mean Scores (APS Pre-K – No APS Pre-K)

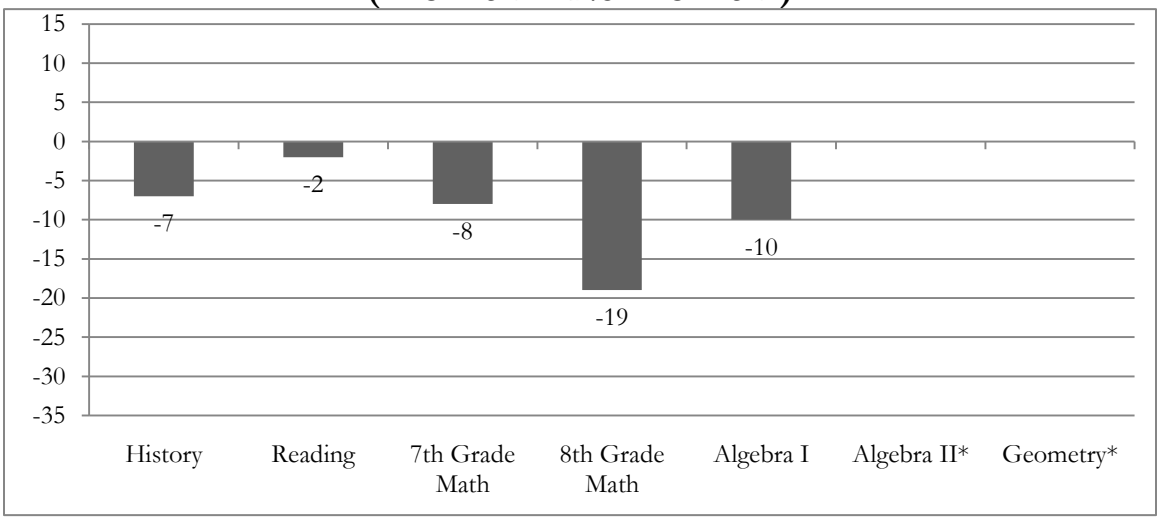


* This difference is not shown due to insufficient data.

Turning to seventh grade SOL test results, we once again see that non-participants outscored APS Pre-K participants in every test. The difference ranged from two points in Reading to 19 points in Eighth Grade Math.

Seventh Grade Standards of Learning – Mean Scores														
Group	History		Reading		7th Grade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
APS Pre-K	129	487	129	494	64	415	50	538	11	529			1	544
No APS Pre-K	956	494	957	496	531	423	307	557	115	539	1	600	2	562
Middle School Cohort	**1085**	**493**	**1086**	**496**	**595**	**422**	**357**	**554**	**126**	**538**	**1**	**600**	**3**	**556**

Difference in Seventh Grade Standards of Learning Mean Scores (APS Pre-K – No APS Pre-K)

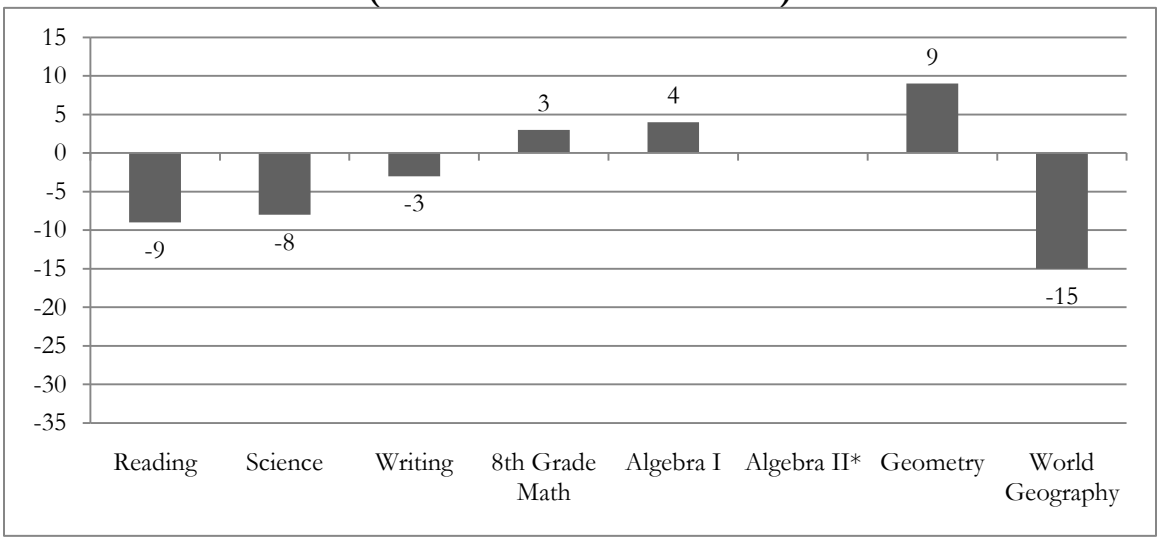


* This difference is not shown due to insufficient data.

The picture changes somewhat in eighth grade; while APS Pre-K participants lagged behind non-participants in Reading, Science, Writing, and World Geography, they scored higher in 8th Grade Math, Algebra I and Geometry.

Eighth Grade Standards of Learning – Mean Scores																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
APS Pre-K	128	487	128	490	128	446	54	451	62	509	1	581	11	553	127	470
No APS Pre-K	934	496	937	498	936	449	402	448	417	505	2	538	109	544	932	485
Middle School Cohort	**1062**	**495**	**1065**	**497**	**1064**	**448**	**456**	**449**	**479**	**505**	**3**	**552**	**120**	**545**	**1059**	**483**

Difference in Eighth Grade Standards of Learning Mean Scores (APS Pre-K – No APS Pre-K)



* This difference is not shown due to insufficient data.

