THE PATH TO GRADUATION

Arlington Public Schools

December 2017

In the following report, Hanover Research explores the academic and demographic factors of APS students which predict on-time graduation and the attainment of advanced vs standard diplomas within Arlington Public Schools based on the data for three graduating cohorts – 2013/14 through 2015/16.

This study is limited to two primary research questions and was not expanded to other potential areas for inquiry identified during the course of the investigation. As such, this study should be considered a starting point for research into factors contributing to graduation at APS.

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INTRODUCTION

Beginning in early 2017, Hanover Research began a large-scale study to identify behavioral and academic factors that are correlated with successful outcomes for Arlington Public Schools (APS) students. This project addresses two primary research questions:

- What student and academic factors correlate most strongly to **on-time graduation**?
- What student and academic factors correlate most strongly to **the award of advanced rather than standard diplomas**?

Since the outcomes of this project occur at the end of high school, we examine students who have recently graduated from APS.

Hanover uses logistic regression models, which allow the calculation of marginal effects of the explanatory variables on the outcomes. The use of these models enables both the comparison of correlations across predictors and simple interpretation of the substantive changes in the outcome variable based on a change in the predictor. The results of this analysis will allow APS stakeholders to compare the extent to which different academic and non-academic characteristics correlate with successful outcomes.

This study is limited to the two primary research questions elaborated on this page, and was not expanded to other potential areas for inquiry identified during the course of the investigation. As such, this study should be considered a starting point for research into factors contributing to graduation at APS.

KEY FINDINGS

ELEMENTARY SCHOOL ANALYSIS

- **Students who perform at or above grade level in terms of their Mathematics Level in Grades 2 or 5 are more likely than those who perform below grade level to receive an advanced diploma rather than a standard diploma, by roughly 24 percent**. The relationship is also positive, but not statistically significant, in other grade levels. Students with a Reading Level at or above their grade level in Grade 1 or who succeed in terms of Reading Level Achievement or Writing in Grade 2 are also more likely to receive an advanced diploma.
- When we break success down into three groups by letter marks, we find that **receiving an A mark in Science in Grades 4-5 or Writing in Grades 3-4 corresponds to a higher chance of a student receiving an advanced diploma.** Similarly, receiving an A in Reaching Achievement in Grade 4 correlates with a higher chance of attaining an advanced diploma rather than a standard diploma (an increase of 4 percent)**.**

- **SOL scores are also positively correlated with the likelihood of graduating with an advanced diploma.** For instance, for every extra point on the math assessment in Grade 3, the chance of receiving an advanced diploma increases by 0.11 percent.

- **Students who participate in the Language Immersion program in Grade 5 are 10 percent more likely than other students to graduate with an advanced diploma rather than a standard diploma.** Special education students, on the other hand, are more likely to receive a standard diploma as opposed to an advanced diploma.

- **Performing well on the Mathematics Level class in Grade 2 correlates with a higher chance of on-time graduation**. Performance in most other classes in Grades 1-5 does not appear to be significantly predictive of on-time graduation. The same is true of SOL scores, which are mostly not statistically significant.

- **Attendance in Grade 5 is correlated with on-time graduation**, where for every day a student is absent the likelihood of graduating on time declines by 0.01 percent.

MIDDLE SCHOOL ANALYSIS

- **Math SOL scores are positively correlated with the likelihood of attaining an advanced diploma relative to the standard diploma**. A 10-point increase in math SOL score in Grade 8 would increase the chance of graduating with an advanced diploma by roughly 1 percent for the average student. Reading SOL scores show the same relationship, but only in Grade 7.

- **For most classes considered, better performance leads to higher chances of attaining an advanced diploma relative to a standard diploma.** Taking classes of a higher level (for example, Algebra I rather than Math 8 in Grade 8) also results in a higher chance of graduating with an advanced diploma. On average, course performance in later grades is more likely to be correlated with the likelihood of attaining an advanced diploma.

- **Performing well in US History/Civ/Eco 1865-Present and Science 7 classes in Grade 7 correlates with a higher chance of on-time graduation**. Performance in most other classes in Grades 6-8 does not appear to matter significantly when it comes to on-time graduation. The same is true of SOL scores, which are mostly not statistically significant.

- **Being absent is negatively correlated with on-time graduation, where for every day a student is absent in Grade 6 the likelihood of graduating on time declines by 0.06 percent.** The likelihood of on-time graduation declines to a lesser extent in Grades 7 and 8, indicating that attendance in earlier grades has a more significant impact on on-time graduation.

- **ESOL/HILT:**
  - **Students who take classes in the 1st or 2nd levels (HILT A and B, respectively) become less likely to receive an advanced diploma the later they take these classes.** For example, among students who graduated with a diploma, taking HILT A English in Grade 6 increases the likelihood of receiving an advanced diploma compared to taking this class in Grade 8. This pattern does not hold for classes in the 3rd and 4th levels (HILTEX A and B, respectively).
  - **Students in level 1-3 classes are less likely to graduate on time if they take courses in later grades**. For level 4 and math classes the pattern is still not conclusive.
  - Roughly 37 percent of students have been at the district for 4 or more years by the time they took the recorded HILT/HILTEX classes. In Grades 7 and 8, 26 and 18 percent of HILT/HILTEX students, respectively, spent less than 1 year in the APS system. Hence, students taking HILT and HILTEX classes in later grades are more likely to have only recently started at APS.

HIGH SCHOOL ANALYSIS

- **Students with higher history SOL scores in Grades 9 and 11 are more likely to earn an advanced diploma than a standard diploma**. An average student with a History SOL score that is 10 points higher in Grade 11 would be approximately 0.5 percent more likely to earn an advanced diploma. Math SOL scores show the same relationship for students in Grade 10.

- **For most classes considered, students who obtain higher grades are more likely to earn an advanced diploma than a standard diploma.** Taking classes of a higher level (for example, Algebra II rather than Geometry in Grade 10) also results in a higher chance of graduating with an advanced diploma. However, the reverse (for example, taking Geometry rather than Algebra II in Grade 11) results in a lower chance of graduating with an advanced diploma. Marks in Social Studies classes are more important to the likelihood of earning an advanced diploma in Grades 9-10, and marks in math classes are relevant across all grades. Failing a World Language course in Grade 9 or 10 also has a negative impact on the likelihood of earning an advanced diploma.

- **Students with higher math and science SOL scores are more likely to graduate on time**. However, the relationship does not hold consistently over all grade levels.

- **Students who perform well in ELA and science classes in Grade 10 are more likely to graduate on time.** Getting an "A" in either of these subjects increases the chance of on-time graduation by roughly 2 percent. Performance in most other classes in Grades 9-12 does not appear to significantly impact on-time graduation. The only exception is that students who receive "A" marks on Social Studies courses in Grade 11 are less likely to graduate on time by 0.5 percent.

- **The more often students are absent, the less likely they are to graduate on time and earn an advanced diploma.** The effect is stronger and more consistent for advanced diplomas than for on-time graduation.

- **ESOL/HILT:**
  - **Students who take HILT classes are less likely to receive an advanced diploma the later they take these classes**. For example, among students who graduated with a diploma, those who take HILT A English in Grade 9 are more likely to receive an advanced diploma than those who take this class in Grade 11. The percentage of students achieving an advanced diploma are higher for HILTEX-taking students relative to HILT-taking students; however, the difference diminishes in Grade 11.
  - **Students in HILT classes are also less likely to graduate on time if they take these courses in later grades.**
  - Roughly 12 percent of students have been at the district for 4 or more years by the time they took the recorded HILT/HILTEX classes. In Grades 10 and 11, 25 and 16 percent of HILT/HILTEX students, respectively, spent less than 1 year in the APS system. Hence, students taking HILT and HILTEX classes in later grades are more likely to have only recently started at APS.

SECTION I: DATA AND METHODOLOGY

In this section, Hanover briefly summarizes the available data and discusses the methodology used in the analysis.

DATA

APS has provided Hanover with the following data files used in Phase 1 analysis:

- **1_1_Cohort_Data_Last_3_Yrs:** contains student ID, school, graduation cohort and status, and type of diploma received.
- **1_2_Student_Details**: contains student ID, ethnicity/race, date of birth, gender, first and district entry dates.
- **2_SOL**: contains student ID, Standards of Learning (SOL) test date, name and subject, the level of proficiency achieved, score, and best score indicator.
- **3_Enrollment_Yearly_Profile:** contains student ID, year-end status, last school indicator, transfer code, attendance-related variables, LEP, special education, free or reduced lunch (FRL), Gifted, Montessori, Language Immersion program, Title 1, and 504 Plan statuses.
- **Elem_Report_Cards 2003-2008** and **back to 2009** (two files): contains student ID, grade levels for Elementary School, course description and course mark, and school names.[1]

VARIABLES OF INTEREST

ON-TIME GRADUATION

We construct the on-time graduation variable based on the information on whether each student who entered in a certain grade graduated with the same cohort. By graduation date these three cohorts are:

- 2014 Cohort (Grade 12 in 2013/14 academic year),
- 2015 Cohort (Grade 12 in 2014/15 academic year),
- 2016 Cohort (Grade 12 in 2015/16 academic year).

For example, a student entering the district as a Grade 2 student in the 2003/04 academic year is classified as an on-time graduate if he graduates in 2013/14. However, if he graduates in 2014/15, this student is not classified as an on-time graduate.

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[1] We are only retaining mark values within marking period "MP4," which we understand are the final grades.

STANDARD VS ADVANCED DIPLOMA

We create this variable of interest based on the "Graduate Completer Type" variable. We retain values for advanced (Advanced Studies Diploma, and IB Diploma) and standard diplomas (Standard Diploma, and Modified Standard Diploma). Other completer types are not considered. The advantage of this variable is that compared to the on-time graduation it is more evenly distributed.

EXPLANATORY VARIABLES

Due to the availability of data by grade some of the variables are only used for select grades. For instance, we only include data on unexcused absences and Language Immersion program status for Grade 5 students. We also use Limited English Proficiency and Special Education statuses in Grade 5 for all other grades so that we can include these indicators in all models despite not having data prior to the 2006/07 school year. We use Grade 5 status to ensure that all three cohorts are placed on equal footing; using the earliest available status would likely flag more students as LEP in the cohorts for which these statuses are available in Grade 3 or 4.

SPECIAL EDUCATION STATUS

We create a status variable based on the special education indicator from the **Student Details** file and participation in the courses designated as special education. Therefore, this variable takes on three values: "SPED" if the student has taken any class in the "SPED" department in that year, "SPED, no class" if the student has taken no classes in the "SPED" department that year, but is identified as special education student in **Student Details** file, and "Not SPED" if neither of the previous conditions is satisfied.

SOLs

Figure 1.1 through Figure 1.3 shows the availability of SOL test scores as well as the mean values at each academic level.

Figure 1.1: Elementary School SOL Test Scores by Grade[2]

SOL	GRADE 3		GRADE 4		GRADE 5	
	N	Mean	N	Mean	N	Mean
Math	880	512.8	1,864	486.9	2,858	517.6
Reading	880	485.9	1,820	505.2	2,794	498.3
Writing	--	--	--	--	2,800	513.6

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[2] SOL scores are only available for Grades 3-5, with Writing scores only being available for Grade 5. It is worth noting that in Grade 3 we only have scores for the 2016 cohort, and in Grade 4 we only have observations for the 2015 and 2016 cohorts, which limits the number of observations.

Figure 1.2: Middle School SOL Test Scores by Grade[3]

SOL	GRADE 6		GRADE 7		GRADE 8	
	N	Mean	N	Mean	N	Mean
History	2,009	455.1	3,110	495.6	3,205	466.9
Math	2,997	463.4	3,120	478	3,258	468
Reading	2,924	491.8	3,065	498	3,209	502.2
Science	--	--	--	--	3,258	497.9
Writing	--	--	--	--	3,241	461.6

Figure 1.3: High School SOL Test Scores by Grade[4]

SOL	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
	N	Mean	N	Mean	N	Mean	N	Mean
History	3,415	459.4	1,632	595.0	3,747	449.2	569	474.5
Math	3,374	469.3	3,367	452.5	1,633	445.3	848	442.8
Reading	128	376.7	88	387.7	3,682	454.8	712	481.2
Science	3,382	470.6	3,546	464.6	1,276	446.4	720	474.7
Writing	--	--	33	462.0	3,643	485.8	760	508.1

ELEMENTARY SCHOOL COURSE MARKS

As the marks for Elementary school classes are not standardized across schools, Hanover creates a "Success" variable for every class instead of constructing a GPA proxy variable. Because the set of courses that students take in elementary school is highly standardized and limited in scope, we can examine these more granular measures of course success. In higher grade levels, the analysis will likely shift to examining higher-level summaries of course performance, as students begin to take a wider variety of courses in each grade level.

If a student receives one of the marks A, B, C, or P or has a numeric score that is equal to or higher than their grade, they receive a code of 1 for the "Success" variable; otherwise, they receive a code of 0.

For the classes that have letter marks, we also create a variable that puts students into three performance groups: those who received an "A," those who received a "B" or a "C," and those who received a "D" or an "E" mark. The same courses that have letter marks in Grades 3-5 have a binary performance indicator in Grades 1-2, which is why these courses appear multiple times in the regression output tables in the next section.

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[3] Writing and Science SOL scores are only available for Grade 8. It is worth noting that in Grade 6 we only have History scores for the 2015 and 2016 cohorts, which limits the number of observations for that grade level. Consequently, we only include History SOL scores for Grade 7-8 models.

[4] Shaded values denote which scores we control for at each grade level. We do not control for any scores in Grade 12 as there are few students who take SOL tests in that grade.

In addition, we omit Spanish-language courses from the analysis due to a low number of usable observations.

MIDDLE SCHOOL COURSE MARKS

Compared to the *Elementary School Analysis*, there are more courses available for students to take at the middle school level. As a result, we only consider courses with sufficient enrollment (at least 200 students in at least one grade). We further recode the courses to include Special Education, Montessori, and Spanish Immersion versions of these classes.[5] A full list of changes made is displayed in Figure 1.4.

Figure 1.4: List of Courses

COURSES	MODIFICATIONS
Algebra I	Excludes Algebra I in Grade 7
Algebra I, Intensified	Includes Algebra I in Grade 7
American Studies 6-7	Both courses include Montessori, Sp.Ed., and Spanish Immersion counterparts
English 6-8	Include Montessori, and Sp.Ed. English counterparts
Geometry, Intensified	Includes Geometry
Life Science	Includes Sp.Ed.
Math 6-8	Math 7 includes Math 7 for 6th Graders; Math 8 includes Math 8 for 7th Graders. Includes Sp.Ed.
Physical Science	Includes Sp.Ed.
Reading 6	Includes Montessori Reading 6
Science 6-7	Both courses include Montessori Science, Spanish Immersion Science counterparts. Science 6 includes Sp.Ed.
US Hist/Civ/Eco 1875-Present	
US Hist/Civ/Eco to 1865	
World Geography	Includes Spanish Immersion and Sp.Ed. World Geography

Out of these classes we only retain those that have letter marks A-F. We create a variable that divides students into three performance groups: those who received an "A," those who received a "B/B+" or a "C/C+," and those who received a "D/D+," an "E," or an "F" mark. In some instances, these courses have a "P" for Pass, or marks on the O/S/U scale (outstanding/satisfactory/unsuccessful). We ignore such observations.

