Prince George's County Public Schools

EVALUATION REPORT

The Impact of the French Immersion Program on Achievement and College Readiness

Prepared by
Akilah D. Swinton, Ph.D.
Berhane B. Araia, Ph.D.

Division of Teaching and Learning
DEPARTMENT OF TESTING, RESEARCH, and EVALUATION

Phone: 301-780-6807

Table of Contents

List of Tables

The Impact of the French Immersion Program on Achievement and College Readiness

EXECUTIVE SUMMARY

Since the French Immersion program has been operating in the school district for decades, Prince George's County Public Schools (PGCPS) decision-makers are interested in the impact of attending a French Immersion school. The French Immersion program is a full immersion model where all academic subjects are taught in the French language from kindergarten through the 8th grade, with an option to continue some coursework in high school. During elementary and middle school, French-speaking teachers totally immerse students in French as they learn the PGCPS curriculum in mathematics, science, social studies, and English Language Arts (ELA). Placement in a French Immersion school is through a lottery process and students can only be placed in a French Immersion school in kindergarten. There are two K-8 French Immersion schools in PGCPS, Maya Angelou French Immersion and Dora Kennedy French Immersion. The current study focused on the impact of attending a French Immersion school at Grade 3, Grade 5, Grade 8, and Grade 11. Examining the effect of French Immersion education while students are enrolled in the program is important, because it provides a better understanding on the added value of a child attending French Immersion, versus attending another type of school. Examining the long-term effect of French Immersion in Grade 11 will provide insight on whether the impact of French Immersion sustains throughout high school.

The following research questions guided this study: 1) Do third, fifth, and eighth grade students who are enrolled in French Immersion have better ELA, math, and science scores compared to similar students with other schooling experiences?; 2) Are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?; and 2a) After accounting for academic achievement in elementary and middle grades, are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?

To address the research questions, we used SY15-SY16 enrollment data to create the analytical samples and French Immersion lottery participation data across several years, starting in SY05, as a proxy for parental motivation. The outcomes of interest for this study were ELA and math proficiency in Grades 3, 5, 8 and 11; whether a student takes advanced math in Grade 8; science proficiency in Grades 5 and 8; and whether a student is considered college ready in ELA and math in Grade 11. PARCC ELA and math data, MSA science data, and

Maryland State's College and Career Readiness (CCR) report data were used for the outcomes. The samples were restricted to students who attended the same elementary schools (i.e. K-5 and K-3 for the Grade 3 analysis) and had available achievement data for the respective analysis. Each French Immersion student in the sample was then matched with a demographically identical student. To estimate the impacts of French Immersion experience on PARCC proficiency rate for each grade, we used the Average Treatment Effect on the Treated (ATET) model.

The Impact of French Immersion Education in Elementary and Middle School

The findings from the Grade 3, Grade 5, and Grade 8 treatment effect analysis show a consistent pattern of positive impact (measured in differentials in the percent proficient) of French Immersion enrollment across grade levels in ELA, mathematics, and science. The results demonstrate that the size of the impact progressively increased as students moved though elementary and middle school. In ELA, estimates range from six percentage points in Grade 3 to about 38 percentage points in Grade 8. Previous evaluations of French Immersion programs found that students often score significantly lower in English than non-immersion students in the early grades, but the gap typically disappears within one year of receiving instruction in English (Lindholm-Leary and Genesee, 2014). The findings in this study are consistent with these previous findings in that by the end of Grade 3 (after one full year of instruction English Language and Arts), French Immersion students are as proficient as their peers in English only schools. In mathematics, French Immersion students outperform their peers by 14 percentage points to 39 percentage points, depending on grade level, and in science, they outperform by nine percentage points to 25 percentage points. The study also explored the role of parental motivation in moderating the impact of French Immersion education. After controlling for parental motivation, findings further suggests that there were positive and statistically significant impacts in ELA, mathematics, and science at each observed grade level. These findings are important given that French Immersion students study mathematics and science in French through Grade 8 and they do not start learning in the English language until Grade 2.

Long-term Effect of French Immersion Education in Grade 11

The findings from the Grade 11 treatment effect analysis, show that high school students who had attended French Immersion program were better prepared for college and career than similar students who attended traditional elementary and middle schools in PGCPS. Specifically, French Immersion students performed as well as their matched high school peers on PARCC Algebra II and performed better than their peers on the PARCC ELA, CCR ELA and CCR Math. Additional analyses were conducted to ascertain whether the observed rates of readiness for former French Immersion students were a result of the advantages in proficiency in math and reading during their enrollment in French Immersion program. The findings

showed that French Immersion students were more likely to be consistently proficient in reading and mathematics in Grades 3 through 8, and this early advantage was associated with the higher readiness rate for college in reading and in mathematics at the end of high school. The findings confirmed that the impact of French Immersion sustained long after students graduated from the program.