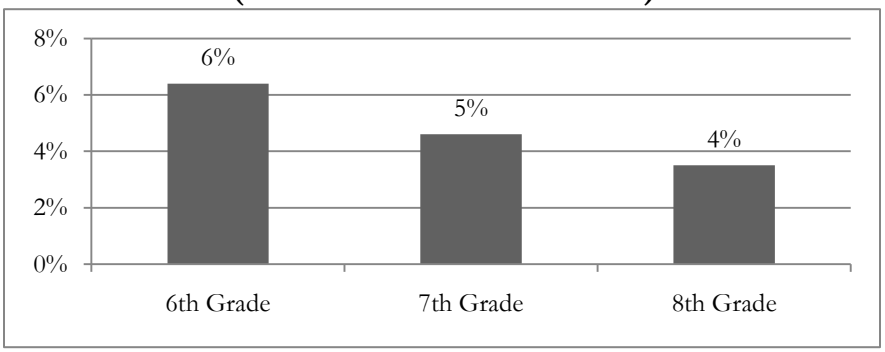
Which Students Take Advanced Courses and SOL Tests

A total of 654 students within the middle school cohort took at least one advanced math class (as evidenced by SOL tests) during grades six through eight. Of these, **576 (88.1 percent) did not attend an APS Pre-K while 78 (11.9 percent) did.**

When we consider when students enrolled in advanced math courses, we see that APS Pre-K participants and non-participants were most likely to enroll later in middle school; the percentage of students who enrolled in sixth grade was lower than the percentage who enrolled in seventh grade, which in turn was lower than the percentage who enrolled in eighth grade. For each grade, a slightly greater percentage of APS Pre-K participants than non-participants enrolled in advanced math courses. This difference ranged from 6 percent in sixth grade to 4 percent in eighth grade.

Advanced Math Course Enrollment[13]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
APS Pre-K (n=142)	60	42.3%	62	43.7%	74	52.1%
No APS Pre-K (n=1,087)	390	35.9%	425	39.1%	528	48.6%
Middle School Cohort (n=1,220)	**450**	**36.6%**	**487**	**39.6%**	**602**	**49.0%**

Difference in Percent Enrollment in Advanced Math Courses (APS Pre-K – No APS Pre-K)



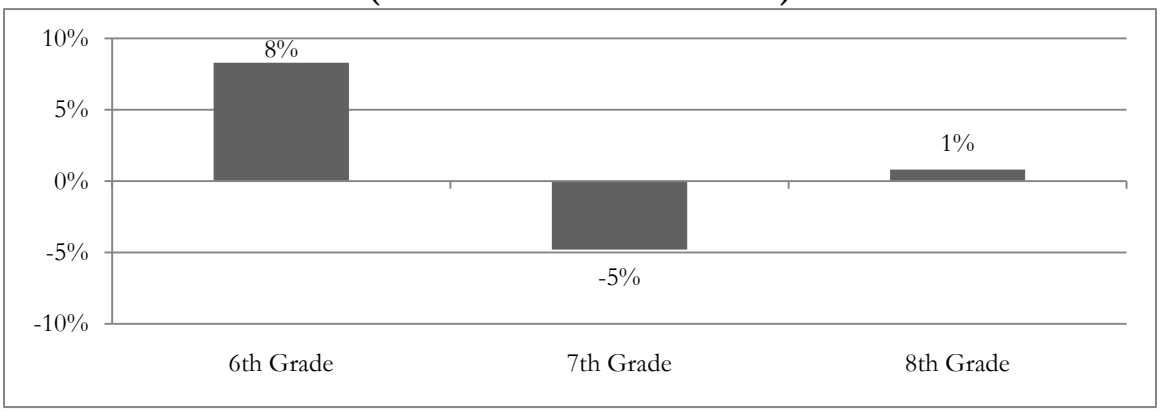
[13] Because this table shows the percentage of all students in each group who were enrolled in an advanced math class during each of the three middle school years, the total percentage does not add to 100%.

World Languages Coursework

A total of 924 (75.2 percent) students within the middle school cohort enrolled in a world language course during middle school. Of these, 135 (14.6 percent) started in sixth grade, 693 (75.0 percent) in seventh grade and 96 (10.4 percent) in eighth. As the table below indicates, in general, both APS Pre-K participants and non-participants followed the general trend experienced by the entire cohort. However, it is interesting to note a higher percentage of APS Pre-K students began taking world languages in middle school in grades six and eight in comparison to grade seven when a greater percentage of non-participants began such courses.

Initial World Language Course Enrollment by Grade and APS Pre-K Enrollment[14]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
APS Pre-K (n=142)	26	18.3%	74	52.1%	12	8.5%
No APS Pre-K (n=1,087)	109	10.0%	619	56.9%	84	7.7%
Middle School Cohort (n=1,220)	**135**	**11.0%**	**693**	**56.4%**	**96**	**7.8%**

Difference in Percent Enrollment in World Language Courses (APS Pre-K – No APS Pre-K)



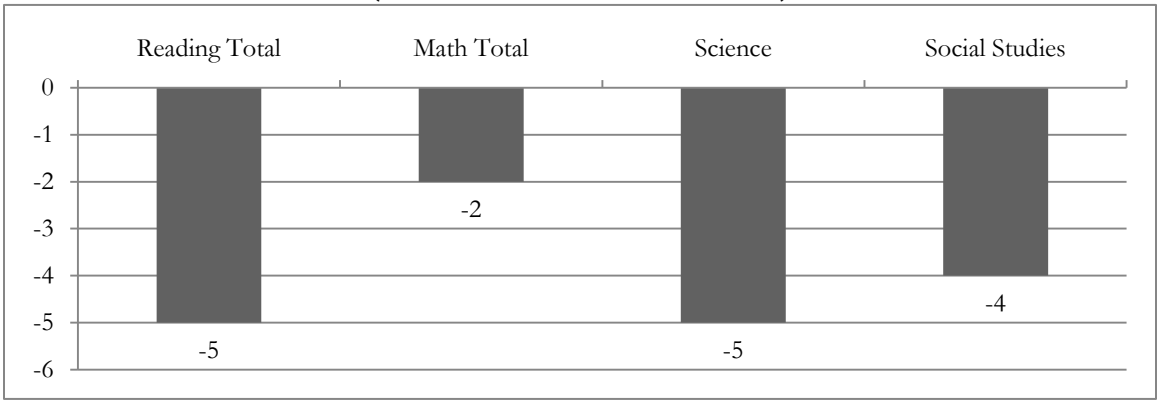
[14] Because not all students in each group took a world language course at some point during middle school, these percentages do not add to 100%.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

If we focus on a selection of Stanford 10 tests, it appears that APS Pre-K participants and non-participants performed at fairly similar levels. The difference between these two groups on each of the tests described in the table below is five points or less.