HIGH SCHOOL COURSE MARKS

Compared to the *Elementary and Middle School Analyses*, there are more courses available for students to take at the high school level. As a result, we only consider courses with sufficient enrollment (at least 1,000 students overall, with the exception of AP Calculus and Pre-Calculus). We further recode the courses to include Special Education, International

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[5] We control for special education status and Language Immersion status as described above, to make sure that we establish any differences between these courses and regular classes. We do not control for Montessori program as there are too few students enrolled (fewer than 20 in many cases).

Baccalaureate (IB), and Dual Enrollment versions of these classes.[6] A full list of changes made is displayed in Figure 1.5.

Figure 1.5: List of Courses

COURSE	ALSO INCLUDES	DEPARTMENT
Geometry	St/Geometry	Math
Algebra I	Algebra I Part 2	Math
Algebra II		Math
Algebra II/Trig, Intensified		Math
Mathematical Analysis/Trig		Math
Pre-Calculus	Pre-Calculus I/NOVA Math 163/164; Pre-Calculus/Trig; Pre-Calculus, Intensified; IB Mtds/Pre-Calculus	Math
AP Calculus	AP Calculus AB; AP Calculus BC; Multivariable Calculus; AP Calculus AB N; IB Mtds/Calculus	Math
Statistics	Probability and Statistics	Math
AP Statistics	AP Statistics N	Math
Economics & Personal Finance		Social Studies
World History (g:1500)	World History (g:ancnt); World History (g:1000)	Social Studies
World History, Intensified	AP World History	Social Studies
US & VA Government	VA/US Government Sp	Social Studies
AP US & VA Government	AP US/VA Government & Comp Government	Social Studies
US & VA History		Social Studies
AP US & VA History	AP VA/US History N	Social Studies
English 9		ELA
English 9, Intensified		ELA
English 10		ELA
English 10, Intensified		ELA
English 11		ELA
AP English 11	AP English Language Comp N; English 11 AP/IB	ELA
English 12		ELA
AP English 12	AP English Literature Comp N; English 12 Dual Enrollment	ELA
Biology		Science
Biology Intensified	AP Biology N; AP Biology; Biology AP/IB; IB Biology HL, Part 2; IB Biology (SL)	Science
Chemistry		Science
Chemistry, Intensified	IB Chemistry HL, Part 2; Chemistry AP/IB; AP Chemistry	Science
Earth Space	Earth Science	Science
Physics		Science

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[6] We control for special education status as described above, to make sure that we establish any differences between these courses and regular classes.

Out of these classes we only retain those that have letter marks A-F. We create a variable that divides students into three performance groups: those who received an "A," those who received a "B/B+" or a "C/C+," and those who received a "D/D+," an "E," or an "F" mark. In some instances, these courses have a "P" for Pass, or marks on the O/S/U scale (outstanding/satisfactory/unsuccessful). We ignore such observations.

METHODOLOGY

Since the variables of interest are binary, we apply logistic regression (logit) models to the data. We use logistic regression models rather than linear probability models because the logistic regression models are more useful when predicting students' probability of graduating on time or receiving a particular type of diploma, since, unlike linear probability models, they produce predicted probabilities that are bounded by 0 and 100 percent. The disadvantage of these models is that they can be more difficult to interpret than a linear probability model. To mitigate this, we report the results of the regressions primarily as marginal effects at the mean (MEMs). For numeric variables, such as SOL test scores, the MEMs show the effect on the probability of on-time graduation of a one point increase in the variable in question, for a student whose is near the average for both the variable in question and for all other variables. For categorical variables, such as letter grades, the MEMs show the difference in predicted probability of matriculation when moving from a reference category to the category in question (for example, from B to A) for a student who is average in terms of all other variables.

We analyze the trends in the variables of interest using the following set of models for each grade level separately:

$$[1]$$
$$OnTimeGraduation_i = \alpha + \sum_t^T \gamma_k SOL_{ij} + \sum_t^T \delta_k Success\ in\ Courses_i + \beta_1 Immersion_i + \beta_2 Cohort_i + +\beta_3 Demographics_{it} + \sum_t^T \varepsilon_k Attendance_i + \epsilon_{it},$$

$$[2]$$
$$AdvancedDiploma_i = \alpha + \sum_t^T \gamma_t SOL_{ij} + \sum_t^T \delta_t Success\ in\ Courses_i + \beta_1 Immersion_i + \beta_2 Cohort_i + +\beta_3 Demographics_{it} + \sum_t^T \varepsilon_t Attendance_i + \epsilon_{it},$$

The independent variables include an indicator for the student participating in the Language Immersion program, and demographic variables such as gender, race/ethnicity, LEP, and special education statuses, as well as course performance, math and English SOL scores, and attendance in grade j. We also control for the graduation cohort to capture cohort-specific trends.

SECTION II: ELEMENTARY SCHOOL ANALYSIS

In this section, Hanover summarizes the descriptive and regression analysis results.

DESCRIPTIVE ANALYSIS

Figure 2.1 shows the demographic characteristics of students in the sample segmented by cohort. Across different variables the shares remain remarkably constant across cohorts.

Figure 2.1: Demographic Characteristics by Cohort

VARIABLES	2014		2015		2016		TOTAL	
	N	Pct	N	Pct	N	Pct	N	Pct
Gender								
Male	515	51.60%	524	50.58%	555	53.62%	1,594	51.94%
Female	483	48.40%	512	49.42%	480	46.38%	1,475	48.06%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**
Race/Ethnicity								
Asian	94	9.42%	77	7.43%	93	8.99%	264	8.60%
Black	110	11.02%	113	10.91%	117	11.30%	340	11.08%
Hispanic	278	27.86%	294	28.38%	275	26.57%	847	27.60%
Other	44	4.41%	64	6.18%	51	4.93%	159	5.18%
White	472	47.29%	488	47.10%	499	48.21%	1,459	47.54%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**
Limited English Proficiency in Grade 5								
Not LEP	671	67.23%	712	68.73%	694	67.05%	2,077	67.68%
LEP	253	25.35%	275	26.54%	293	28.31%	821	26.75%
Missing	74	7.41%	49	4.73%	48	4.64%	171	5.57%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**
Special Education in Grade 5								
Not Special Ed	787	78.86%	841	81.18%	843	81.45%	2,471	80.51%
Special Education	137	13.73%	146	14.09%	144	13.91%	427	13.91%
Missing	74	7.41%	49	4.73%	48	4.64%	171	5.57%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**

Figure 2.2 shows the number of students in Language Immersion in each cohort and grade level. In the years and grades where there are students in the immersion program, it includes about ten percent of students. There are no students in the immersion program in the 2007/08 academic year (the Grade 4 year for cohort 2016 and the Grade 5 year for cohort 2015).[7]

Figure 2.2: Language Immersion by Cohort

VARIABLES	2014		2015		2016		TOTAL	
	N	Pct	N	Pct	N	Pct	N	Pct
Language Immersion in Grade 3								
No Language Immersion	0	0.00%	0	0.00%	795	76.81%	795	25.90%
Language Immersion	0	0.00%	0	0.00%	101	9.76%	101	3.29%
Missing	998	100.00%	1,036	100.00%	139	13.43%	2,173	70.80%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**
Language Immersion in Grade 4								
No Language Immersion	2	0.20%	828	79.92%	954	92.17%	1,784	58.13%
Language Immersion	0	0.00%	107	10.33%	1	0.10%	108	3.52%
Missing	996	99.80%	101	9.75%	80	7.73%	1,177	38.35%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**
Language Immersion in Grade 5								
No Language Immersion	825	82.67%	987	95.27%	887	85.70%	2,699	87.94%
Language Immersion	99	9.92%	0	0.00%	100	9.66%	199	6.48%
Missing	74	7.41%	49	4.73%	48	4.64%	171	5.57%
Total	**998**	**100.00%**	**1,036**	**100.00%**	**1,035**	**100.00%**	**3,069**	**100.00%**

Figure 2.3 details the "Success" variable that shows whether the student succeeded in a class. Reading and Mathematics courses are not included in the regression analysis due to a low number of usable observations or lack of variation.

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[7] Immersion data, like SOL data, is also missing for years prior to 2006/07.

Figure 2.3: Success in Courses by Grade

COURSES	GRADE 1		GRADE 2		GRADE 3		GRADE 4		GRADE 5	
	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct
Mathematics										
No Success	10	0.41%	22	0.85%	0	0.00%	0	0.00%	0	0.00%
Success	2,378	98.67%	2,527	97.95%	0	0.00%	0	0.00%	0	0.00%
Missing	22	0.91%	31	1.20%	2,489	100.00%	2,773	100.00%	2,906	100.00%
Total	**2,410**	**100.00%**	**2,580**	**100.00%**	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Mathematics Level										
No Success	69	2.86%	88	3.41%	71	2.85%	126	4.54%	347	11.94%
Success	2,335	96.89%	2,484	96.28%	2,323	93.33%	2,566	92.54%	2,429	83.59%
Missing	6	0.25%	8	0.31%	95	3.82%	81	2.92%	130	4.47%
Total	**2,410**	**100.00%**	**2,580**	**100.00%**	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Oral Communication										
No Success	114	4.73%	180	6.98%	0	0.00%	0	0.00%	0	0.00%
Success	2,251	93.40%	2,364	91.63%	0	0.00%	0	0.00%	0	0.00%
Missing	45	1.87%	36	1.40%	2,489	100.00%	2,773	100.00%	2,906	100.00%
Total	**2,410**	**100.00%**	**2,580**	**100.00%**	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Reading										
No Success	0	0.00%	0	0.00%	0	0.00%	0	0.00%	64	2.20%
Success	0	0.00%	0	0.00%	0	0.00%	2	0.07%	843	29.01%
Missing	2,410	100.00%	2,580	100.00%	2,489	100.00%	2,771	99.93%	1,999	68.79%
Total	**2,410**	**100.00%**	**2,580**	**100.00%**	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Reading Level										
No Success	213	8.84%	255	9.88%	253	10.16%	320	11.54%	886	30.49%
Success	2,168	89.96%	2,289	88.72%	2,088	83.89%	2,289	82.55%	1,826	62.84%
Missing	29	1.20%	36	1.40%	148	5.95%	164	5.91%	194	6.68%
Total	**2,410**	**100.00%**	**2,580**	**100.00%**	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Reading Level Achievement										
No Success	172	7.14%	164	6.36%	0	0.00%	0	0.00%	0	0.00%
Success	2,176	90.29%	2,309	89.50%	0	0.00%	0	0.00%	0	0.00%
Missing	62	2.57%	107	4.15%	2,489	100.00%	2,773	100.00%	2,906	100.00%
Total	**2,410**	**100.00%**	**2,580**	**100.00%**	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**

Figure 2.4 shows the breakdown of student achievement by letter marks attained in Grades 3-5. The choice of grouping different letter marks together is based on the number of observations and whether a mark is considered a success.

Figure 2.4: Success in Courses with Letter Marks by Grade

COURSE GRADE	GRADE 3		GRADE 4		GRADE 5	
	N	Pct	N	Pct	N	Pct
Reading Achievement						
A	963	38.69%	1,157	41.72%	901	31.00%
B or C	1,232	49.50%	1,293	46.63%	800	27.53%
D or E	34	1.37%	46	1.66%	38	1.31%
Missing	260	10.45%	277	9.99%	1,167	40.16%
Total	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Science						
A	1,236	49.66%	1,388	50.05%	1,433	49.31%
B or C	1,080	43.39%	1,219	43.96%	1,243	42.77%
D or E	66	2.65%	66	2.38%	89	3.06%
Missing	107	4.30%	100	3.61%	141	4.85%
Total	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Social Studies						
A	1,260	50.62%	1,214	43.78%	1,636	56.30%
B or C	1,005	40.38%	1,293	46.63%	1,076	37.03%
D or E	79	3.17%	168	6.06%	57	1.96%
Missing	145	5.83%	98	3.53%	137	4.71%
Total	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**
Writing						
A	779	31.30%	978	35.27%	1,283	44.15%
B or C	1,404	56.41%	1,479	53.34%	1,275	43.87%
D or E	50	2.01%	56	2.02%	50	1.72%
Missing	256	10.29%	260	9.38%	298	10.25%
Total	**2,489**	**100.00%**	**2,773**	**100.00%**	**2,906**	**100.00%**

REGRESSION ANALYSIS

Figures 2.5 and Figure 2.6 display the logistic regression model results reported as MEMs. Figure 2.5 shows how different characteristics relate to the likelihood of attaining an advanced diploma rather than a standard one. We find that students who succeed in Mathematics Level in Grades 2 or 5 are more likely to receive an advanced diploma by roughly 24 percent. Students who perform well in Reading Level in Grade 1 and in Reading Level Achievement and Writing in Grade 2 are also more likely to receive an advanced diploma, but to a lesser extent. It appears that succeeding in Oral Communication in Grade

1 has a negative correlation with the likelihood of advanced diploma attainment, although this is based on a relatively small sample size of students who failed Oral Communication.

For courses where students are separated into three groups, the reference group is those students who received a B or a C mark. Hanover finds that receiving an A in Reaching Achievement in Grade 4 correlates with a higher chance of attaining an advanced diploma (an increase of 4 percent). Similarly, receiving an A in Science in Grades 4-5 or Writing in Grades 3-4 corresponds to a student receiving an advanced diploma with more certainty.

SOL scores are also positively correlated with the likelihood of graduating with an advanced diploma. For instance, for every extra point on the math assessment in Grade 3 the chance of receiving an advanced diploma increases by 0.11 percent.

We also find that students who participate in the Language Immersion program in Grade 5 are more likely to graduate with an advanced diploma by 10 percent, though participation in Grades 3 and 4 is not predictive at a statistically significant level. In addition, special education students are more likely to receive a standard diploma.