I. INTRODUCTION

The benefits of bilingualism are numerous, including improved executive function and attention control. These benefits have been a driving force in the creation of language immersion schools, which have become increasingly popular in the United States in recent years. Starting in kindergarten, these schools provide native English learners speakers and English learners with instruction in two languages. A growing body of research suggests that students who learn in dual language settings academically outperform their counterparts who learn in mainstream settings (e.g., Steele et al., 2015). For example, Immersion students outperform other students in traditional foreign language classes and typically achieve in academic areas more or as well as students in English-only programs (e.g. Lindholm-Leary and Genesee, 2014; Lindholm-Leary and Howard, 2008; Thomas et al, 1993). The effect of learning French as a second language on English language skills has been shown to be positive in several studies (Bournot-Trites and Tallowitz , 2002).

Currently, Prince George's County Public School District (PGCPS) has two types of language immersion programs: French Immersion program and Spanish Immersion. While the Spanish Immersion program is quite new to the district, the French Immersion Program began in PGCPS in 1982. Thus, the focus of this report will be on the impact of the PGCPS French Immersion program. The French Immersion program is a full immersion model where all academic subjects are taught in the French language from kindergarten through the 8th grade, with an option to continue some coursework in high school. Placement in a French Immersion school is through a lottery process and students can only be placed in a French Immersion school in kindergarten. There are two K-8 French Immersion schools in PGCPS, Maya Angelou French Immersion and Dora Kennedy French Immersion. During elementary and middle school, French-speaking teachers totally immerse students in French as they learn the PGCPS curriculum in mathematics, science, social studies, and English Language Arts (ELA). According to PGCPS French Immersion program staff, French Immersion students can express themselves quite well in French by the end of Grade 1, and students have a strong academic background and should be bilingual in French and English when they complete Grade 8. The high school program continuation is at Central High School. In high school, the immersion students are offered two immersion classes together which are part of a pre-International Baccalaureate (IB) Program.

Scope and Purpose of the Evaluation

Since the French Immersion program has been operating in the school district for decades, PGCPS decision-makers are interested in the impact of attending a French Immersion school. The current study focused on the impact of attending a French Immersion school at

Grade 3, Grade 5, Grade 8, and Grade 11. These grades were chosen because they are considered critical points in a child's educational trajectory. Third grade is a pivotal year for students, particularly for reading. It is often considered a "make-or-break" period of academic success as this year is when students transition from learning to read to reading to learn. Third grade is also the first grade where students begin to take the required state assessment, currently the Partnership for Assessment of Readiness for College and Careers (PARCC) and previously the Maryland State Assessment (MSA). Fifth grade is considered a pivotal year as Grade 5 performance is a good indication for how prepared students are for middle school. Eighth grade is a critical time because it marks the end of full-day French Immersion education as well as the end of middle school. Eleventh grade is considered a crucial year for preparing for college and/or career; therefore, Grade 11 achievement outcomes are often used to determine whether a student is college or career ready. Thus, the study focused on relatively short term effect of French Immersion in elementary and middle school grades as well as the long-term effects of the French Immersion program into high school.

Research Questions

The study addresses the following research questions:

1. Do third, fifth, and eighth grade students who are enrolled in French Immersion have better ELA, math, and science scores compared to similar students with other schooling experiences?
2. Are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?
   2a. After accounting for academic achievement in elementary and middle grades, are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?

Organization of Report

This report is organized into four major sections. Following this introductory section, the second section describes the methods and procedures used in data collection and the analysis plan developed to answer the aforementioned research questions. Section III contains the findings by research question. Conclusions that can be drawn from the findings are contained in Section IV.

II. METHODS

Table 1 outlines the sample, data, and analytic procedure used for this study. Below, we further explain the data, sampling, and method of analysis for each question.

Table 1: Study Questions, Data Sources, & Analysis Techniques

Evaluation Questions	Sample	Data	Analytic procedure
1. Do third, fifth, and eighth grade students who are enrolled in French Immersion have better ELA, math, and science scores compared to similar students with other schooling experiences?	SY15 and SY16 Grade 3, Grade 5, and Grade 8 French Immersion students and matched PGCPS students	PGCPS SY05-SY16 enrollment and demographic data; French Immersion SY10-SY13, SY08-SY11, and SY05-SY08 lottery data; SY15 and SY16 end-of Grade 3, 5, and 8 PARCC data	Treatment effects analysis - Comparison of French Immersion students vs. other demographically similar students
2. Are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?	SY15 and SY16 Grade 11 French Immersion students and matched PGCPS students	PGCPS SY15 and SY16 enrollment and demographic data; French Immersion SY04-SY05 lottery data; SY15 and SY16 end-of Grade 11 PARCC data	Treatment effects analysis - Comparison of French Immersion students vs. other demographically similar students
2a. After accounting for academic achievement in elementary and middle grades, are eleventh graders who completed French Immersion education more likely to be ready for college and career?	SY15 and SY16 Grade 11 French Immersion students and matched PGCPS students	PGCPS SY15 and SY16 enrollment and demographic data; French Immersion SY04-SY05 lottery data; SY12 and SY13 (Grade 8), SY09 and SY10 (Grade 5), SY07 and SY08 (Grade 3) MSA math and English data;	The population-average logistic regression model Treatment effects analysis - Comparison of French Immersion students vs. other demographically similar students