Stanford 10 – Mean Scores								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
APS Pre-K	135	59	134	66	134	61	134	62
No APS Pre-K	992	64	991	68	995	66	992	66
Middle School Cohort	**1127**	**63**	**1125**	**68**	**1129**	**65**	**1126**	**65**

Difference in Stanford 10 Mean Scores (APS Pre-K – No APS Pre-K)



Specific APS Pre-Kindergarten Programs

In this section, we compare specific APS Pre-K programs in order to determine whether they display a difference in terms of future academic performance. As an organizational issue, our main comparisons include Montessori versus VPI programs and Special Education versus Dual Enrolled Special Education programs. An appendix provides tables comparing all of these groups together.

Montessori and VPI

There were 76 Montessori students included in the APS middle school cohort. Of these students, approximately half were designated as economically disadvantaged (ED) when they entered the program. Further, 38.2 percent were designated Limited English Proficient (LEP) when they entered APS. As for racial/ethnic composition, 38.2 percent of the Montessori participants were white, 31.6 percent Hispanic, 22.4 percent black, and 7.9 percent Asian. This group has more females than males, with 53.9 percent female representation

By comparison, 27 of the middle school students participated in VPI. As would be expected due to the eligibility requirements of the program, a much larger percentage of these students (81.5 percent) were designated as economically disadvantaged when they entered APS. Approximately 81.5 percent were Limited English Proficient when they entered APS. Approximately 59.3 percent of the VPI group was listed as Hispanic, 18.5 percent white, 11.1 percent black, and 11.1 percent Asian. This group also has more females than males, with 59.3 percent female representation.

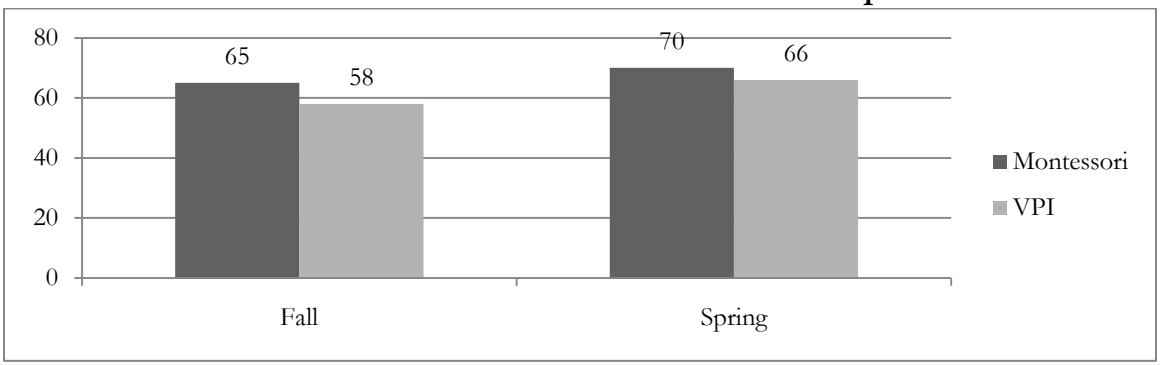
In terms of mean scores, with very few exceptions, **Montessori students outperformed VPI students on all assessments, including DRP, SOL and Stanford 10 tests, from sixth through eighth grade.**

Degrees of Reading Power (DRP) Program

For example, the table below presents Fall and Spring DRP results for Montessori and VPI students. Note that the average (.75) scores for Montessori students are higher. While the percentage of Montessori students who were identified for remediation was lower than the corresponding percentage of VPI students in the fall, this was reversed on the spring test.

Degrees of Reading Power – Montessori and VPI Comparison										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
Montessori	74	64.80	12.43	20	27.0%	70	70.03	13.61	14	20.0%
VPI	**26**	**57.50**	**10.80**	**8**	**30.8%**	**23**	**65.78**	**10.08**	**3**	**13.0%**

Mean DRP Scores – Montessori and VPI Comparison



Standard of Learning (SOL)

In terms of SOL scores, there were twelve sets of scores with at least ten corresponding Montessori and 10 VPI students. **Montessori students scored higher than VPI students on nine of these twelve tests**. The three exceptions to this trend are sixth grade math, seventh grade math taken by seventh graders, and eighth grade math taken by seventh graders. The tables below display these disparities in SOL test scores, with the majority of tests displaying a difference of at least 10 points.

Mean Scale Scores

Sixth Grade Standards of Learning – Montessori and VPI Score Comparison										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Montessori	38	390	30	505	6	509	74	489		
VPI	15	402	9	453			24	471		

Seventh Grade Standards of Learning – Montessori and VPI Score Comparison														
	History		Reading		7thGrade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Montessori	69	496	69	497	31	409	24	524	10	522			3	544
VPI	26	457	26	491	14	438	12	550						

Eighth Grade Standards of Learning – Montessori and VPI Score Comparison																
	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Montessori	69	491	69	495	70	448	29	453	29	509	1	581	10	555	69	474
VPI	25	487	25	478	26	438	8	447	17	502					25	452

In terms of passing rates, the Montessori and VPI programs appear to be more comparable. In fact, **no clear pattern emerges; for some tests, Montessori students passed at greater rates than VPI, for others this was reversed**. The table below displays SOL passing rates for a selection of sixth, seventh and eighth grade assessments for which both groups had at least 10 students.