Figure 2.5: Advanced vs Standard Diploma (MEM)

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
Courses					
Mathematics Level	0.0764	0.2399**	0.1278	0.0953	0.2385**
	(0.0746)	(0.1043)	(0.1312)	(0.0705)	(0.1195)
Reading Level	0.1137*	-0.0173	-0.0064	-0.0024	0.0305
	(0.0594)	(0.0419)	(0.0469)	(0.0310)	(0.0421)
Reading Achievement (A)			0.0400	0.0404*	0.0277
			(0.0346)	(0.0219)	(0.0238)
Reading Achievement (D or E)			0.0593	-0.0964	-0.1113
			(0.0935)	(0.1134)	(0.1070)
Science (A)			-0.0119	0.0414*	0.0773***
			(0.0325)	(0.0220)	(0.0234)
Science (D or E)			-0.0784	-0.0307	-0.1566
			(0.1218)	(0.0771)	(0.1020)
Social Studies (A)			0.0273	0.0135	0.0200
			(0.0313)	(0.0219)	(0.0231)
Social Studies (D or E)			-0.0839	-0.0225	0.0639
			(0.1738)	(0.0451)	(0.0390)
Writing (A)			0.0746**	0.0394*	0.0354
			(0.0350)	(0.0230)	(0.0233)
Writing (D or E)			-0.2296	-0.0652	-0.0727
			(0.2562)	(0.1026)	(0.1063)

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
Oral Communication	-0.0766*	-0.0625			
	(0.0426)	(0.0405)			
Reading Level Achievement	0.0548	0.1554***			
	(0.0439)	(0.0558)			
Writing	0.0822	0.1413***			
	(0.0550)	(0.0534)			
Science		0.0431			
		(0.1273)			
Social Studies		0.0514			
		(0.0885)			
SOL Scores					
Math Score			0.0011***	0.0010***	0.0010***
			(0.0002)	(0.0002)	(0.0002)
Reading Score			0.0005**	0.0005***	0.0008***
			(0.0002)	(0.0002)	(0.0002)
Writing Score					0.0003**
					(0.0001)
Demographic Variables					
Gender (Female)	0.0515***	0.0390**	0.0436	0.0205	0.0397**
	(0.0179)	(0.0183)	(0.0265)	(0.0182)	(0.0202)
LEP	-0.1365***	-0.1324***	-0.0018	-0.0271	-0.0376
	(0.0304)	(0.0306)	(0.0413)	(0.0272)	(0.0284)
Special Ed	-0.3257***	-0.3354***	-0.1467**	-0.1473***	-0.1132***
	(0.0346)	(0.0353)	(0.0625)	(0.0383)	(0.0373)
Immersion			0.0392	0.0327	0.1032***
			(0.0323)	(0.0326)	(0.0214)
Absences			-0.0020*	-0.0011	-0.0009
			(0.0012)	(0.0008)	(0.0010)
Graduation Cohort (Ref Group=Cohort 2014)					
Graduation Cohort (2015)	0.0226	0.0177		0.0176	0.0338*
	(0.0221)	(0.0225)		(0.0172)	(0.0201)
Graduation Cohort (2016)	0.0166	0.0149			-0.6004**
	(0.0224)	(0.0226)			(0.2705)
Observations	**2,194**	**2,312**	**694**	**1,606**	**1,631**

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Race/Ethnicity is controlled for, but the coefficients are not displayed.

Similarly to the previous figure, Figure 2.6 shows a regression analysis output but with on-time graduation as the variable of interest. Performing well on the Mathematics Level class in Grade 2 still correlates with a higher chance of a superior outcome (on-time graduation in this case). Performance in most other classes in Grades 1-5 does not appear to matter significantly when it comes to on-time graduation. The same is true of SOL scores, which are mostly not statistically significant.

We do find that being absent in Grade 5 is negatively correlated with on-time graduation, where for every day a student is absent the likelihood of graduating on time declines by 0.01 percent.

Figure 2.6: On-Time Graduation (MEM)

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
Courses					
Mathematics Level	0.0280	0.0398*		0.0035	0.0014
	(0.0177)	(0.0240)		(0.0056)	(0.0022)
Oral Communication	-0.0015	-0.0010			
	(0.0075)	(0.0054)			
Reading Level	0.0010	0.0067	-0.0056	-0.0008	-0.0045***
	(0.0091)	(0.0090)	(0.0037)	(0.0013)	(0.0017)
Reading Level Achievement	0.0150	-0.0024			
	(0.0128)	(0.0047)			
Writing	0.0019	0.0090			
	(0.0084)	(0.0091)			
Science		0.0062			
		(0.0133)			
Social Studies		0.0278			
		(0.0273)			
Science (A)			-0.0012	-0.0001	-0.0008
			(0.0042)	(0.0016)	(0.0017)
Science (D or E)			0.0040	-0.0020	-0.0028
			(0.0039)	(0.0038)	(0.0042)
Social Studies (A)			0.0015	0.0071**	0.0006
			(0.0036)	(0.0035)	(0.0017)
Social Studies (D or E)			-0.1306	-0.0021	-0.0158
			(0.0956)	(0.0055)	(0.0149)
Reading Achievement (A)				0.0014	
				(0.0023)	

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
Reading Achievement (D or E)				-0.0009	
				(0.0047)	
Writing (A)				-0.0016	0.0025
				(0.0027)	(0.0022)
Writing (D or E)				0.0008	-0.0029
				(0.0018)	(0.0074)
SOL Scores					
Math Score			0.0000	0.0000*	0.0000*
			(0.0000)	(0.0000)	(0.0000)
Reading Score			-0.0000	-0.0000	-0.0000
			(0.0000)	(0.0000)	(0.0000)
Writing Score					0.0000
					(0.0000)
Demographic Variables					
Gender (Female)	0.0032	-0.0007	0.0077	0.0016	0.0004
	(0.0036)	(0.0035)	(0.0054)	(0.0018)	(0.0015)
LEP	-0.0065	-0.0073	-0.0160	-0.0029	-0.0048
	(0.0065)	(0.0064)	(0.0186)	(0.0030)	(0.0043)
Special Ed	-0.0138	-0.0090	0.0012	-0.0013	-0.0077*
	(0.0085)	(0.0074)	(0.0055)	(0.0025)	(0.0045)
Immersion			0.0045	-0.0013	0.0015
			(0.0047)	(0.0055)	(0.0019)
Absences			-0.0001	-0.0001	-0.0001**
			(0.0001)	(0.0001)	(0.0001)
Graduation Cohort (Ref Group=Cohort 2014)					
Graduation Cohort (2015)	-0.0195***	-0.0110**			-0.0034*
	(0.0052)	(0.0044)			(0.0018)
Graduation Cohort (2016)	-0.0277***	-0.0140***			-0.0152***
	(0.0058)	(0.0046)			(0.0048)
Observations	**2,224**	**2,339**	**696**	**1,624**	**2,488**

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Race/Ethnicity is controlled for, but the coefficients are not displayed.

SECTION III: MIDDLE SCHOOL ANALYSIS

In this section, Hanover summarizes the descriptive and regression analysis results for middle school data. This section also includes a descriptive analysis of HILT student outcomes.

DESCRIPTIVE ANALYSIS

Figure 3.1 shows the demographic characteristics of students in the sample segmented by cohort. Across different variables the shares remain remarkably constant across cohorts. The largest differences are seen in the unexcused absence count variable, which shows a significant decline in the 2016 cohort.

Figure 3.1: Demographic Characteristics by Cohort

VARIABLES	2014		2015		2016		TOTAL	
	N	Pct	N	Pct	N	Pct	N	Pct
Gender								
Male	588	50.82%	595	51.03%	621	54.28%	1,804	52.03%
Female	569	49.18%	571	48.97%	523	45.72%	1,663	47.97%
Total	**1,157**	**100.00%**	**1,166**	**100.00%**	**1,144**	**100.00%**	**3,467**	**100.00%**
Race/Ethnicity								
Asian	121	10.46%	91	7.80%	105	9.18%	317	9.14%
Black	150	12.96%	131	11.23%	147	12.85%	428	12.34%
Hispanic	312	26.97%	337	28.90%	294	25.70%	943	27.20%
Other	51	4.41%	68	5.83%	57	4.98%	176	5.08%
White	523	45.20%	539	46.23%	541	47.29%	1,603	46.24%
Total	**1,157**	**100.00%**	**1,166**	**100.00%**	**1,144**	**100.00%**	**3,467**	**100.00%**
Language Immersion								
No Language Immersion	1,048	90.58%	1,050	90.05%	1,039	90.82%	3,137	90.48%
Language Immersion	57	4.93%	84	7.20%	75	6.56%	216	6.23%
Missing	52	4.49%	32	2.74%	30	2.62%	114	3.29%
Total	**1,157**	**100.00%**	**1,166**	**100.00%**	**1,144**	**100.00%**	**3,467**	**100.00%**
Limited English Proficiency								
Not LEP	778	67.24%	831	71.27%	796	69.58%	2,405	69.37%
LEP	320	27.66%	300	25.73%	317	27.71%	937	27.03%
Missing	59	5.10%	35	3.00%	31	2.71%	125	3.61%
Total	**1,157**	**100.00%**	**1,166**	**100.00%**	**1,144**	**100.00%**	**3,467**	**100.00%**

Variables	2014		2015		2016		Total	
Gifted								
Not Gifted	787	68.02%	771	66.12%	806	70.45%	2,364	68.19%
Gifted	311	26.88%	360	30.87%	307	26.84%	978	28.21%
Missing	59	5.10%	35	3.00%	31	2.71%	125	3.61%
Total	**1,157**	**100.00%**	**1,166**	**100.00%**	**1,144**	**100.00%**	**3,467**	**100.00%**
Free or Reduced Lunch								
Not FRL	771	66.64%	799	68.52%	753	65.82%	2,323	67.00%
FRL	327	28.26%	332	28.47%	360	31.47%	1,019	29.39%
Missing	59	5.10%	35	3.00%	31	2.71%	125	3.61%
Total	1,157	100.00%	1,166	100.00%	1,144	100.00%	3,467	100.00%
Special Education								
Not Sp. Ed.	985	85.13%	1,000	85.76%	982	85.84%	2,967	85.58%
Sp. Ed.	94	8.12%	93	7.98%	88	7.69%	275	7.93%
Sp. Ed., no classes	78	6.74%	73	6.26%	74	6.47%	225	6.49%
Total	1,157	100.00%	1,166	100.00%	1,144	100.00%	3,467	100.00%
Unexcused Absence Count (Sum Across 3 Grade Levels)								
	N	Mean	N	Mean	N	Mean	N	Mean
Absence	1,157	6.086	1,166	6.204	1,144	5.589	3,467	5.962

Note: Student demographic data is recorded in the earliest available grade level. Every student is counted once.

Figure 3.2 through Figure 3.5 show the distribution of students based on their mark, class taken, and grade level. These figures also identify which courses are used in the regression models for each grade. For example, taking Algebra I is only controlled for in the Grade 8 model, as there are no values in other grades.[8]

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[8] All values for Algebra I in Grade 7 are counted towards Algebra I, Intensified as students who take either of these classes in Grade 7 are high achieving, and grouping them together helps avoid issues with analyzing small groups of students, as fewer than 30 students take Algebra I in Grade 7.

Figure 3.2: Success in Math Courses by Grade

MARKS	GRADE 6		GRADE 7		GRADE 8	
	N	Pct	N	Pct	N	Pct
Algebra I						
A	0	0.00%	0	0.00%	215	6.31%
B/C	0	0.00%	0	0.00%	715	21.00%
D/E	0	0.00%	0	0.00%	73	2.14%
Missing	3,005	100.00%	3,147	100.00%	2,402	70.54%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Algebra I, Intensified						
A	0	0.00%	198	6.29%	242	7.11%
B/C	1	0.03%	141	4.48%	382	11.22%
D/E	0	0.00%	2	0.06%	14	0.41%
Missing	3,004	99.97%	2,806	89.16%	2,767	81.26%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Geometry, Intensified						
A	0	0.00%	0	0.00%	215	6.31%
B/C	0	0.00%	3	0.10%	122	3.58%
D/E	0	0.00%	0	0.00%	4	0.12%
Missing	3,005	100.00%	3,144	99.90%	3,064	89.99%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Math 6						
A	360	11.98%	0	0.00%	0	0.00%
B/C	1,348	44.86%	2	0.06%	4	0.12%
D/E	221	7.35%	0	0.00%	1	0.03%
Missing	1,076	35.81%	3,145	99.94%	3,400	99.85%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Math 7						
A	403	13.41%	410	13.03%	0	0.00%
B/C	426	14.18%	1,123	35.68%	2	0.06%
D/E	7	0.23%	193	6.13%	1	0.03%
Missing	2,169	72.18%	1,421	45.15%	3,402	99.91%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Math 8						
A	113	3.76%	407	12.93%	161	4.73%
B/C	38	1.26%	540	17.16%	965	28.34%
D/E	0	0.00%	16	0.51%	225	6.61%
Missing	2,854	94.98%	2,184	69.40%	2,054	60.32%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**

Figure 3.3: Success in Social Studies Courses by Grade

Marks	Grade 6		Grade 7		Grade 8	
	N	Pct	N	Pct	N	Pct
US History/Civ/Eco to 1865 (History 6)[9]						
A	1,200	39.93%	0	0.00%	0	0.00%
B/C	1,041	34.64%	0	0.00%	0	0.00%
D/E	123	4.09%	0	0.00%	0	0.00%
Missing	641	21.33%	3,147	100.00%	3,405	100.00%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
US Hist/Civ/Eco 1865 - Present (History 7)						
A	0	0.00%	1,284	40.80%	0	0.00%
B/C	0	0.00%	1,161	36.89%	0	0.00%
D/E	0	0.00%	131	4.16%	0	0.00%
Missing	3,005	100.00%	571	18.14%	3,405	100.00%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
American Studies 6						
A	102	3.39%	0	0.00%	0	0.00%
B/C	225	7.49%	0	0.00%	0	0.00%
D/E	63	2.10%	0	0.00%	0	0.00%
Missing	2,615	87.02%	3,147	100.00%	3,405	100.00%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
American Studies 7						
A	0	0.00%	116	3.69%	0	0.00%
B/C	0	0.00%	245	7.79%	0	0.00%
D/E	0	0.00%	47	1.49%	1	0.03%
Missing	3,005	100.00%	2,739	87.04%	3,404	99.97%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
World Geography						
A	0	0.00%	0	0.00%	1,396	41.00%
B/C	0	0.00%	2	0.06%	1,566	45.99%
D/E	0	0.00%	0	0.00%	213	6.26%
Missing	3,005	100.00%	3,145	99.94%	230	6.75%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**

[9] This and the following class are denoted as History 6 and History 7 for simplicity.

Figure 3.4: Success in Science Courses by Grade

Marks	Grade 6		Grade 7		Grade 8	
	N	Pct	N	Pct	N	Pct
Life Science						
A	0	0.00%	1,167	37.08%	0	0.00%
B/C	0	0.00%	1,386	44.04%	0	0.00%
D/E	0	0.00%	221	7.02%	0	0.00%
Missing	3,005	100.00%	373	11.85%	3,405	100.00%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Science 6						
A	1,142	38.00%	0	0.00%	0	0.00%
B/C	1,458	48.52%	0	0.00%	0	0.00%
D/E	252	8.39%	0	0.00%	0	0.00%
Missing	153	5.09%	3,147	100.00%	3,405	100.00%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Science 7						
A	0	0.00%	94	2.99%	0	0.00%
B/C	0	0.00%	104	3.30%	0	0.00%
D/E	0	0.00%	20	0.64%	0	0.00%
Missing	3,005	100.00%	2,929	93.07%	3,405	100.00%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Physical Science						
A	0	0.00%	0	0.00%	1,079	31.69%
B/C	0	0.00%	1	0.03%	1,677	49.25%
D/E	0	0.00%	0	0.00%	411	12.07%
Missing	3,005	100.00%	3,146	99.97%	238	6.99%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**

Figure 3.5: Success in English and Reading Courses by Grade

MARKS	GRADE 6		GRADE 7		GRADE 8	
	N	Pct	N	Pct	N	Pct
English 6, 7, and 8						
A	1,144	38.07%	1,364	43.34%	1,169	34.33%
B/C	1,468	48.85%	1,377	43.76%	1,699	49.90%
D/E	82	2.73%	139	4.42%	240	7.05%
Missing	311	10.35%	267	8.48%	297	8.72%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**
Reading 6						
A	1,207	40.17%	2	0.06%	4	0.12%
B/C	1,051	34.98%	0	0.00%	2	0.06%
D/E	111	3.69%	0	0.00%	0	0.00%
Missing	636	21.16%	3,145	99.94%	3,399	99.82%
Total	**3,005**	**100.00%**	**3,147**	**100.00%**	**3,405**	**100.00%**

REGRESSION ANALYSIS

Figure 3.6 displays the logistic regression model results reported as MEMs. For courses where students are separated into three groups, the reference group is those students who received a B or a C mark. Hanover controls for the mark in the most enrolled-in course in a particular department in particular grade (for example, English 6 would be the "reference" class for Grade 6 in ELA), as well as whether the student opted for a different class in that semester using the dummy variables such as "Math 7 Taken." Only one class per student/grade/department combination is possible.[10] The reference class in the brackets denotes the comparison. For example, the Science 7 coefficient shows the likelihood of attaining the outcome of interest if the student takes Science 7 instead of Life Science in Grade 7 (holding the student's mark in the course and other characteristics constant).

The "Diploma" column shows how different characteristics relate to the likelihood of attaining an advanced diploma rather than a standard one. Math SOL scores are positively correlated with the outcome; i.e., higher scores correspond with a higher chance of receiving an advanced diploma. We have scaled the SOL scores by a factor of 10, which means that, for example, earning a math SOL score that is 10 points higher in Grade 8 would increase the chance of graduating with an advanced diploma by roughly 1 percent. Reading SOL scores show the same relationship, but only in Grade 7.

For most classes considered, better performance leads to higher chances of attaining an advanced diploma relative to a standard diploma. Taking classes of higher level (for example, Algebra I rather than Math 8) also results in a higher chance of graduating with an

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[10] Fewer than 10 students have multiple classes per department. We retain the class with the highest rank in those cases (for example, Algebra I over Math 8).

advanced diploma. On average, course performance in later grades is more likely to be correlated with the likelihood of attaining an advanced diploma.

Similarly, the "On-Time Graduation" column shows a regression analysis output with on-time graduation as the variable of interest. Performing well on the Social Studies (History 7) and Science 7 classes in Grade 7 correlates with a higher chance of a superior outcome (on-time graduation in this case). Performance in most other classes in Grades 6-8 does not appear to matter significantly when it comes to on-time graduation. The same is true of SOL scores, which are mostly not statistically significant.

We do find that being absent is negatively correlated with on-time graduation, where for every day a student is absent in Grade 6 the likelihood of graduating on time declines by 0.06 percent. The likelihood of on-time graduation declines to a lesser extent in Grades 7 and 8, indicating that attendance in earlier grades has a more significant impact on on-time graduation.

Figure 3.6: Regression Analysis (MEM)

VARIABLES	DIPLOMA			ON-TIME GRADUATION		
	Grade 6	Grade 7	Grade 8	Grade 6	Grade 7	Grade 8
Courses						
Social Studies (A)	0.0603***	0.0721***	0.0248	0.0015	0.0050*	-0.0021
	(0.0204)	(0.0177)	(0.0167)	(0.0045)	(0.0027)	(0.0032)
Social Studies (D/E)	-0.1045*	-0.1302**	-0.0450	-0.0089	-0.0142*	-0.0068
	(0.0633)	(0.0541)	(0.0371)	(0.0091)	(0.0083)	(0.0045)
ELA (A)	0.0110	0.0288	0.0802***	0.0056	-0.0007	0.0013
	(0.0196)	(0.0181)	(0.0192)	(0.0037)	(0.0022)	(0.0029)
ELA (D/F)	-0.0152	-0.0377	-0.1586***	-0.0111	-0.0015	-0.0125*
	(0.0431)	(0.0347)	(0.0468)	(0.0123)	(0.0022)	(0.0070)
Math (A)	0.0193	0.0706***	0.0434**	-0.0026	0.0012	0.0009
	(0.0223)	(0.0164)	(0.0193)	(0.0040)	(0.0025)	(0.0036)
Math (D/E)	-0.0220	-0.0623	-0.0949**	-0.0068	-0.0069	-0.0058
	(0.0272)	(0.0411)	(0.0389)	(0.0079)	(0.0043)	(0.0039)
Science (A)	0.0151	0.0085	0.0202	0.0035	0.0035	0.0002
	(0.0222)	(0.0182)	(0.0241)	(0.0037)	(0.0030)	(0.0036)
Science (D/E)	-0.0203	-0.1114***	-0.0671**	-0.0059	-0.0020	-0.0053
	(0.0289)	(0.0415)	(0.0269)	(0.0080)	(0.0032)	(0.0038)
Reading (A)	0.0686***			-0.0035		
	(0.0215)			(0.0037)		
Reading (D/E)	-0.1167*			0.0023		
	(0.0615)			(0.0016)		

VARIABLES	DIPLOMA			ON-TIME GRADUATION		
Math 7 Taken [Ref=Math 6]	0.0580***			-0.0004		
	(0.0174)			(0.0030)		
Math 8 Taken [Ref Grade 6=Math 6, Ref Grade 7=Math 7]	0.0432	0.0463**		-0.0122	-0.0045	
	(0.0394)	(0.0183)		(0.0154)	(0.0041)	
Algebra I Taken [Ref=Math 8]			0.0892***			0.0017
			(0.0145)			(0.0028)
Algebra I, Intensified Taken [Ref Grade 7=Math 7, Ref Grade 8=Math 8]		0.0645***	0.1528***		-0.0024	0.0032
		(0.0248)	(0.0178)		(0.0069)	(0.0044)
Geometry, Intensified Taken [Ref=Math 8]			0.0950***			0.0029
			(0.0227)			(0.0043)
American Studies 6 Taken [Ref=History 6]	-0.1143			-0.0122		
	(0.0723)			(0.0125)		
American Studies 7 Taken [Ref=History 7]		-0.0144			-0.0045	
		(0.0364)			(0.0042)	
Science 7 Taken [Ref=Life Science]		0.0693			0.0039**	
		(0.0570)			(0.0018)	
SOL Scores						
History score		0.0025	0.0040		0.0001	-0.0000
		(0.0016)	(0.0032)		(0.0001)	(0.0003)
Math score	0.0087***	0.0084***	0.0095***	-0.0000	0.0002	0.0000
	(0.0013)	(0.0016)	(0.0020)	(0.0002)	(0.0002)	(0.0002)
Reading score	0.0021	0.0036**	0.0025	-0.0001	-0.0001	-0.0001
	(0.0013)	(0.0015)	(0.0016)	(0.0002)	(0.0001)	(0.0002)
Science score			0.0010			0.0002
			(0.0022)			(0.0002)
Writing score			0.0025			0.0007
			(0.0016)			(0.0005)
Demographic Variables						
Gifted	-0.0264	-0.0183	-0.0467**	-0.0034	-0.0016	-0.0051
	(0.0191)	(0.0179)	(0.0200)	(0.0038)	(0.0024)	(0.0036)
Free/Reduced Lunch	-0.0574**	-0.0686***	-0.0599***	-0.0011	-0.0005	0.0002
	(0.0243)	(0.0227)	(0.0216)	(0.0040)	(0.0020)	(0.0021)
Language Immersion (Classes Taken)	-0.0301	0.0078	0.0620***			-0.0024
	(0.1994)	(0.0944)	(0.0189)			(0.0049)
Gender (Female)	0.0275*	0.0281**	0.0297*	0.0035	0.0003	-0.0022
	(0.0141)	(0.0142)	(0.0152)	(0.0024)	(0.0015)	(0.0022)
Limited English Proficiency	0.0159	0.0142	0.0108	-0.0040	-0.0029	-0.0018
	(0.0201)	(0.0187)	(0.0195)	(0.0066)	(0.0030)	(0.0029)

VARIABLES	DIPLOMA			ON-TIME GRADUATION		
Special Education	-0.0732	-0.1435***	-0.2336***	-0.0101	-0.0030	-0.0124
	(0.0522)	(0.0403)	(0.0475)	(0.0105)	(0.0040)	(0.0083)
Special Education, No Classes	-0.0878***	-0.1099***	-0.0891***	-0.0081	-0.0018	0.0004
	(0.0336)	(0.0405)	(0.0327)	(0.0070)	(0.0043)	(0.0029)
Graduation Cohort [Ref Group=Cohort 2014]						
Graduation Cohort (2015)	0.0305*	0.0210	0.0358*	-0.0012	-0.0011	-0.0006
	(0.0168)	(0.0163)	(0.0217)	(0.0028)	(0.0017)	(0.0020)
Graduation Cohort (2016)	0.0118	0.0079	0.0895***	-0.0015	-0.0050*	-0.0058*
	(0.0179)	(0.0170)	(0.0218)	(0.0028)	(0.0026)	(0.0031)
Attendance						
Unexcused Absence Count	-0.0036*	-0.0032*	-0.0033**	-0.0006**	-0.0003**	-0.0002**
	(0.0020)	(0.0019)	(0.0015)	(0.0002)	(0.0001)	(0.0001)
Observations	**2,309**	**2,816**	**3,041**	**2,325**	**2,853**	**3,083**

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Race/Ethnicity is controlled for, but the coefficients are not displayed.

HILT DESCRIPTIVE ANALYSIS

In this section, Hanover presents descriptive analysis for the English for Speakers of Other Languages/High Intensity Language Training (ESOL/HILT) program. As the courses for this program are scored on a different scale than regular courses (O/S/U rather than A-F letter grades), we are not able to include them in the model described in the previous section.

Figure 3.7 shows shares of students who received advanced rather than standard diploma based on what class in which grade they took.[11] Students who take classes in the 1st or 2nd levels (HILT A and B, respectively) are less likely to receive an advanced diploma the later they take these classes. For example, among students who graduated with a diploma, those who take HILT A English in Grade 6 are more likely to receive an advanced diploma than those who take this class in Grade 8. This pattern does not hold for classes in the 3rd and 4th levels (HILTEX A and B, respectively).

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[11] Most students pass these courses, which is why we did not specify which marks the students attained. These shares represent student outcomes regardless of class success.

Figure 3.7: Standard vs Advanced Diploma Attainment for HILT Students

HILT Course	GRADE 6				GRADE 7				GRADE 8			
	Standard Diploma		Advanced Diploma		Standard Diploma		Advanced Diploma		Standard Diploma		Advanced Diploma	
	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct
English												
HILT A English	29	63.04%	17	36.96%	31	73.81%	11	26.19%	24	92.31%	2	7.69%
HILT B English	30	50.85%	29	49.15%	26	57.78%	19	42.22%	26	61.90%	16	38.10%
HILTEX A English	40	56.34%	31	43.66%	18	50.00%	18	50.00%	14	51.85%	13	48.15%
HILTEX B English	27	50.00%	27	50.00%	20	57.14%	15	42.86%	15	48.39%	16	51.61%
Reading												
HILT A Reading	29	63.04%	17	36.96%	31	73.81%	11	26.19%	24	92.31%	2	7.69%
HILT B Reading	30	49.18%	31	50.82%	28	58.33%	20	41.67%	27	62.79%	16	37.21%
HILTEX A Reading	55	53.92%	47	46.08%	40	51.95%	37	48.05%	32	59.26%	22	40.74%
HILTEX B Reading	34	51.52%	32	48.48%	29	59.18%	20	40.82%	21	50.00%	21	50.00%
Science, Social Studies, Math												
HILT A Science	30	62.50%	18	37.50%	28	73.68%	10	26.32%	21	91.30%	2	8.70%
HILT B Science	30	51.72%	28	48.28%	28	58.33%	20	41.67%	29	64.44%	16	35.56%
HILT A Social Studies	30	63.83%	17	36.17%	21	77.78%	6	22.22%	16	88.89%	2	11.11%
HILT B Social Studies	29	50.88%	28	49.12%	22	59.46%	15	40.54%	18	81.82%	4	18.18%
HILT Math Level I	21	77.78%	6	22.22%	19	73.08%	7	26.92%	13	100.00%	0	0.00%
HILT Math Level II	27	69.23%	12	30.77%	21	72.41%	8	27.59%	13	81.25%	3	18.75%
Total	**441**	**56.47%**	**340**	**43.53%**	**362**	**62.52%**	**217**	**37.48%**	**293**	**68.46%**	**135**	**31.54%**

Figure 3.8 displays shares of students who graduate on time relative to those who do not graduate on time. Here, students in level 1-3 classes are less likely to graduate on time if they take these courses in later grades. For level 4 and Math classes, the pattern is still not conclusive.

The difference in patterns might be due to students with greater knowledge of English being able to fulfill all requirements for on-time graduation or advanced diploma with more ease than those in levels 1 and 2. Alternatively, the difference may be due to students in levels 3 and 4 only receiving 2-3 periods of instruction daily compared to 4-5 periods at levels 1 and 2.[12]

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[12] Secondary HILT/HILTEX Program. https://www.apsva.us/esol-hilt/secondary-hilt/

Figure 3.8: On-Time Graduation for HILT Students

HILT Course	GRADE 6				GRADE 7				GRADE 8			
	Did not Graduate on Time		Graduated on Time		Did not Graduate on Time		Graduated on Time		Did not Graduate on Time		Graduated on Time	
	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct
English												
HILT A English	14	25.45%	41	74.55%	17	30.91%	38	69.09%	18	45.00%	22	55.00%
HILT B English	10	15.87%	53	84.13%	12	24.49%	37	75.51%	11	22.45%	38	77.55%
HILTEX A English	5	6.76%	69	93.24%	3	7.69%	36	92.31%	7	23.33%	23	76.67%
HILTEX B English	4	7.14%	52	92.86%	4	10.53%	34	89.47%	2	6.25%	30	93.75%
Reading												
HILT A Reading	14	25.45%	41	74.55%	17	30.91%	38	69.09%	18	45.00%	22	55.00%
HILT B Reading	10	15.38%	55	84.62%	12	23.08%	40	76.92%	11	22.00%	39	78.00%
HILTEX A Reading	9	8.41%	98	91.59%	11	13.25%	72	86.75%	12	19.67%	49	80.33%
HILTEX B Reading	5	7.25%	64	92.75%	7	12.96%	47	87.04%	3	6.98%	40	93.02%
Science, Social Studies, Math												
HILT A Science	17	29.31%	41	70.69%	14	28.57%	35	71.43%	16	44.44%	20	55.56%
HILT B Science	8	12.90%	54	87.10%	14	25.93%	40	74.07%	12	23.08%	40	76.92%
HILT A Social Studies	17	29.82%	40	70.18%	14	37.84%	23	62.16%	11	42.31%	15	57.69%
HILT B Social Studies	8	13.11%	53	86.89%	13	30.23%	30	69.77%	11	37.93%	18	62.07%
HILT Math Level I	14	41.18%	20	58.82%	11	32.35%	23	67.65%	11	52.38%	10	47.62%
HILT Math Level II	17	36.96%	29	63.04%	14	35.90%	25	64.10%	10	40.00%	15	60.00%
Total	**152**	**17.63%**	**710**	**82.37%**	**163**	**23.94%**	**518**	**76.06%**	**153**	**28.65%**	**381**	**71.35%**

Figure 3.9 below shows the number of academic years each student taking HILT/HILTEX classes in a particular grade spent in the district. The number of years is calculated as the difference between the district entry date and the academic year a particular class is taken in.