Middle School Standards of Learning – Montessori and VPI Comparison										
Group	6th Grade		7th Grade				8th Grade			
	Reading		History		Reading		Science		Writing	
	n	%	n	%	n	%	n	%	n	%
Montessori	21	87.5%	22	84.6%	24	92.3%	25	100%	25	96.2%
VPI	64	86.5%	64	92.8%	64	92.8%	65	94.2%	69	98.6%

Which Students Take Advanced Courses and SOL Tests

Next we examine differences in what percentage of Montessori and VPI students take advanced math tests (as evidenced by SOL tests) in each grade level. **Forty-four of the 79 Montessori students (55.7 percent) took at least one advanced math class during grades six through eight. This compares with 17 of 27 VPI students (63.0 percent)** who took at least one advanced class. When we consider when these students took advanced math classes, both groups were most likely to enroll in eighth grade.

Advanced Math Course Enrollment – Montessori and VPI Comparison[15]								
Group	6th Grade		7th Grade		8th Grade		Anytime in Middle School	
	n	%	n	%	n	%	n	%
Montessori (n=76)	36	47.4%	35	46.1%	40	52.6%	44	56%
VPI (n=27)	9	33.3%	12	44.4%	17	63.0%	17	63%

Which Students Take a World Language

Of the 76 students in the middle school cohort who attended the Montessori APS Pre-K program, 63 (82.9 percent) took at least one world languages course in middle school. This compares with the 27 VPI students, 21 (77.8 percent) of whom took at least one such course.

The table below provides the frequencies and percentages with which Montessori and VPI participants began enrolling in world languages courses. Note that students in both groups were most likely to enroll in these courses starting in seventh grade.

Initial World Language Course Enrollment – Montessori and VPI Comparison[16]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
Montessori (n=76)	20	26.3%	36	47.4%	7	9.2%
VPI (n=27)	4	14.8%	16	59.3%	1	3.7%

[15] Because this table shows the percentage of all students in each group who were enrolled in an advanced math class during each of the three middle school years, the total percentage does not add to 100%.

[16] Because not all students in each group took a world language course at some point during middle school, these percentages do not add to 100%.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

Looking at the Stanford 10 test results, Montessori students outperformed VPI students in each subject area. This difference ranged from two points in the Math Total score to seven points in Science.

Stanford 10 - Montessori and VPI Comparison								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
Montessori	74	62	73	69	73	64	73	65
VPI	25	56	25	67	25	57	25	59

Special Education and Dual Enrolled Special Education

There were 19 students who participated in an APS special education pre-kindergarten program and went on to enroll in at least one middle school grade at APS. As this number is small, caution must be used when interpreting the results in this section. Of these students, 10 (52.6 percent) were designated as economically disadvantaged when they entered APS Pre-K. Further, 8 students (42.1 percent) were designated as Limited English Proficient upon entry to APS.

In terms of racial/ethnic composition, 42.1 percent of special education students were listed as Hispanic, 31.6 percent white, 15.8 percent black, and 10.5 percent Asian. As for gender, the group has a high proportion of males to females, with 73.7 percent male representation.

By comparison, 20 dual enrolled special education middle school students were included in the cohort. As this number is small, caution must be used when interpreting the results in this section. Two of these students (10 percent) were designated as economically disadvantaged when they enrolled in APS, and the same number were Limited English Proficient in 2004-2005. Eighty-five percent of these students were listed as white, and 15 percent were Hispanic. This group also has a higher proportion of males to females, with 70 percent male representation.

Overall, **dual enrolled students scored higher than special education students in all tests for which there were at least 10 corresponding special education and 10 dual enrolled students**. The following table displays a comparison of DRP scores for these two groups.

Degrees of Reading Power (DRP) Program

Degrees of Reading Power – Special Education and Dual Enrolled Comparison										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
Special Education	17	47.65	12.88	13	76.5%	17	52.65	15.51	12	70.6%
Dual Enrolled	19	66.95	13.59	4	21.1%	28	71.39	11.63	2	11.1%

Standard of Learning (SOL)

Mean Scale Scores

When we consider mean scale SOL scores, Reading was the only SOL with sufficient numbers for comparison; on this test dual enrolled students scored 95 points higher than their Special Education counterparts. No students from either of these groups enrolled in 8th Grade Math or Algebra I in sixth grade.

Sixth Grade Standards of Learning – Special Ed and Dual Enrolled Comparison										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Special Ed	16	345	2	511			18	406		
Dual Enrolled	7	405	13	504			20	501		

In seventh grade, dual enrolled students outscored special education students in all tests. The differences in History and Reading scores were 60 points or higher.

Seventh Grade Standards of Learning – Special Ed and Dual Enrolled Comparison														
Group	History		Reading		7thGrade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Special Ed	14	455	14	456	12	397	2	600						
Dual Enrolled	20	516	20	516	7	423	12	545	1	600				

Special education student scores came closest to dual enrolled student scores in Eighth Grade Writing; this difference was only 26 points.

Eighth Grade Standards of Learning – Special Ed and Dual Enrolled Comparison																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Special Ed	15	435	15	455	14	431	12	430	3	512	0		0		15	435
Dual Enrolled	19	511	19	521	18	457	5	498	13	518	0		1	534	18	508

Which Students Take Advanced Courses and SOL Tests

There were three special education students who took an advanced math course during middle school (as evidenced by SOL tests). This compares with 14 dual enrolled students. The table below displays when these students enrolled in an advanced class. Note that the majority of dual enrolled students took advanced math classes in each grade during middle school. By comparison, only 10-16 percent of special education students enrolled in these advanced classes.

Advanced Math Course Enrollment – Special Ed and Dual Enrolled Comparison[17]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
Special Ed (n=3)	2	10.5%	2	10.5%	3	15.8%
Dual Enrolled (n=14)	13	65.0%	13	65.0%	14	70.0%

[17] Because this table shows the percentage of all students in each group who were enrolled in an advanced math class during each of the three middle school years, the total percentage does not add to 100%.

Which Students Take a World Language

Of the 20 students in the middle school cohort who dual enrolled in special education during APS Pre-K, 19 (95 percent) enrolled in at least one world language course during middle school. This compares with nine special education students (47.4 percent) who enrolled in such a course. The table below presents the grades during which students in both groups initially enrolled in a world language course.