It is important to note that only 37 percent of students have been at the district for 4 or more years by the time they took the recorded HILT/HILTEX classes. In Grades 7 and 8, 26 and 18 percent of HILT/HILTEX students, respectively, spent less than 1 year in the APS system. Hence, students taking HILT and HILTEX classes in later grades are more likely to have only recently started at APS.

Figure 3.9: Shares of HILT/HILTEX Students by District Starting Grade (Grades 6-8)

YEARS IN THE DISTRICT	HILT GRADE							
	GRADE 6		GRADE 7		GRADE 8		TOTAL	
	N	Pct	N	Pct	N	Pct	N	Pct
0	43	16.54%	51	26.15%	29	17.68%	123	19.87%
1	33	12.69%	32	16.41%	45	27.44%	110	17.77%
2	38	14.62%	28	14.36%	27	16.46%	93	15.02%
3	19	7.31%	22	11.28%	22	13.41%	63	10.18%
4	19	7.31%	12	6.15%	11	6.71%	42	6.79%
5	20	7.69%	12	6.15%	4	2.44%	36	5.82%
6	88	33.85%	11	5.64%	6	3.66%	105	16.96%
7	0	0.00%	27	13.85%	3	1.83%	30	4.84%
8	0	0.00%	0	0.00%	17	10.37%	17	2.75%
Total	**260**	**100.00%**	**195**	**100.00%**	**164**	**100.00%**	**619**	**100.00%**

Note: These numbers are at student-year level, i.e. one student can take several HILT/HILTEX classes.

SECTION IV: HIGH SCHOOL ANALYSIS

In this section, Hanover summarizes the descriptive and regression analysis results for high school data. This section also includes a descriptive analysis of HILT student outcomes.

DESCRIPTIVE ANALYSIS

Figure 4.1 shows the demographic characteristics of students in the sample segmented by cohort. Across different variables, the percentages remain remarkably constant across cohorts. The largest differences are seen in the unexcused absence count variable, which shows a significant decline over time from an average of 19 absences in the earliest cohort to 9 absences in the 2016 cohort.

Figure 4.1: Demographic Characteristics by Cohort

VARIABLES	2014		2015		2016		TOTAL	
	N	Pct	N	Pct	N	Pct	N	Pct
Gender								
Male	730	51.59%	702	50.91%	749	53.46%	2,181	51.99%
Female	685	48.41%	677	49.09%	652	46.54%	2,014	48.01%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%
Race/Ethnicity								
Asian	169	11.94%	131	9.50%	131	9.35%	431	10.27%
Black	181	12.79%	167	12.11%	193	13.78%	541	12.90%
Hispanic	396	27.99%	391	28.35%	383	27.34%	1,170	27.89%
Other	63	4.45%	76	5.51%	64	4.57%	203	4.84%
White	606	42.83%	614	44.53%	630	44.97%	1,850	44.10%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%
Language Immersion								
No Language Immersion	1,392	98.37%	1,331	96.52%	1,362	97.22%	4,085	97.38%
Language Immersion	21	1.48%	47	3.41%	36	2.57%	104	2.48%
Missing	2	0.14%	1	0.07%	3	0.21%	6	0.14%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%
Limited English Proficiency								
Not LEP	1,045	73.85%	1,026	74.40%	1,054	75.23%	3,125	74.49%
LEP	368	26.01%	352	25.53%	344	24.55%	1,064	25.36%
Missing	2	0.14%	1	0.07%	3	0.21%	6	0.14%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%
Gifted								
Not Gifted	1,057	74.70%	974	70.63%	1,042	74.38%	3,073	73.25%
Gifted	356	25.16%	404	29.30%	356	25.41%	1,116	26.60%
Missing	2	0.14%	1	0.07%	3	0.21%	6	0.14%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%

VARIABLES	2014		2015		2016		TOTAL	
Free or Reduced Lunch								
Not FRL	963	68.06%	977	70.85%	952	67.95%	2,892	68.94%
FRL	450	31.80%	401	29.08%	446	31.83%	1,297	30.92%
Missing	2	0.14%	1	0.07%	3	0.21%	6	0.14%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%
Special Education								
Not Sp. Ed.	1,221	86.29%	1,205	87.38%	1,207	86.15%	3,633	86.60%
Sp. Ed.	133	9.40%	125	9.06%	130	9.28%	388	9.25%
Sp. Ed., no classes	61	4.31%	49	3.55%	64	4.57%	174	4.15%
Total	1,415	100.00%	1,379	100.00%	1,401	100.00%	4,195	100.00%
	N	Mean	N	Mean	N	Mean	N	Mean
Unexcused Absence Count								
Absence	1,415	18.80	1,379	12.93	1,401	9.118	4,195	13.64

Figure 4.2 through Figure 4.5 show the distribution of students based on their mark, class taken, and grade level for the courses which were taken by enough students to be included in the regression models. These figures identify which courses are used in the regression models for each grade. For example, taking Algebra I is controlled for in only the Grade 9 and Grade 10 models, as few students take this course in other grades.[13]

Figure 4.2: Success in Math Courses by Grade

MARKS	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
	N	Pct	N	Pct	N	Pct	N	Pct
Algebra I								
A	194	4.85%	42	1.03%	0	0.00%	0	0.00%
B/C	1,019	25.49%	219	5.37%	0	0.00%	0	0.00%
D/E	268	6.70%	134	3.28%	0	0.00%	0	0.00%
Missing	2,517	62.96%	3,686	90.32%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Algebra II								
A	0	0.00%	360	8.82%	153	3.77%	20	0.47%
B/C	0	0.00%	662	16.22%	624	15.36%	156	3.65%
D/E	0	0.00%	64	1.57%	137	3.37%	152	3.56%
Missing	3,998	100.00%	2,995	73.39%	3,148	77.50%	3,945	92.32%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

[13] We omit cases where only a few students take the class in a particular grade. For example, five students take Mathematical Analysis/Trig in Grade 9.

MARKS	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
Algebra II/Trig, Intensified								
A	184	4.60%	218	5.34%	0	0.00%	0	0.00%
B/C	115	2.88%	435	10.66%	0	0.00%	0	0.00%
D/E	3	0.08%	27	0.66%	0	0.00%	0	0.00%
Missing	3,696	92.45%	3,401	83.34%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Geometry								
A	454	11.36%	135	3.31%	15	0.37%	0	0.00%
B/C	630	15.76%	866	21.22%	161	3.96%	0	0.00%
D/E	55	1.38%	230	5.64%	117	2.88%	0	0.00%
Missing	2,859	71.51%	2,850	69.84%	3,769	92.79%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Mathematical Analysis/Trig								
A	0	0.00%	0	0.00%	159	3.91%	13	0.30%
B/C	0	0.00%	0	0.00%	465	11.45%	130	3.04%
D/E	0	0.00%	0	0.00%	99	2.44%	113	2.64%
Missing	3,998	100.00%	4,081	100.00%	3,339	82.20%	4,017	94.01%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Pre-Calculus								
A	0	0.00%	178	4.36%	291	7.16%	32	0.75%
B/C	0	0.00%	141	3.46%	553	13.61%	231	5.41%
D/E	0	0.00%	9	0.22%	59	1.45%	102	2.39%
Missing	3,998	100.00%	3,753	91.96%	3,159	77.77%	3,908	91.46%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
AP Calculus								
A	0	0.00%	0	0.00%	177	4.36%	395	9.24%
B/C	0	0.00%	0	0.00%	132	3.25%	560	13.11%
D/E	0	0.00%	0	0.00%	2	0.05%	42	0.98%
Missing	3,998	100.00%	4,081	100.00%	3,751	92.34%	3,276	76.67%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Statistics								
A	0	0.00%	0	0.00%	0	0.00%	159	3.72%
B/C	0	0.00%	0	0.00%	0	0.00%	358	8.38%
D/E	0	0.00%	0	0.00%	0	0.00%	115	2.69%
Missing	3,998	100.00%	4,081	100.00%	4,062	100.00%	3,641	85.21%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

MARKS	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
				AP Statistics				
A	0	0.00%	0	0.00%	0	0.00%	59	1.38%
B/C	0	0.00%	0	0.00%	0	0.00%	230	5.38%
D/E	0	0.00%	0	0.00%	0	0.00%	44	1.03%
Missing	3,998	100.00%	4,081	100.00%	4,062	100.00%	3,940	92.21%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

Figure 4.3: Success in English/World Language Courses by Grade

MARKS	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
	N	Pct	N	Pct	N	Pct	N	Pct
				English 9				
A	437	10.93%	0	0.00%	0	0.00%	0	0.00%
B/C	1,364	34.12%	0	0.00%	0	0.00%	0	0.00%
D/E	234	5.85%	0	0.00%	0	0.00%	0	0.00%
Missing	1,963	49.10%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
				English 9, Intensified				
A	648	16.21%	0	0.00%	0	0.00%	0	0.00%
B/C	923	23.09%	0	0.00%	0	0.00%	0	0.00%
D/E	50	1.25%	0	0.00%	0	0.00%	0	0.00%
Missing	2,377	59.45%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
				English 10				
A	0	0.00%	480	11.76%	0	0.00%	0	0.00%
B/C	0	0.00%	1,174	28.77%	0	0.00%	0	0.00%
D/E	0	0.00%	310	7.60%	0	0.00%	0	0.00%
Missing	3,998	100.00%	2,117	51.87%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
				English 10, Intensified				
A	0	0.00%	708	17.35%	0	0.00%	0	0.00%
B/C	0	0.00%	921	22.57%	0	0.00%	0	0.00%
D/E	0	0.00%	121	2.96%	0	0.00%	0	0.00%
Missing	3,998	100.00%	2,331	57.12%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
				English 11				
A	0	0.00%	0	0.00%	460	11.32%	34	0.80%
B/C	0	0.00%	0	0.00%	915	22.53%	107	2.50%
D/E	0	0.00%	0	0.00%	247	6.08%	39	0.91%
Missing	3,998	100.00%	4,081	100.00%	2,440	60.07%	4,093	95.79%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

Marks	Grade 9		Grade 10		Grade 11		Grade 12	
AP English 11								
A	0	0.00%	0	0.00%	670	16.49%	0	0.00%
B/C	0	0.00%	0	0.00%	802	19.74%	0	0.00%
D/E	0	0.00%	0	0.00%	94	2.31%	0	0.00%
Missing	3,998	100.00%	4,081	100.00%	2,496	61.45%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
English 12								
A	0	0.00%	0	0.00%	0	0.00%	345	8.07%
B/C	0	0.00%	0	0.00%	0	0.00%	1,115	26.09%
D/E	0	0.00%	0	0.00%	0	0.00%	410	9.60%
Missing	3,998	100.00%	4,081	100.00%	4,062	100.00%	2,403	56.24%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
AP English 12								
A	0	0.00%	0	0.00%	0	0.00%	625	14.63%
B/C	0	0.00%	0	0.00%	0	0.00%	803	18.79%
D/E	0	0.00%	0	0.00%	0	0.00%	110	2.57%
Missing	3,998	100.00%	4,081	100.00%	4,062	100.00%	2,735	64.01%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
World Languages								
A	1,215	30.39%	1,075	26.34%	942	23.19%	621	14.53%
B/C	1,768	44.22%	1,699	41.63%	1,030	25.36%	466	10.91%
D/E	274	6.85%	279	6.84%	166	4.09%	82	1.92%
Missing	741	18.53%	1,028	25.19%	1,924	47.37%	3,104	72.64%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

Figure 4.4: Success in Science Courses by Grade

Marks	Grade 9 N	Grade 9 Pct	Grade 10 N	Grade 10 Pct	Grade 11 N	Grade 11 Pct	Grade 12 N	Grade 12 Pct
Biology								
A	467	11.68%	0	0.00%	0	0.00%	0	0.00%
B/C	1,200	30.02%	0	0.00%	0	0.00%	0	0.00%
D/E	382	9.55%	0	0.00%	0	0.00%	0	0.00%
Missing	1,949	48.75%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Biology, Intensified								
A	804	20.11%	0	0.00%	0	0.00%	0	0.00%
B/C	596	14.91%	0	0.00%	0	0.00%	0	0.00%
D/E	20	0.50%	0	0.00%	0	0.00%	0	0.00%
Missing	2,578	64.48%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Chemistry								
A	0	0.00%	320	7.84%	79	1.94%	0	0.00%
B/C	0	0.00%	671	16.44%	389	9.58%	0	0.00%
D/E	0	0.00%	120	2.94%	163	4.01%	0	0.00%
Missing	3,998	100.00%	2,970	72.78%	3,431	84.47%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Chemistry, Intensified								
A	0	0.00%	552	13.53%	80	1.97%	64	1.50%
B/C	0	0.00%	537	13.16%	105	2.58%	83	1.94%
D/E	0	0.00%	33	0.81%	10	0.25%	11	0.26%
Missing	3,998	100.00%	2,959	72.51%	3,867	95.20%	4,115	96.30%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Earth Space								
A	0	0.00%	222	5.44%	54	1.33%	70	1.64%
B/C	0	0.00%	641	15.71%	145	3.57%	102	2.39%
D/E	0	0.00%	157	3.85%	52	1.28%	46	1.08%
Missing	3,998	100.00%	3,061	75.01%	3,811	93.82%	4,055	94.90%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
Physics								
A	0	0.00%	0	0.00%	580	14.28%	161	3.77%
B/C	0	0.00%	0	0.00%	534	13.15%	285	6.67%
D/E	0	0.00%	0	0.00%	125	3.08%	87	2.04%
Missing	3,998	100.00%	4,081	100.00%	2,823	69.50%	3,740	87.53%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

Figure 4.5: Success in Social Studies Courses by Grade

MARKS	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
	N	Pct	N	Pct	N	Pct	N	Pct
Economics and Personal Finance								
A	0	0.00%	243	5.95%	0	0.00%	0	0.00%
B/C	0	0.00%	385	9.43%	0	0.00%	0	0.00%
D/E	0	0.00%	121	2.96%	0	0.00%	0	0.00%
Missing	3,998	100.00%	3,332	81.65%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
World History								
A	263	6.58%	100	2.45%	0	0.00%	0	0.00%
B/C	689	17.23%	279	6.84%	0	0.00%	0	0.00%
D/E	249	6.23%	74	1.81%	0	0.00%	0	0.00%
Missing	2,797	69.96%	3,628	88.90%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
World History, Intensified								
A	713	17.83%	195	4.78%	0	0.00%	0	0.00%
B/C	854	21.36%	227	5.56%	0	0.00%	0	0.00%
D/E	54	1.35%	16	0.39%	0	0.00%	0	0.00%
Missing	2,377	59.45%	3,643	89.27%	4,062	100.00%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
US & VA History								
A	0	0.00%	0	0.00%	529	13.02%	0	0.00%
B/C	0	0.00%	0	0.00%	877	21.59%	0	0.00%
D/E	0	0.00%	0	0.00%	202	4.97%	0	0.00%
Missing	3,998	100.00%	4,081	100.00%	2,454	60.41%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
AP US & VA History								
A	0	0.00%	0	0.00%	675	16.62%	0	0.00%
B/C	0	0.00%	0	0.00%	819	20.16%	0	0.00%
D/E	0	0.00%	0	0.00%	110	2.71%	0	0.00%
Missing	3,998	100.00%	4,081	100.00%	2,458	60.51%	4,273	100.00%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%
US & VA Government								
A	0	0.00%	0	0.00%	0	0.00%	503	11.77%
B/C	0	0.00%	0	0.00%	0	0.00%	1,058	24.76%
D/E	0	0.00%	0	0.00%	0	0.00%	349	8.17%
Missing	3,998	100.00%	4,081	100.00%	4,062	100.00%	2,363	55.30%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

MARKS	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
AP US & VA Government								
A	0	0.00%	261	6.40%	0	0.00%	430	10.06%
B/C	0	0.00%	270	6.62%	0	0.00%	848	19.85%
D/E	0	0.00%	9	0.22%	0	0.00%	195	4.56%
Missing	3,998	100.00%	3,541	86.77%	4,062	100.00%	2,800	65.53%
Total	3,998	100.00%	4,081	100.00%	4,062	100.00%	4,273	100.00%

REGRESSION ANALYSIS

Figure 4.6 displays the logistic regression model results reported as marginal effects at the mean (MEMs). For courses where students are separated into three groups, the reference group is those students who received a B or a C mark, and the MEMs represent the effect of earning the given grade (e.g., an A or a D/E) instead of a B or C.

In addition to the letter grades in each subject, Hanover controls for the specific courses that each student takes, using the most enrolled-in course in a particular department in particular grade as the reference course (for example, English 9 would be the "reference" class for Grade 9 in ELA) and including indicators for whether the student opted for a different class in that semester using dummy variables such as "Algebra I Taken." Only one class per student/grade/department combination is possible.[14] The reference class in the brackets denotes the comparison. For example, the AP Calculus coefficient shows the likelihood of attaining the outcome of interest if the student takes AP Calculus instead of Algebra II in Grade 11 (holding the student's mark in the course and other characteristics constant).

ADVANCED DIPLOMA

The "Diploma" column shows how different characteristics relate to the likelihood of attaining an advanced diploma rather than a standard diploma. We exclude Science and World Languages success variables in Grades 11 and 12, as fewer students take these courses in later grades, which limits the number of usable observations to a significant extent.

History and math SOL scores are positively correlated with the likelihood of earning an advanced diploma; that is, higher scores correspond with a higher chance of receiving an advanced diploma. We have scaled the SOL scores by a factor of 10; for example, earning a history SOL score that is 10 points higher in Grade 11 would *increase* the chance of graduating with an advanced diploma by roughly 0.5 percent for the average student. Math SOL scores show the same relationship, but only in Grade 10; that is, earning a math SOL score that is 10 points higher in Grade 10 would *increase* the chance of graduating with an advanced diploma by roughly 0.5 percent for the average student.

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[14] A small share of students have multiple classes per department. We retain the highest-level class in those cases (for example, Algebra II over Algebra I).

For most classes considered, better performance leads to higher chances of attaining an advanced diploma relative to a standard diploma. Taking classes of higher level (for example, Algebra II rather than Geometry in Grade 10) also results in a higher chance of graduating with an advanced diploma. However, the reverse (for example, taking Geometry rather than Algebra II in Grade 11) results in a lower chance of graduating with an advanced diploma. Marks in Social Studies classes are more important in Grades 9-10, while marks in math classes are relevant to the likelihood of receiving an advanced diploma across all grades. Failing a World Language course in Grade 9 or 10 also has a negative impact on the likelihood of earning an advanced diploma.

Absences are negatively correlated with likelihood of earning an advanced diploma. Each day a student in most grade levels is absent, they are 0.3 percent *less* likely to earn an advanced diploma.

ON-TIME GRADUATION

Similarly, the "On-Time Graduation" column shows a regression analysis output with on-time graduation as the variable of interest. As in the previous four models, we exclude Science and World Languages success variables in Grades 11 and 12. We also exclude Social Studies success in Grades 9-10 and ELA success in Grade 9 as students who receive "A" marks in these subjects always graduate on time, and those who receive a "D" or "E" do not significantly differ in likelihood of on-time graduation from students who receive "B" or "C" marks. This perfect prediction of on-time graduation for "A" marks prevents our models from estimating precise coefficients, but does suggest that high performance in these courses contributes to on-time graduation.

Higher math and science SOL scores correlate with a higher chance of on-time graduation. However, the relationship does not hold consistently over all grade levels.

Performing well in ELA and Science classes in Grade 10 correlates with a higher chance graduating on time. Getting an "A" in either of these subjects *increases* the chance of on-time graduation by roughly 2 percent. Performance in most other classes in Grades 9-12 does not appear to significantly impact on-time graduation. The only exception is that students who receive "A" marks on Social Studies courses in Grade 11 are *less* likely to graduate on time by 0.5 percent.

Absences are negatively correlated with likelihood of graduating on time. Each day a Grade 12 student is absent, they are 0.1 percent *less* likely to graduate on time. The likelihood of on-time graduation declines to a lesser extent in Grade 11.

Figure 4.6: Regression Analysis (MEM)

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
	Grade 9	Grade 10	Grade 11	Grade 12	Grade 9	Grade 10	Grade 11	Grade 12
Subjects								
Social Studies (A)	0.0610***	0.0472***	0.0239*	0.0284			-0.0045*	-0.0020
	(0.0213)	(0.0174)	(0.0131)	(0.0183)			(0.0026)	(0.0048)
Social Studies (D/E)	-0.1051**	-0.1460**	-0.0696**	-0.0638**			-0.0040	0.0010
	(0.0436)	(0.0592)	(0.0330)	(0.0314)			(0.0033)	(0.0046)
ELA (A)	0.0325	0.0340**	0.0200	0.0127		0.0023*	-0.0001	-0.0061
	(0.0235)	(0.0171)	(0.0129)	(0.0199)		(0.0013)	(0.0021)	(0.0054)
ELA (D/E)	-0.0201	-0.0307	-0.1107***	-0.0619**		0.0005	0.0016	0.0004
	(0.0333)	(0.0280)	(0.0344)	(0.0280)		(0.0015)	(0.0016)	(0.0043)
Math (A)	0.0198	0.0049	-0.0353**	0.0191	-0.0004	0.0006	-0.0014	0.0021
	(0.0187)	(0.0203)	(0.0168)	(0.0203)	(0.0016)	(0.0020)	(0.0020)	(0.0037)
Math (D/E)	-0.1009**	-0.0490*	-0.0590***	-0.1045***	-0.0076	-0.0005	-0.0052	0.0012
	(0.0424)	(0.0298)	(0.0215)	(0.0237)	(0.0054)	(0.0014)	(0.0041)	(0.0042)
Science (A)	0.0358*	0.0364**			-0.0057	0.0024*		
	(0.0200)	(0.0181)			(0.0035)	(0.0013)		
Science (D/E)	-0.0144	-0.0530			0.0001	-0.0004		
	(0.0267)	(0.0395)			(0.0011)	(0.0018)		
World Languages (A)	-0.0113	-0.0161			0.0027	-0.0008		
	(0.0173)	(0.0189)			(0.0017)	(0.0020)		
World Languages (D/E)	-0.1463***	-0.0703**			0.0006	-0.0015		
	(0.0442)	(0.0310)			(0.0029)	(0.0020)		
Math Courses [Ref Groups: Grade 9=Algebra I, Grade 10=Geometry, Grade 11=Algebra II, Grade 12=AP Calculus]								
Algebra I Taken		-0.0985						
		(0.0814)						
Geometry Taken	0.0749***		-0.2815***					
	(0.0162)		(0.0885)					
Algebra II Taken		0.0761***		-0.4786***				
		(0.0171)		(0.0647)				
Algebra II/Trig, Intensified Taken	0.0672***	0.0876***						
	(0.0243)	(0.0231)						
Pre-Calculus Taken			0.0758***	-0.1026**				
			(0.0136)	(0.0440)				
AP Calculus Taken			0.0454***					
			(0.0174)					
Mathematics Analysis/Trig Taken			0.0599***	-0.1130**				
			(0.0112)	(0.0463)				

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
Statistics Taken				-0.1453***				
				(0.0393)				
AP Statistics Taken				-0.0233				
				(0.0443)				
ELA Courses [Ref Groups: Grade 9=English 9, Grade 10=English 10, Grade 11= English 11, Grade 12=English 12]								
English 9, Intensified Taken	-0.0268							
	(0.0356)							
English 10, Intensified Taken		0.0123						
		(0.0187)						
English 11 Taken			-0.1657*					
			(0.0921)					
AP English 11 Taken			0.0264**					
			(0.0133)					
AP English 12 Taken				0.0695***				
				(0.0179)				
Science Courses [Ref Groups: Grade 9=Biology, Grade 10=Chemistry, Grades 11-12=Physics]								
Biology, Intensified Taken	0.0240							
	(0.0181)							
Chemistry, Intensified Taken		-0.0110	0.0298	-0.0678				
		(0.0277)	(0.0214)	(0.0698)				
Earth Space Taken		-0.0624**	-0.0360	-0.0134				
		(0.0267)	(0.0338)	(0.0387)				
Social Studies Courses [Ref Groups: Grade 9=World History, Intensified, Grade 10=Economics and Personal Finance, Grade 11=US & VA History, Grade 12=US & VA Government]								
World History Taken	-0.0936**	0.0229						
	(0.0423)	(0.0168)						
World History, Intensified Taken		0.0669***						
		(0.0178)						
AP US & VA History Taken			0.0884***					
			(0.0164)					
AP US & VA Government Taken		0.0377		0.0522***				
		(0.0257)		(0.0153)				
Economics and Personal Finance Taken				-0.0883				
				(0.0966)				

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
SOL Scores								
Math score	0.0018	0.0020**			0.0003**	-0.0000		
	(0.0014)	(0.0008)			(0.0001)	(0.0000)		
Science score	0.0034	0.0017			-0.0001	0.0004*		
	(0.0027)	(0.0017)			(0.0002)	(0.0002)		
History score	0.0056**		0.0050**		0.0003		0.0004	
	(0.0024)		(0.0020)		(0.0003)		(0.0004)	
Reading score			0.0030				-0.0003	
			(0.0036)				(0.0006)	
Writing score			0.0013				0.0002	
			(0.0017)				(0.0003)	
Demographic Variables								
Gifted	-0.0332*	0.0016	0.0139	0.0385**	-0.0031	-0.0003	0.0010	0.0042
	(0.0189)	(0.0172)	(0.0135)	(0.0172)	(0.0025)	(0.0014)	(0.0021)	(0.0042)
Free/Reduced Lunch	-0.0204	-0.0811***	-0.0300*	-0.0278	-0.0038	0.0010	0.0023	0.0001
	(0.0190)	(0.0263)	(0.0166)	(0.0192)	(0.0030)	(0.0010)	(0.0015)	(0.0040)
Language Immersion	-0.0174	0.0203						
	(0.0318)	(0.0359)						
Gender (Female)	0.0278*	-0.0100	0.0286**	0.0141	0.0009	0.0008	0.0027*	-0.0010
	(0.0148)	(0.0140)	(0.0119)	(0.0156)	(0.0014)	(0.0013)	(0.0015)	(0.0032)
Limited English Proficiency	0.0118	-0.0048	-0.0233	-0.1619***	-0.0048	-0.0031	-0.0229*	-0.0567***
	(0.0171)	(0.0176)	(0.0192)	(0.0525)	(0.0042)	(0.0033)	(0.0123)	(0.0198)
Special Education	-0.0856	-0.0474	-0.1143**	-0.1753***	-0.0011	-0.0057	0.0023	
	(0.0548)	(0.0439)	(0.0574)	(0.0613)	(0.0039)	(0.0055)	(0.0019)	
Special Education, No Classes	-0.1125**	-0.0721*	-0.0246	-0.0860**	-0.0118	-0.0046	-0.0089	0.0012
	(0.0506)	(0.0426)	(0.0255)	(0.0431)	(0.0089)	(0.0072)	(0.0102)	(0.0084)
Attendance								
Unexcused Absence Count	-0.0033**	-0.0016	-0.0034***	-0.0035*	-0.0001	-0.0001	-0.0003**	-0.0010***
	(0.0013)	(0.0011)	(0.0011)	(0.0021)	(0.0001)	(0.0001)	(0.0001)	(0.0003)
Observations	**1,799**	**1,349**	**2,423**	**2,235**	**2,141**	**2,158**	**2,434**	**2,164**

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Race/Ethnicity, and graduation cohort year are controlled for, but the coefficients are not displayed.

HILT DESCRIPTIVE ANALYSIS

In this section, Hanover presents descriptive analysis for the English for Speakers of Other Languages/High Intensity Language Training (ESOL/HILT) program in Grades 9-11.[15] As the courses for this program are scored on a different scale than regular courses (O/S/U rather than A-F letter grades), we are not able to include them in the model described in the previous section.

Figure 4.7 shows the percentages of students who received an advanced rather than standard diploma based on what class in which grade they took.[16] Students who take HILT classes are less likely to receive an advanced diploma the later they take these classes. For example, among students who graduated with a diploma, those who take HILT A English in Grade 9 are more likely to receive an advanced diploma than those who take this class in Grade 11. The percentage of students achieving an advanced diploma are higher for HILTEX-taking students relative to HILT-taking students. However, the difference diminishes in Grade 11.

Figure 4.7: Standard vs Advanced Diploma Attainment for HILT Students

HILT COURSE	GRADE 9				GRADE 10				GRADE 11			
	Standard Diploma		Advanced Diploma		Standard Diploma		Advanced Diploma		Standard Diploma		Advanced Diploma	
	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct
English												
HILT A English	62	86.11%	10	13.89%	41	95.35%	2	4.65%	17	94.44%	1	5.56%
HILT B English	58	81.69%	13	18.31%	68	90.67%	7	9.33%	27	96.43%	1	3.57%
HILTEX English 9	53	67.09%	26	32.91%	67	82.72%	14	17.28%	61	95.31%	3	4.69%
HILTEX English 10	27	71.05%	11	28.95%	55	73.33%	20	26.67%	88	88.89%	11	11.11%
Reading												
HILT A Reading	63	86.30%	10	13.70%	41	95.35%	2	4.65%	16	94.12%	1	5.88%
HILT B Reading	40	83.33%	8	16.67%	48	90.57%	5	9.43%	17	94.44%	1	5.56%
HILTEX Reading 9	32	66.67%	16	33.33%	41	80.39%	10	19.61%	52	94.55%	3	5.45%
HILTEX Reading 10	4	44.44%	5	55.56%	33	68.75%	15	31.25%	57	86.36%	9	13.64%
Science, Social Studies												
HILT A Science	56	84.85%	10	15.15%	37	97.37%	1	2.63%	14	93.33%	1	6.67%
HILT B Science	35	85.37%	6	14.63%	42	87.50%	6	12.50%	15	93.75%	1	6.25%
HILT A Social Studies	54	87.10%	8	12.90%	34	97.14%	1	2.86%	14	93.33%	1	6.67%
HILT B Social Studies	15	93.75%	1	6.25%	27	87.10%	4	12.90%	14	93.33%	1	6.67%
HILTEX Biology	33	63.46%	19	36.54%	45	67.16%	22	32.84%	48	94.12%	3	5.88%
Total	**532**	**78.81%**	**143**	**21.19%**	**579**	**84.16%**	**109**	**15.84%**	**440**	**92.24%**	**37**	**7.76%**

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[15] Only a few students take HILT classes in Grade 12.
[16] Most students pass these courses, which is why we did not specify which marks the students attained. These percentages represent student outcomes regardless of class success.