Initial World Language Course Enrollment – Special Ed and Dual Enrolled Comparison[18]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
Special Ed (n=19)			7	36.8%	2	10.5%
Dual Enrolled (n=20)	2	10.0%	15	75.0%	2	10.0%

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

With respect to Stanford 10 tests, dual enrolled students outperformed special education students in each of the four test areas described in the table below. The difference between these two groups ranged from 24 points for Science and Social Studies to 27 points for Reading.

Stanford 10 - Special Ed and Dual Enrolled Comparison								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
Special Ed	17	41	17	48	17	45	17	47
Dual Enrolled	19	68	19	73	19	69	19	71

[18] Because not all students in each group took a world language course at some point during middle school, these percentages do not add to 100%.

Economically Disadvantaged Students

Since economically disadvantaged (ED) status is reviewed each year, we begin by examining students who were designated ED as early as pre-kindergarten (or kindergarten, for students who did not attend an APS Pre-K). A total of 62 students in the middle school cohort were designated as ED while they were enrolled in an APS program during the 2000-01 school year.[19] This first ED status is retained regardless of whether these students are still classified as ED as they progress through school. In addition, we employ the ED status upon initial entry to APS – regardless of grade – in our analysis. Please note that this calculation of ED status does differ from the calculation performed in 2008. In the 2008 report, if a student's ED status changed as they progressed through school, then these students were excluded from the analysis, beginning in the year during which they changed status.

APS Pre-K Participants versus Non-Participants

ED students who had participated in APS Pre-K programs outperformed ED non-participants on many assessments during middle school. For example, the following table provides details on DRP scores. Note that for the fall and spring tests, there is an approximately four point difference between these two groups. There is a large disparity between these two groups with respect to the percentage of each that was identified for remediation. More than 86 percent of ED non-participants were identified for remediation in both tests, while less than 14 percent of ED students who had attended an APS Pre-k were identified as such.

Degrees of Reading Power (DRP) Program

Degrees of Reading Power - Economically Disadvantaged Students										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
ED APS Pre-K	57	57.39	12.81	31	13.2%	63	62.88	13.52	21	12.3%
ED No APS Pre-K	358	53.45	12.52	203	86.8%	340	58.91	12.56	150	87.7%

[19] For the 2000-01, 2001-02, 2002-03 and 2003-04 school years, data regarding students' ED status was only available if they were designated as ED. A designation of not ED was omitted for these years. For all subsequent years, both designations were present in the database.

Standard of Learning (SOL)

Mean Scale Scores

With respect to sixth grade SOLs, ED APS Pre-K students and non-participants had the same mean score on the sixth grade math test. APS Pre-K students who were ED scored 17 points higher than non-participants in Reading.

Sixth Grade Standards of Learning – Economically Disadvantaged Students										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
ED APS Pre-K	47	373	19	465	3	553	69	454		
ED No APS Pre-K	309	373	48	488	3	583	326	437		

In seventh grade, this trend continued. ED students who had enrolled in an APS Pre-K scored 5 to 32 points higher on average in each SOL test for which there were 10 or more students in each group.

Seventh Grade Standards of Learning – Economically Disadvantaged Students														
Group	History		Reading		7th Grade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
ED APS Pre-K	63	458	63	476	39	408	19	537	2	501			1	544
ED No APS Pre-K	317	445	317	444	272	400	43	532	10	520			0	

In eighth grade, once again, ED students who had enrolled in an APS Pre-K program outscored non-participants in each SOL test; this difference ranged from four points in Algebra I to 16 points in Science (for tests in which there were at least 10 students in each group).

Eighth Grade Standards of Learning – Economically Disadvantaged Students																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
ED APS Pre-K	63	463	63	467	63	434	36	442	24	501	1	581	2	552	63	440
ED No APS Pre-K	317	449	321	451	317	428	228	435	81	497	0		10	535	316	437

Which Students Take Advanced Courses and SOL Tests

Of the 402 ED APS Pre-K non-participants, 101 (25.1 percent) enrolled in at least one advanced math course during middle school (as evidenced by SOL tests). Of the 74 ED APS Pre-K students, 31 (41.9 percent) enrolled in at least one advanced math course. Both groups were slightly more likely to enroll in such a course during eighth grade than in sixth or seventh.

Advanced Math Course Enrollment Economically Disadvantaged Students[20]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
ED APS Pre-K (n=74)	22	29.7%	22	29.7%	27	36.5%
ED No APS Pre-K (n=402)	51	12.7%	53	13.2%	91	22.6%

Which Students Take a World Language

Of the 402 ED APS Pre-K non-participants, 227 (56.5 percent) enrolled in a world languages course. Of the 74 ED APS Pre-K students, 54 (73 percent) enrolled in a world language course. Students in both groups were most likely to initially enroll in such a course during seventh grade.

Initial World Language Course Enrollment Economically Disadvantaged Students[21]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
ED APS Pre-K (n=74)	7	9.5%	41	55.4%	6	8.1%
ED No APS Pre-K (n=402)	20	5.0%	171	42.5%	36	9.0%

[20] Because this table shows the percentage of all students in each group who were enrolled in an advanced math class during each of the three middle school years, the total percentage does not add to 100%.

[21] Because not all students in each group took a world language course at some point during middle school, these percentages do not add to 100%.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

With respect to the Stanford 10 tests, once again, ED students who had participated in an APS Pre-K program, outscored non-participants by three to five points in every test described in the table below.

Stanford 10 - Economically Disadvantaged Students								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
ED APS Pre-K	70	52	69	60	69	54	69	54
ED No APS Pre-K	336	47	336	55	337	50	337	51

Montessori versus VPI

Due to the substantial percentage of economically disadvantaged students in the VPI and Montessori programs, we further break down the ED data set by APS Pre-K program affiliation.

Economically disadvantaged students in the VPI program outscored Montessori students on almost all DRP, SOL and Stanford 10 tests. This trend follows the one described in our 2008 report in which VPI students began outscoring Montessori students in the first grade.

Degrees of Reading Power Program

Mean DRP scores for fall and spring for ED VPI and ED Montessori students were comparable; the average scores of these groups were within 2.5 points of each other. The percentage of students identified for remediation was higher for ED Montessori students in both tests than for ED VPI students.