Figure 4.8 displays the percentages of students who graduate on time relative to those who do not graduate on time. Here, students who take HILT classes are on average less likely to graduate on time the later they take these classes. However, the difference is less stark between Grades 9 and 10, especially for HILT A classes.

The difference in the percentage of students attaining advanced diploma or graduating on time between HILT and HILTEX classes may be due to students in levels 3 and 4 (HILTEX) having higher levels of English proficiency and only receiving 2-3 periods of instruction daily compared to 4-5 periods at levels 1 and 2 (HILT).[17]

Figure 4.8: On-Time Graduation for HILT Students

HILT COURSE	GRADE 9				GRADE 10				GRADE 11			
	Did not Graduate on Time		Graduated on Time		Did not Graduate on Time		Graduated on Time		Did not Graduate on Time		Graduated on Time	
	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct
English												
HILT A English	164	82.00%	36	18.00%	76	82.61%	16	17.39%	20	86.96%	3	13.04%
HILT B English	62	53.45%	54	46.55%	87	69.05%	39	30.95%	42	85.71%	7	14.29%
HILTEX English 9	37	36.27%	65	63.73%	59	53.15%	52	46.85%	52	61.18%	33	38.82%
HILTEX English 10	9	21.43%	33	78.57%	37	38.95%	58	61.05%	52	41.94%	72	58.06%
Reading												
HILT A Reading	146	80.22%	36	19.78%	73	82.02%	16	17.98%	20	90.91%	2	9.09%
HILT B Reading	44	55.00%	36	45.00%	69	73.40%	25	26.60%	31	86.11%	5	13.89%
HILTEX Reading 9	21	35.00%	39	65.00%	36	50.00%	36	50.00%	44	60.27%	29	39.73%
HILTEX Reading 10	1	10.00%	9	90.00%	22	36.07%	39	63.93%	36	41.86%	50	58.14%
Science, Social Studies												
HILT A Science	134	80.72%	32	19.28%	53	79.10%	14	20.90%	17	94.44%	1	5.56%
HILT B Science	26	42.62%	35	57.38%	61	74.39%	21	25.61%	19	79.17%	5	20.83%
HILT A Social Studies	131	81.37%	30	18.63%	53	77.94%	15	22.06%	19	100.00%	0	0.00%
HILT B Social Studies	15	51.72%	14	48.28%	34	69.39%	15	30.61%	16	72.73%	6	27.27%
HILTEX Biology	20	31.75%	43	68.25%	32	36.36%	56	63.64%	43	64.18%	24	35.82%
Total	**810**	**63.68%**	**462**	**36.32%**	**692**	**63.25%**	**402**	**36.75%**	**411**	**63.43%**	**237**	**36.57%**

Figure 4.9 below shows the number of academic years each student taking HILT/HILTEX classes in a particular grade spent in the district. The number of years is calculated as the difference between the district entry date and the academic year a particular class is taken in.

Roughly 12 percent of students have been at the district for 4 or more years by the time they took the recorded HILT/HILTEX classes (Figure 5). In Grades 10 and 11, 25 and 16 percent of HILT/HILTEX students, respectively, spent less than 1 year in the APS system.

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[17] Secondary HILT/HILTEX Program. https://www.apsva.us/esol-hilt/secondary-hilt/

Hence, students taking HILT and HILTEX classes in later grades are more likely to have only recently started at APS.

Figure 4.9: Shares of HILT/HILTEX Students by Years in the District (Grades 9-11)

YEARS IN THE DISTRICT	HILT GRADE							
	GRADE 9		GRADE 10		GRADE 11		TOTAL	
	N	Pct	N	Pct	N	Pct	N	Pct
0	198	55.00%	82	25.23%	38	16.45%	318	34.72%
1	73	20.28%	110	33.85%	41	17.75%	224	24.45%
2	38	10.56%	64	19.69%	59	25.54%	161	17.58%
3	21	5.83%	36	11.08%	48	20.78%	105	11.46%
4	16	4.44%	15	4.62%	29	12.55%	60	6.55%
5	6	1.67%	7	2.15%	10	4.33%	23	2.51%
6	4	1.11%	6	1.85%	2	0.87%	12	1.31%
7	1	0.28%	2	0.62%	2	0.87%	5	0.55%
8	1	0.28%	2	0.62%	2	0.87%	5	0.55%
9	2	0.56%	0	0.00%	0	0.00%	2	0.22%
10	0	0.00%	1	0.31%	0	0.00%	1	0.11%
Total	**360**	**100.00%**	**325**	**100.00%**	**231**	**100.00%**	**916**	**100.00%**

Note: These numbers are at student-year level, i.e. one student can take several HILT/HILTEX classes.

APPENDIX I: ELEMENTARY REGRESSION MODELS

Below is the full logistic regression model output that corresponds to the MEM output for the *Elementary School Analysis*.

Figure A.1.1: Advanced vs Standard Diploma (Logistic Regression Model Output)

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
Courses					
Mathematics Level	0.4450	1.1542***	0.8478	0.6607	1.2944**
	(0.3884)	(0.4259)	(0.6900)	(0.4030)	(0.5066)
Reading Level	0.6402**	-0.1109	-0.0572	-0.0207	0.2227
	(0.2928)	(0.2775)	(0.4280)	(0.2704)	(0.2876)
Reading Achievement (A)			0.3561	0.3507*	0.2159
			(0.3187)	(0.1892)	(0.1847)
Reading Achievement (D or E)			0.5716	-0.6073	-0.6581
			(1.1265)	(0.6042)	(0.5387)
Science (A)			-0.1058	0.3516*	0.5945***
			(0.2902)	(0.1814)	(0.1757)
Science (D or E)			-0.5866	-0.2146	-0.8044*
			(0.7572)	(0.5050)	(0.4489)
Social Studies (A)			0.2379	0.1171	0.1521
			(0.2676)	(0.1898)	(0.1739)
Social Studies (D or E)			-0.5563	-0.1761	0.5613
			(0.9818)	(0.3331)	(0.4140)
Writing (A)			0.7109*	0.3492*	0.2756
			(0.3639)	(0.2102)	(0.1818)
Writing (D or E)			-1.2080	-0.4395	-0.4483
			(1.0772)	(0.6070)	(0.5811)
Oral Communication	-0.6110	-0.4422			
	(0.4211)	(0.3281)			
Reading Level Achievement	0.3320	0.8047***			
	(0.2446)	(0.2486)			
Writing	0.4802*	0.7477***			
	(0.2877)	(0.2474)			
Science		0.2504			
		(0.6927)			
Social Studies		0.2954			
		(0.4723)			

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
SOL Scores					
Math score			0.0093***	0.0088***	0.0074***
			(0.0022)	(0.0015)	(0.0016)
Reading score			0.0043**	0.0047***	0.0059***
			(0.0017)	(0.0014)	(0.0016)
Writing score					0.0020**
					(0.0009)
Demographic Variables					
Gender (Female)	0.3413***	0.2443**	0.3863*	0.1774	0.3096*
	(0.1195)	(0.1148)	(0.2343)	(0.1569)	(0.1587)
LEP	-0.7936***	-0.7393***	-0.0162	-0.2229	-0.2767
	(0.1577)	(0.1550)	(0.3613)	(0.2131)	(0.1969)
Special Ed	-1.6276***	-1.6205***	-0.9948***	-0.9911***	-0.7387***
	(0.1527)	(0.1532)	(0.3417)	(0.2096)	(0.2081)
Immersion			0.3824	0.3117	1.1496***
			(0.3431)	(0.3442)	(0.3551)
Absences			-0.0174*	-0.0095	-0.0069
			(0.0101)	(0.0071)	(0.0076)
Race/Ethnicity (Ref Group=White)					
Asian	-0.4121*	-0.4807**	-0.3778	-0.4919	-0.1468
	(0.2503)	(0.2329)	(0.5052)	(0.2995)	(0.2922)
Black	-1.8620***	-1.8638***	-0.8568**	-0.7930***	-0.5682**
	(0.1852)	(0.1759)	(0.3344)	(0.2307)	(0.2408)
Hispanic	-0.8903***	-0.9259***	-0.1687	-0.3369	-0.4613**
	(0.1642)	(0.1612)	(0.3987)	(0.2342)	(0.2132)
Other	-0.5608**	-0.6451**	-0.6114	-0.3039	-0.0071
	(0.2660)	(0.2512)	(0.5137)	(0.3268)	(0.3806)
Graduation Cohort (Ref Group=Cohort 2014)					
Graduation Cohort (2015)	0.1480	0.1095		0.1571	0.2649*
	(0.1443)	(0.1392)		(0.1546)	(0.1564)
Graduation Cohort (2016)	0.1074	0.0919			-2.7995*
	(0.1443)	(0.1390)			(1.5219)
Constant	0.8990*	-0.4848	-6.1432***	-5.7897***	-8.1727***
	(0.4902)	(0.8116)	(1.2529)	(0.9399)	(1.0161)
Observations	**2,194**	**2,312**	**694**	**1,606**	**1,631**

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Figure A.1.2: On-Time Graduation (Logistic Regression Model Output)

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
Courses					
Mathematics Level	1.2212***	1.6522***		0.8295	0.3237
	(0.4526)	(0.4850)		(0.8178)	(0.4476)
Oral Communication	-0.1266	-0.1012			
	(0.6838)	(0.5688)			
Reading Level	0.0815	0.5175	-1.2695	-0.3484	-1.5470***
	(0.6802)	(0.5653)	(0.8966)	(0.5965)	(0.5203)
Reading Level Achievement	0.8311*	-0.2557			
	(0.5037)	(0.5747)			
Writing	0.1432	0.6629			
	(0.5987)	(0.5165)			
Science		0.4757			
		(0.8299)			
Social Studies		1.3516*			
		(0.7372)			
Science (A)			-0.1691	-0.0383	-0.2220
			(0.5856)	(0.5647)	(0.4740)
Science (D or E)			0.9493	-0.5494	-0.6286
			(1.2910)	(0.8021)	(0.6890)
Social Studies (A)			0.2338	2.1902**	0.1633
			(0.5620)	(0.9444)	(0.4527)
Social Studies (D or E)			-3.0749***	-0.2321	-1.6218**
			(0.9085)	(0.5498)	(0.7647)
Reading Achievement (A)				0.5100	
				(0.7851)	
Reading Achievement (D or E)				-0.2318	
				(1.0751)	
Writing (A)				-0.5304	0.6700
				(0.7357)	(0.5898)
Writing (D or E)				0.4622	-0.4497
				(1.2238)	(0.9200)

VARIABLES	GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5
SOL Scores					
Math score			0.0069	0.0084***	0.0063**
			(0.0069)	(0.0030)	(0.0028)
Reading score			-0.0013	-0.0015	-0.0018
			(0.0038)	(0.0022)	(0.0033)
Writing score					0.0009
					(0.0019)
Demographic Variables					
Gender (Female)	0.2558	-0.0715	1.0943	0.5835	0.0996
	(0.2983)	(0.3365)	(0.8292)	(0.4934)	(0.4260)
LEP	-0.4616	-0.5977	-1.4732	-0.8086	-0.9589*
	(0.3668)	(0.4419)	(1.1831)	(0.5111)	(0.5476)
Special Ed	-0.8176**	-0.6836	0.1801	-0.3946	-1.2565***
	(0.3707)	(0.4503)	(0.8680)	(0.6709)	(0.4695)
Immersion			0.8584	-0.3931	0.5074
			(0.8853)	(1.3857)	(0.7919)
Absences			-0.0196	-0.0256*	-0.0392***
			(0.0193)	(0.0148)	(0.0119)
Race/Ethnicity (Ref Group=White)					
Asian	0.6155	0.0372		-0.1164	-0.0167
	(0.8787)	(0.6120)		(1.1216)	(0.8251)
Black	-0.8097*	-0.9527*	0.0226	-0.9828	-0.8202
	(0.4360)	(0.4890)	(1.2346)	(0.7434)	(0.5344)
Hispanic	-0.0491	0.0780	0.6441	-0.5085	0.4541
	(0.4196)	(0.5334)	(1.3862)	(0.6759)	(0.6835)
Other	-0.9268*	-0.8520	-1.0806	-1.6671*	-0.8801
	(0.5214)	(0.6674)	(1.2702)	(0.8767)	(0.7210)
Graduation Cohort (Ref Group=Cohort 2014)					
Graduation Cohort (2015)	-2.2557***	-1.3550***		1.2003*	-1.8058**
	(0.7551)	(0.4963)		(0.6220)	(0.7431)
Graduation Cohort (2016)	-2.5825***	-1.5402***			-3.1622***
	(0.7349)	(0.4631)			(0.8846)
Constant	4.2141***	1.7969	2.9133	0.8015	5.5229***
	(1.0626)	(1.1318)	(3.2960)	(1.9827)	(1.7909)
Observations	**2,224**	**2,339**	**696**	**1,624**	**2,488**

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX II: MIDDLE SCHOOL REGRESSION MODELS

Below is the full logistic regression model output that corresponds to the MEM output for the *Middle School Analysis*.

Figure A.2.1: Logistic Regression Model Output

VARIABLES	DIPLOMA			ON-TIME GRADUATION		
	Grade 6	Grade 7	Grade 8	Grade 6	Grade 7	Grade 8
Courses						
Social Studies (A)	0.5915***	0.6947***	0.2249	0.3020	1.0894*	-0.3560
	(0.1970)	(0.1696)	(0.1511)	(0.8863)	(0.6160)	(0.5569)
Social Studies (D/E)	-0.6653**	-0.7709***	-0.3339	-0.9348*	-1.0759***	-0.8848**
	(0.3352)	(0.2649)	(0.2483)	(0.5510)	(0.3909)	(0.3535)
ELA (A)	0.1073	0.2746	0.7937***	1.1308*	-0.1521	0.2522
	(0.1931)	(0.1730)	(0.2067)	(0.6681)	(0.4572)	(0.5571)
ELA (D/E)	-0.1355	-0.2918	-0.9010***	-0.8586	-0.2978	-1.1333***
	(0.3664)	(0.2457)	(0.2161)	(0.6757)	(0.3777)	(0.3482)
Math (A)	0.1935	0.7309***	0.4343**	-0.4928	0.2758	0.1719
	(0.2304)	(0.1816)	(0.2110)	(0.6999)	(0.6314)	(0.7036)
Math (D/F)	-0.1906	-0.4285*	-0.6470***	-0.9741	-0.8928***	-0.6950**
	(0.2206)	(0.2477)	(0.2202)	(0.6930)	(0.3212)	(0.3188)
Science (A)	0.1482	0.0841	0.1910	0.7129	0.7772	0.0309
	(0.2197)	(0.1798)	(0.2333)	(0.7880)	(0.6834)	(0.6637)
Science (D/E)	-0.1767	-0.7951***	-0.4950***	-0.6262	-0.2765	-0.6776**
	(0.2380)	(0.2345)	(0.1698)	(0.6424)	(0.3776)	(0.3424)
Reading (A)	0.6698***			-0.6458		
	(0.2039)			(0.7239)		
Reading (D/E)	-0.7139**			0.8578		
	(0.3138)			(0.6386)		
Math 7 Taken [Ref=Math 6]	0.6052***			-0.0814		
	(0.1993)			(0.5656)		
Math 8 Taken [Ref Grade 6=Math 6, Ref Grade 7=Math 7]	0.4935	0.4600**		-1.2645	-0.8177	
	(0.5379)	(0.1924)		(1.0057)	(0.5807)	
Algebra I Taken [Ref=Math 8]			0.9045***			0.2994
			(0.1493)			(0.5347)
Algebra I, Intensified Taken [Ref Grade 7=Math 7, Ref Grade 8=Math 8]		0.7541**	1.9646***		-0.4358	0.6322
		(0.3734)	(0.3394)		(1.0789)	(1.0696)
Geometry, Intensified Taken [Ref=Math 8]			1.1761***			0.6055
			(0.4099)			(1.1077)

VARIABLES	DIPLOMA			ON-TIME GRADUATION		
American Studies 6 Taken [Ref=History 6]	-0.8322**			-1.2390*		
	(0.4162)			(0.7479)		
American Studies 7 Taken [Ref=History 7]		-0.1302			-0.7200	
		(0.3171)			(0.5096)	
Science 7 Taken [Ref=Life Science]		0.8569			1.4092*	
		(0.9511)			(0.8464)	
SOL Scores						
History score		0.0236	0.0351		0.0146	-0.0010
		(0.0146)	(0.0285)		(0.0216)	(0.0559)
Math score	0.0847***	0.0790***	0.0838***	-0.0080	0.0519*	0.0074
	(0.0124)	(0.0148)	(0.0169)	(0.0460)	(0.0285)	(0.0307)
Reading score	0.0207	0.0335**	0.0222	-0.0247	-0.0147	-0.0138
	(0.0126)	(0.0137)	(0.0143)	(0.0451)	(0.0227)	(0.0277)
Science score			0.0091			0.0324
			(0.0191)			(0.0331)
Writing score			0.0224			0.1178
			(0.0145)			(0.0866)
Demographic Variables						
Gifted	-0.2484	-0.1688	-0.3935**	-0.5883	-0.3148	-0.7412*
	(0.1737)	(0.1619)	(0.1594)	(0.5491)	(0.4431)	(0.4296)
Free/Reduced Lunch	-0.4994***	-0.5784***	-0.4882***	-0.1976	-0.1134	0.0364
	(0.1879)	(0.1703)	(0.1588)	(0.6770)	(0.3955)	(0.3585)
Language Immersion (Classes Taken)	-0.2637	0.0756	0.6852***			-0.3501
	(1.5915)	(0.9331)	(0.2590)			(0.6187)
Gender (Female)	0.2669*	0.2646*	0.2643*	0.6633	0.0689	-0.3689
	(0.1369)	(0.1352)	(0.1369)	(0.4705)	(0.3264)	(0.3477)
Limited English Proficiency	0.1598	0.1378	0.0975	-0.6251	-0.5285	-0.2723
	(0.2103)	(0.1873)	(0.1801)	(0.8381)	(0.4537)	(0.4099)
Special Education	-0.5951*	-1.0224***	-1.4373***	-1.1568	-0.5297	-1.2150***
	(0.3497)	(0.2240)	(0.2129)	(0.7434)	(0.5231)	(0.4712)
Special Education, No Classes	-0.6894***	-0.8346***	-0.6943***	-1.0042*	-0.3532	0.0771
	(0.2164)	(0.2440)	(0.2078)	(0.6005)	(0.6969)	(0.5816)
Race/Ethnicity [Ref=White]						
Asian	0.3472	0.1755	0.1769	0.1712	0.0273	0.0656
	(0.2820)	(0.2596)	(0.2455)	(0.8734)	(0.7986)	(0.6455)
Black	-0.0638	-0.2774	-0.1117	-0.0678	-0.5233	0.3245
	(0.2282)	(0.2081)	(0.2070)	(0.8136)	(0.4592)	(0.4751)
Hispanic	0.1188	0.1863	0.1419	0.4270	-0.1034	0.3119
	(0.2011)	(0.1909)	(0.1890)	(0.8830)	(0.4880)	(0.4710)

VARIABLES	DIPLOMA			ON-TIME GRADUATION		
Other	-0.1076	-0.3368	-0.3883	-1.1802**	-0.9384	-0.4227
	(0.2899)	(0.2646)	(0.2723)	(0.5729)	(0.6994)	(0.6345)
Graduation Cohort (Ref Group=Cohort 2014)						
Graduation Cohort (2015)	0.2976*	0.1978	0.2691*	-0.2519	-0.2984	-0.1265
	(0.1630)	(0.1533)	(0.1608)	(0.5829)	(0.4441)	(0.4339)
Graduation Cohort (2016)	0.1070	0.0707	0.8101***	-0.2887	-0.9817**	-0.8640**
	(0.1626)	(0.1533)	(0.1904)	(0.5742)	(0.4135)	(0.4338)
Attendance						
Unexcused Absence Count	-0.0352*	-0.0301*	-0.0292**	-0.1121***	-0.0551***	-0.0401**
	(0.0191)	(0.0180)	(0.0133)	(0.0368)	(0.0185)	(0.0169)
Constant	-4.0377***	-5.5238***	-7.5426***	7.1841**	3.3648**	-0.4718
	(0.6765)	(0.7892)	(1.4603)	(3.5831)	(1.5925)	(3.8862)
Observations	**2,309**	**2,816**	**3,041**	**2,325**	**2,853**	**3,083**

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

APPENDIX III: HIGH SCHOOL REGRESSION MODELS

Below is the full logistic regression model output that corresponds to the MEM output for the *High School Analysis*.

Figure A.3.1: Logistic Regression Model Output

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
	Grade 9	Grade 10	Grade 11	Grade 12	Grade 9	Grade 10	Grade 11	Grade 12
Courses								
Social Studies (A)	0.8153***	0.7729**	0.3633*	0.2947			-1.0768**	-0.2012
	(0.3111)	(0.3104)	(0.2030)	(0.1991)			(0.4757)	(0.4683)
Social Studies (D/E)	-0.7726***	-1.1271***	-0.6845***	-0.4937**			-0.9946*	0.1177
	(0.2525)	(0.3244)	(0.2603)	(0.2132)			(0.5674)	(0.5528)
ELA (A)	0.4008	0.5267*	0.3118	0.1301		1.1119	-0.0353	-0.5697
	(0.3205)	(0.2974)	(0.2079)	(0.2082)		(0.9413)	(0.5148)	(0.4372)
ELA (D/E)	-0.1958	-0.3340	-1.0020***	-0.5001**		0.1654	0.4995	0.0500
	(0.3036)	(0.2734)	(0.2315)	(0.1980)		(0.5117)	(0.5633)	(0.5550)
Math (A)	0.2412	0.0745	-0.4908**	0.2208	-0.1651	0.2846	-0.3666	0.2294
	(0.2317)	(0.3106)	(0.2082)	(0.2449)	(0.6354)	(0.9027)	(0.4747)	(0.4189)
Math (D/E)	-0.8141***	-0.5639**	-0.7357***	-0.8128***	-1.4885**	-0.1954	-0.9768*	0.1260
	(0.2642)	(0.2812)	(0.2077)	(0.1572)	(0.6403)	(0.4508)	(0.5016)	(0.4444)
Science (A)	0.4307*	0.5743*			-1.5204**	1.2055		
	(0.2542)	(0.3146)			(0.6173)	(0.9287)		
Science (D/E)	-0.1389	-0.5321			0.0669	-0.1003		
	(0.2454)	(0.3277)			(0.7161)	(0.4679)		
World Languages (A)	-0.1367	-0.2356			1.2153	-0.3316		
	(0.2032)	(0.2669)			(0.8714)	(0.6909)		
World Languages (D/E)	-1.1697***	-0.8044***			0.1650	-0.5549		
	(0.2471)	(0.2623)			(0.8599)	(0.5296)		
Math Courses [Ref Groups: Grade 9=Algebra I, Grade 10=Geometry, Grade 11=Algebra II, Grade 12=AP Calculus]								
Algebra I Taken		-0.9560*						
		(0.5609)						
Geometry Taken	0.8583***		-1.9958***					
	(0.1766)		(0.3847)					
Algebra II Taken		1.2185***		-2.6020***				
		(0.2664)		(0.2913)				

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
Algebra II/Trig, Intensified Taken	0.9895**	1.5070***						
	(0.4893)	(0.4710)						
Pre-Calculus Taken			1.3047***	-0.7891***				
			(0.2564)	(0.2842)				
AP Calculus Taken			0.8565*					
			(0.4442)					
Mathematics Analysis/Trig Taken			1.0385***	-0.8466***				
			(0.2104)	(0.2859)				
Statistics Taken				-1.1178***				
				(0.2567)				
AP Statistics Taken				-0.2106				
				(0.3777)				
ELA Courses [Ref Groups: Grade 9=English 9, Grade 10=English 10, Grade 11= English 11, Grade 12=English 12]								
English 9, Intensified Taken	-0.3098							
	(0.4170)							
English 10, Intensified Taken		0.1724						
		(0.2597)						
English 11 Taken				-1.1018**				
				(0.4606)				
AP English 11 Taken			0.3678**					
			(0.1851)					
AP English 12 Taken				0.6560***				
				(0.1694)				
Science Courses [Ref Groups: Grade 9=Biology, Grade 10=Chemistry, Grades 11-12=Physics]								
Biology, Intensified Taken	0.2749							
	(0.2087)							
Chemistry, Intensified Taken		-0.1535	0.5146	-0.5419				
		(0.3833)	(0.4621)	(0.4731)				
Earth Space Taken		-0.7566***	-0.4335	-0.1233				
		(0.2664)	(0.3467)	(0.3424)				
Social Studies Courses [Ref Groups: Grade 9=World History, Intensified, Grade 10=Economics and Personal Finance, Grade 11=US & VA History, Grade 12=US & VA Government]								
World History Taken	-0.9900**	0.3583						
	(0.4062)	(0.2856)						
World History, Intensified Taken		1.2016***						
		(0.3430)						

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
AP US & VA History Taken			1.1382***					
			(0.1916)					
AP US & VA Government Taken		0.5985		0.4958***				
		(0.4549)		(0.1460)				
Economics and Personal Finance Taken				-0.6322				
				(0.5712)				
SOL Scores								
Math score	0.0209	0.0288***			0.0977***	-0.0067		
	(0.0154)	(0.0107)			(0.0346)	(0.0148)		
Science score	0.0384	0.0240			-0.0542	0.1667**		
	(0.0304)	(0.0238)			(0.0682)	(0.0686)		
History score	0.0643**		0.0710**		0.0970		0.0935	
	(0.0274)		(0.0282)		(0.0893)		(0.1045)	
Reading score			0.0432				-0.0792	
			(0.0514)				(0.1607)	
Writing score			0.0187				0.0495	
			(0.0239)				(0.0712)	
Demographic Variables								
Gifted	-0.3607*	0.0224	0.2039	0.3951**	-0.9648*	-0.1331	0.2644	0.4800
	(0.1928)	(0.2457)	(0.2014)	(0.1900)	(0.5348)	(0.6005)	(0.5868)	(0.5337)
Free/Reduced Lunch	-0.2234	-0.9266***	-0.3912**	-0.2539	-1.0855*	0.4705	0.6927	0.0119
	(0.1999)	(0.2456)	(0.1984)	(0.1665)	(0.6536)	(0.4739)	(0.4467)	(0.4200)
Language Immersion	-0.1849	0.3301						
	(0.3184)	(0.6681)						
Gender (Female)	0.3143*	-0.1426	0.4104**	0.1366	0.3453	0.3242	0.6865*	-0.1001
	(0.1644)	(0.1988)	(0.1668)	(0.1493)	(0.5060)	(0.4590)	(0.3840)	(0.3281)
Limited English Proficiency	0.1388	-0.0667	-0.3015	-1.1139***	-1.1919*	-0.9424*	-2.1582***	-2.1376***
	(0.2086)	(0.2406)	(0.2235)	(0.2741)	(0.7183)	(0.5635)	(0.5377)	(0.3530)
Special Education	-0.7531**	-0.5521	-1.0807***	-1.1696***	-0.3768	-1.3271**	0.9047	
	(0.3757)	(0.4162)	(0.3816)	(0.3052)	(1.0988)	(0.6107)	(1.2016)	
Special Education, No Classes	-0.9268***	-0.7665**	-0.3197	-0.6771**	-1.7963**	-1.1756	-1.1979	0.1357
	(0.3159)	(0.3524)	(0.2940)	(0.2779)	(0.7646)	(0.7600)	(0.7318)	(0.9908)
Race/Ethnicity [Ref Group=White]								
Asian	0.2487	0.2274	0.3011	-0.1241	0.9714	1.1046	-1.1309*	-1.3830***
	(0.3408)	(0.3941)	(0.2840)	(0.2625)	(1.0286)	(0.8725)	(0.6033)	(0.5204)

VARIABLES	DIPLOMA				ON-TIME GRADUATION			
Black	-0.0778	0.4336	0.1485	-0.6685***	0.4799	1.2920	-0.6428	-0.3137
	(0.2548)	(0.3520)	(0.2697)	(0.2152)	(0.9886)	(1.1741)	(0.7654)	(0.7217)
Hispanic	0.1615	0.4827*	0.3175	0.1201	0.3395	-0.4092	-1.0673*	-0.5535
	(0.2463)	(0.2907)	(0.2286)	(0.1878)	(0.8211)	(0.6148)	(0.6243)	(0.5786)
Other	-0.4256	0.3797	-0.1251	-0.3093	-1.4600	-1.7006**	-0.9450	-0.3221
	(0.3461)	(0.5996)	(0.3386)	(0.2861)	(0.9452)	(0.6739)	(1.0660)	(1.0733)
Graduation Cohort [Ref Group=Cohort 2014]								
Graduation Cohort (2015)	0.3071	0.1467	-0.0455	0.2940*	0.6811	1.4504*	0.2631	0.7634*
	(0.2047)	(0.3010)	(0.2031)	(0.1642)	(0.6718)	(0.8157)	(0.5586)	(0.4270)
Graduation Cohort (2016)	0.1011	-0.2347	-0.1126	0.2652	-0.0117	-0.4763	0.0856	0.6474
	(0.2105)	(0.2992)	(0.2011)	(0.1695)	(0.6504)	(0.5590)	(0.4855)	(0.4051)
Attendance								
Unexcused Absence Count	-0.0375***	-0.0224	-0.0487***	-0.0333*	-0.0426**	-0.0382***	-0.0664***	-0.1046***
	(0.0141)	(0.0145)	(0.0157)	(0.0194)	(0.0215)	(0.0138)	(0.0188)	(0.0228)
Constant	-3.9558**	-1.2495	-5.1246***	2.3245***	0.1728	-2.2610	3.3648	4.9307***
	(1.6265)	(1.2468)	(1.6709)	(0.3096)	(3.0418)	(3.0252)	(4.8906)	(0.5442)
Observations	**1,799**	**1,349**	**2,423**	**2,235**	**2,141**	**2,158**	**2,434**	**2,164**

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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