Degrees of Reading Power – Economically Disadvantaged Students Montessori and VPI Comparison										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
ED Montessori	38	60.53	12.37	15	39.5%	38	65.82	11.88	11	28.9%
ED VPI	21	58.24	10.43	6	28.6%	18	66.33	10.09	2	11.1%

Standards of Learning

When considering the Math SOLs taken at each grade level, ED VPI students outscored ED Montessori students by 21 points in sixth grade and 44 points in seventh grade. With respect to Reading SOLs, ED VPI students scored higher than ED Montessori students by 9 points in sixth grade, 20 points in seventh grade and 33 points in eighth grade.

Mean Scale Scores

Sixth Grade Standards of Learning — Economically Disadvantaged Students Montessori and VPI Comparison										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
ED Montessori	26	376	9	473	3	553	38	463	0	
ED VPI	11	397	8	460	0		19	472	0	

Seventh Grade Standards of Learning — Economically Disadvantaged Students Montessori and VPI Comparison														
Group	History		Reading		7th Grade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
ED Montessori	33	471	33	474	21	397	7	504	2	501			1	544
ED VPI	21	454	21	494	11	441	10	552	0				0	

Eighth Grade Standards of Learning — Economically Disadvantaged Students Montessori and VPI Comparison																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Montessori	34	459	34	463	34	436	23	453	8	490	1	581	2	552	34	445
VPI	20	492	20	485	21	435	6	434	14	505					20	453

Which Students Take Advanced Courses and SOL Tests

Of 40 ED Montessori students, 15 (37.5 percent) enrolled in at least one advanced math course during middle school (as evidenced by SOL tests). Of the 22 ED VPI students, 14 (63.6 percent) enrolled in at least one advanced math course.

Which Students Take World Languages

Approximately 75 percent of the ED Montessori students enrolled in a world language course during middle school. This compares with 77.3 percent of ED VPI students.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

In three of the four tests described in the table below, ED VPI students outscored ED Montessori students. This difference was most pronounced in Math. The two groups achieved approximately the same mean score in Social Studies.

Stanford 10 – Economically Disadvantaged Students Montessori and VPI Comparison								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
ED Montessori	38	54	37	59	37	55	37	56
ED VPI	20	56	20	68	20	57	20	56

Limited English Proficient Students

The data set designated students as Limited English Proficient (LEP) beginning in 2004-2005. Through a method comparable to that employed for economically disadvantaged students, we concentrate our analysis on students' initial LEP status upon entry to APS. Please note that this calculation of LEP status does differ from the calculation performed in the 2008 report. In the 2008 report, if a students' LEP status changed as they progressed through school, then these students were excluded from this analysis, beginning in the year during which they changed status

Among APS Pre-K participants, 61 individuals (43.0 percent) were designated as LEP There were 353 (32.5 percent) corresponding non-participants designated as LEP.

APS Pre-K Participants versus Non-Participants

Overall, LEP students who participated in an APS Pre-K program outperformed students who did not participate. The following table presents DRP scores for LEP Pre-K participants and non-participants. Note that LEP APS Pre-K students' mean scores, for both fall and spring, were about five points higher than those of non-participants. There was a large disparity in the percentage of students identified for remediation; 11-12 percent of LEP students who participated in APS Pre-K programs were identified, in comparison with 88-90 percent of LEP non-participants.

Degrees of Reading Power (DRP) Program

Degrees of Reading Power – Limited English Proficient Students										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
LEP APS Pre-K	60	58.37	11.45	23	11.7%	56	64.59	13.26	16	11.0%
LEP No APS Pre-K	319	54.05	13.00	174	88.3%	308	60.08	13.03	129	89.0%

Standards of Learning (SOL)

This trend continues with respect to SOL scores. LEP students who attended an APK Pre-K program scored higher than non-participants on all seventh and eighth grade tests for which there were 10 or more students in each group. However, sixth grade SOL scores are an exception; non-participant scores were higher on this test.

Mean Scale Scores

Sixth Grade Standards of Learning – Limited English Proficient Students										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
LEP APS Pre-K	36	378	20	473	2	532	58	458		
LEP No APS Pre-K	270	383	54	491	3	581	290	444		

Seventh Grade Standards of Learning – Limited English Proficient Students														
Group	History		Reading		7thGrade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
LEP APS Pre-K	53	461	53	478	29	410	20	534	3	514				
LEP No APS Pre-K	295	447	293	446	240	405	51	533	11	519				

Eighth Grade Standards of Learning – Economically Disadvantaged Students																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
LEP APS Pre-K	53	470	53	475	53	436	27	446	23	501	0		3	568	53	447
LEP No APS Pre-K	288	451	291	454	291	429	194	438	85	499	0		11	543	287	439

Which Students Take Advanced Courses and SOL Tests

Of the 61 LEP APS Pre-K students, 29 (47.5 percent) enrolled in at least one advanced math course during middle school (as evidenced by SOL tests). Of the 353 non-participants, 108 (30.6 percent) enrolled in at least one advanced math course. Students in both groups were most likely to enroll in these courses in eighth grade.

Advanced Math Course Enrollment Limited English Proficient Students[22]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
LEP APS Pre-K (n=61)	22	36.1%	23	37.7%	26	42.6%
LEP No APS Pre-K (n=353)	57	16.1%	62	17.6%	96	27.2%

Which Students Take a World Language

Of the 353 LEP students who did not participate in APS Pre-K, 216 (61.2 percent) enrolled in a world languages course. Of the 61 APS Pre-K participants, 46 (75.4 percent) enrolled in a world languages course. Both groups were most likely to initially enroll in these courses during seventh grade.

Initial World Language Course Enrollment Limited English Proficient Students[23]						
Group	6th Grade		7th Grade		8th Grade	
	n	%	n	%	n	%
LEP APS Pre-K (n=61)	7	11.5%	35	57.4%	4	6.6%
LEP No APS Pre-K (n=353)	23	6.5%	164	46.5%	29	8.2%

[22] Because this table shows the percentage of all students in each group who were enrolled in an advanced math class during each of the three middle school years, the total percentage does not add to 100%.

[23] Because not all students in each group took a world language course at some point during middle school, these percentages do not add to 100%.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

In all four tests described in the table below, LEP students who participated in an APS Pre-K program outscored non-participants. The difference in these scores ranged from four points in Social Studies to six points for both Reading and Math.

Stanford 10 – Limited English Proficient Students								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
LEP APS Pre-K	59	54	58	64	58	56	58	56
LEP No APS Pre-K	294	48	294	58	294	51	294	52

Montessori versus VPI

We examined LEP-designated Montessori and VPI students in order to determine whether students from one program exhibit higher academic performance than students from the other. We found that Montessori LEP students received higher scores than VPI LEP students on almost every assessment during middle school. The following table provides DRP scores for these students. Note that for both fall and spring average (0.75) scores, LEP Montessori students were comparable with LEP VPI students; the scores for each were within l-2 points of each other. LEP Montessori students were more frequently identified for remediation than LEP VPI students.

Degrees of Reading Power Program

Degrees of Reading Power – Limited English Proficient Students Montessori and VPI Comparison										
Group	Fall					Spring				
	Average DRP (.75) Score			Percentage Identified for Remediation		Average DRP (.75) Score			Percentage Identified for Remediation	
	n	Mean	Standard Deviation	n	%	n	Mean	Standard Deviation	n	%
LEP Montessori	28	61.54	10.80	9	32.1%	28	67.71	13.04	8	28.6%
LEP VPI	22	58.68	10.38	6	27.3%	19	66.74	9.97	2	10.5%

Standards of Learning

When considering the Math SOLs taken at grade level, LEP VPI students outscored LEP Montessori students by 33 points in sixth grade and 30 points in seventh grade. There were insufficient data to examine the difference in eighth grade.

With respect to Reading SOLs, ED VPI students scored higher than ED Montessori students by 33 points in sixth grade and by 30 points in seventh grade. With respect to Reading SOLs, LEP VPI students scored higher than LEP Montessori students by 6 points in sixth grade, 15 points in seventh grade, and 23 points in eighth grade.

Mean Scale Scores

Sixth Grade Standards of Learning –Limited English Proficient Students Montessori and VPI Comparison										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
LEP Montessori	16	372	10	488	2	532	28	467	0	
LEP VPI	12	405	8	460	0		20	473	0	

Seventh Grade Standards of Learning –Limited English Proficient Students Montessori and VPI Comparison														
Group	History		Reading		7th Grade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
LEP Montessori	23	478	23	479	12	402	7	488	3	514	0		0	
LEP VPI	21	455	21	494	10	432	11	555	0		0		0	

Eighth Grade Standards of Learning –Limited English Proficient Students Montessori and VPI Comparison																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
LEP Montessori	24	469	24	475	24	438	14	463	7	489	0		3	568	24	458
LEP VPI	20	492	20	485	21	437	6	434	14	504	0		0		20	451

Which Students Take Advanced Courses and SOL Tests

Of the 29 LEP Montessori students, 13 (44.8 percent) enrolled in at least one advanced math course during middle school (as evidenced by SOL tests). Of the 22 LEP VPI students, 14 (63.6 percent) enrolled in at least one advanced math course.

Which Students Take World Languages

Approximately 79.3 percent of the LEP Montessori students enrolled in a world language course during middle school. This compares with 77.3 percent of ED VPI students who enrolled in at least one of these courses.

Stanford Achievement Test Series, Tenth Edition (Stanford 10)

In three of the four tests described in the table below, LEP VPI student mean scores were comparable to those of LEP Montessori students. This difference was not more than two points for any test.

Stanford 10 – Limited English Proficient Students Montessori and VPI Comparison								
Group	Reading Total		Math Total		Science		Social Studies	
	n	Mean	n	Mean	n	Mean	n	Mean
LEP Montessori	28	57	27	66	27	58	27	59
LEP VPI	21	57	21	68	21	58	21	57

Appendix A – Summary Tables

Degrees of Reading Power – Score and Remediation Summary										
Group	Fall					Spring				
	Average DRP (.75) Score			Identified for remediation		Average DRP (.75) Score			Identified for remediation	
	# Tested	Mean	Standard Deviation	n	%	# Tested	Mean	Standard Deviation	n	%
Middle School Cohort	1158	64.47	15.66	332	28.6%	1097	69.61	15.05	234	21.3%
APS Pre-K	136	61.56	13.67	45	33.1%	128	67.15	14.22	31	24.2%
No APS Pre-K	1022	64.86	15.87	287	28.1%	969	69.94	15.13	203	20.9%
VPI	26	57.50	10.80	8	30.8%	23	65.78	10.08	3	13.0%
Special Ed	17	47.65	12.88	13	76.5%	17	52.65	15.51	12	70.6%
Montessori	74	64.80	12.43	20	27.0%	70	70.03	13.61	14	20.0%
Dual Enrolled	19	66.95	13.59	4	21.1%	18	71.39	11.63	2	11.1%

Sixth Grade Standards of Learning – Passing Rates Summary										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	%	n	%	n	%	n	%	n	%
Middle School Cohort	359	51.2%	374	97.9%	65	100%	951	85.4%	3	100%
APS Pre-K	31	40.8%	51	94.4%	6	100%	115	84.6%		
No APS Pre-K	328	52.5%	323	98.5%	59	100%	836	85.6%	3	100%
VPI	8	53.3%	9	100%			21	87.5%		
Special Ed	3	18.8%	2	100%			10	55.6%		
Montessori	15	39.5%	27	90.0%	6	100%	64	86.5%		
Dual Enrolled	5	71.4%	13	100%			20	100%		

Seventh Grade Standards of Learning – Passing Rates Summary														
Group	History		Reading		7th Grade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Middle School Cohort	965	88.9%	968	89.1%	354	59.5%	357	100%	126	100%	1	100%	3	100%
APS Pre-K	117	90.7%	119	92.2%	33	51.6%	50	100%	11	100%			1	100%
No APS Pre-K	848	88.7%	849	88.7%	321	60.5%	307	100%	115	100%	1	100%	2	100%
VPI	22	84.6%	24	92.3%	9	64.3%	12	100%						
Special Ed	11	78.6%	11	78.6%	5	41.7%	2	100%						
Montessori	64	92.8%	64	92.8%	14	45.2%	24	100%	10	100%			1	100%
Dual Enrolled	20	100%	20	100%	5	71.4%	12	100%	1	100%				

Eighth Grade Standards of Learning – Passing Rates Summary																
	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Middle School Cohort	952	89.6%	987	92.7%	1016	95.5%	330	72.4%	478	99.8%	3	100%	120	100%	923	87.2%
APS Pre-K	111	86.7%	120	93.8%	124	96.9%	40	74.1%	62	100%	1	100%	11	100%	108	85.0%
No APS Pre-K	841	90.0%	867	92.5%	892	95.3%	290	72.1%	416	99.8%	2	100%	109	100%	815	87.4%
VPI	22	88.0%	25	100%	25	96.2%	5	62.5%	17	100%					23	92.0%
Special Ed	11	73.3%	11	73.3%	12	85.7%	8	66.7%	3	100%					10	66.7%
Montessori	59	85.5%	65	94.2%	69	98.6%	22	75.9%	29	100%	1	100%	10	100%	59	85.5%
Dual Enrolled	19	100%	19	100%	18	100%	5	100%	13	100%			1	100%	16	88.9%

Sixth Grade Standards of Learning – Score Summary										
Group	6th Grade Math		7th Grade Math		8th Grade Math		Reading		Algebra I	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Middle School Cohort	701	401	382	521	65	572	1113	489	3	572
APS Pre-K	76	384	54	496	6	509	136	477		
No APS Pre-K	625	403	328	525	59	578	977	490	3	572
VPI	15	402	9	453			24	471		
Special Ed	16	345	2	511			18	406		
Montessori	38	390	30	505	6	509	74	489		
Dual Enrolled	7	405	13	504			20	501		

Seventh Grade Standards of Learning – Score Summary														
Group	History		Reading		7th Grade Math		8th Grade Math		Algebra I		Algebra II		Geometry	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Middle School Cohort	1085	493	1086	496	595	422	357	554	126	538	1	600	3	556
APS Pre-K	129	487	129	494	64	415	50	538	11	529			1	544
No APS Pre-K	956	494	957	496	531	423	307	557	115	539	1	600	2	562
VPI	26	457	26	491	14	438	12	550						
Special Ed	14	455	14	456	12	397	2	600						
Montessori	69	496	69	497	31	409	24	524	10	522			1	544
Dual Enrolled	20	516	20	516	7	423	12	545	1	600				

Eighth Grade Standards of Learning – Score Summary																
Group	Reading		Science		Writing		8th Grade Math		Algebra I		Algebra II		Geometry		World Geography	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Middle School Cohort	1062	495	1065	497	1064	448	456	449	479	505	3	552	120	545	1059	483
APS Pre-K	128	487	128	490	128	446	54	451	62	509	1	581	11	553	127	470
No APS Pre-K	934	496	937	498	936	449	402	448	417	505	2	538	109	544	932	485
VPI	25	487	25	478	26	438	8	447	17	502					25	452
Special Ed	15	435	15	455	14	431	12	430	3	512					15	435
Montessori	69	491	69	495	70	448	29	453	29	509	1	581	10	555	69	474
Dual Enrolled	19	511	19	521	18	457	5	498	13	518			1	534	18	508

Stanford 10 - Score Summary (Part 1 of 2)																
Group	Reading Total		Word Study[24]		Vocabulary		Reading Comprehension		Math Total		Math Problem Solving		Math Procedures		Language	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Middle School Cohort	1127	63			1127	61	1131	63	1125	68	1127	68	1129	66	1127	63
APS Pre-K	135	59			135	59	135	59	134	66	135	66	134	65	134	60
No APS Pre-K	992	64			992	61	996	64	991	68	992	69	995	66	993	64
VPI	25	56			25	54	25	56	25	67	25	65	25	67	25	59
Special Ed	17	41			17	39	17	44	17	48	17	44	17	53	17	47
Montessori	74	62			74	64	74	60	73	69	74	69	73	66	73	63
Dual Enrolled	19	68			19	63	19	69	19	73	19	74	19	69	19	66

[24] There were no mean scores present in the data sample for Word Study.

Stanford 10 - Score Summary (Part 2 of 2)																
Group	Pre-Writing		Composing		Editing		Spelling		Science		Social Science		Partial		Total	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Middle School Cohort	1127	61	1127	61	1127	61	1128	58	1129	65	1126	65	1123	63	1123	64
APS Pre-K	134	59	134	58	134	59	134	56	134	61	134	62	134	61	134	61
No APS Pre-K	993	62	993	61	993	61	994	58	995	66	992	66	989	64	989	64
VPI	25	61	25	56	25	57	25	52	25	57	25	59	25	59	25	59
Special Ed	17	46	17	47	17	47	17	48	17	45	17	47	17	46	17	46
Montessori	73	60	73	59	73	61	73	58	73	64	73	65	73	63	73	64
Dual Enrolled	19	63	19	66	19	62	19	57	19	69	19	71	19	66	19	67

Appendix B – Description of Excel File

The Excel file that accompanies this report, entitled "APS Summary Assessment File," includes mean scores, standard deviations, pass rates, and percentages of students identified for remediation for each performance measure that was included in the original raw data file. The first worksheet, entitled "Readme" contains a description of each of the worksheets in the file. A worksheet entitled "Cohort Breakdown," lists the values for each major subset of the data including:

- Full APS Cohort
- All APS Pre-K Attendees
- No APS Pre-K
- Montessori
- Virginia Preschool Initiative
- Special Education
- Dual Enrolled Special Education

For every measure, each subset has a numerical value (i.e., the number of students who took the test, number of students who passed, number identified for remediation, etc.), a mean score (or percentage in the case of pass rates or remediation), and a standard deviation, if applicable.

A worksheet, titled "ED and LEP" presents similar data for APS Pre-K participants and non-participants, broken down by economically disadvantaged and Limited English Proficient status.

The third and final worksheet provides similar data for Montessori and VPI students, broken down by economically disadvantaged and LEP status.

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