Types of Data Used

Enrollment, demographic, and lottery data: To address the research questions, we used school year 2015 and 2016 (SY15-SY16) enrollment data to create the analytical samples and demographic data to use for controls in the analyses. We also used prior years of enrollment data to track the schools that students attend each year. Our primary interest was in the differences in achievement outcomes between French Immersion and all other similar PGCPS students. However, we were also interested in how French Immersion students compared to other students with similar parental motivation before the French Immersion kindergarten entry year. We used French Immersion lottery participation data across several years, starting In SY02, as a proxy for parental motivation.

Achievement data: The outcomes of interest for this study were ELA and math proficiency in Grades 3, 5, 8 and 11; whether a student takes advanced math in Grade 8; science proficiency in Grades 5 and 8; and whether a student is considered college ready in ELA and math in Grade 11. The outcome measures were extracted from PARCC ELA and math data (proficiency status), MSA science data (proficiency status), and College and Career Readiness (CCR) report data (being ready for college and career).

Analytic Procedures

Research Question 1 and 2: To answer research questions 1 and 2, we utilized reading and math proficiency at the end of Grades 3, 5, 8, and 11 (and science proficiency at the end of Grades 5 and 8) in SY15 and SY16 as measured by PARCC and MSA. For each grade, the sampling frame was restricted to students who attended the same elementary schools (i.e. K-5 and K-3 for the Grade 3 analysis) and had available achievement data for the respective analysis. In addition, students attending Montessori schools were excluded.

To estimate the impacts of French Immersion experience on PARCC proficiency rate for each grade, we used treatment effects analysis based on the potential-outcomes estimation framework of the Average Treatment Effect on the Treated (ATET) model. In this framework, there is a potential outcome (i.e., PARCC proficiency) with treatment (i.e., French Immersion enrollment) and the opposite potential outcome without treatment (e.g., enrollment in another school). Treatment effects analysis allows us to estimate the counterfactual (i.e., the PARCC proficiency for a student in French Immersion had he/she not enrolled in French Immersion) by using several observations in the non-treatment group who have similar observable characteristics. These observable characteristics of interest were used to control for differences in student characteristics and parental motivation. The control variables we included for all grades were: Free- or reduced-priced meals (FARMS) status, race/ethnicity, and gender. An

additional analysis also included parent participation in French Immersion lottery to account for differences in parent motivation prior to the students starting kindergarten. For the Grade 11 analysis, we used nearest-neighbor matching to include exact matching on the high school attended. That is, a French Immersion student is matched with a similar non-French Immersion student who also attended the same high school.

The Grade 3, 5, and 8 French Immersion samples consisted of 243, 215, and 189 students, respectively. Each student enrolled in a French Immersion school starting in kindergarten and consistently attended French Immersion each year. As stated above, for each grade, we used gender, race/ethnicity, and FARMS status to match each French Immersion student with a demographically identical peer student who attended a non-French Immersion school. For the analysis of Grade 3 PARCC ELA and PARCC math, matching of the sample is conducted from a sampling frame of 10,184 students who attended the same elementary school from kindergarten to Grade 3 and took these assessments in SY15 and SY16. For the analysis of Grade 5 PARCC ELA, PARCC math, and MSA science, matching of the sample is conducted from a sampling frame of 7,045, 7,042, and 6,453 students, respectively, who attended the same elementary school from kindergarten through Grade 5 and took these assessments in SY15 and SY16. For the analysis of Grade 8 PARCC ELA, PARCC math and advanced math indicator, and MSA science, matching of the sample is conducted from a sampling frame of 9,255, 9,492, and 8,141 students, respectively, who attended the same elementary school from kindergarten through Grade 5 and took these assessments in SY15 and SY16.

The 11th grade French Immersion sample consisted of 108 students who had (a) begun their French Immersion education in kindergarten; (b) completed the 8th grade between 2012 and 2013; and (c) maintained active status within the PGCPS throughout high school. Of these 108 French Immersion students, 89 (82 percent) attended 7 (out of 29 possible in 2013-2016) PGCPS high schools; each of these high schools had at least 5 former French Immersion students. It should be noted that 60% of all French Immersion students in the sample attended four (Central, Roosevelt, Suitland and Bowie) high schools, two (Roosevelt and Bowie) of which have highly selective specialty programs. Using the criteria of gender, race/ethnicity, and FARMS status, a demographically identical peer student was matched with a French Immersion student at each high school. For the analysis of Grade 11 PARCC ELA the matching of the sample is conducted from a sampling frame of 1,211 students who attended the same elementary school from Kindergarten through Grade 5, attend PGCPS high schools and took PARCC ELA assessment in SY15 and SY16 (i.e. 41 French Immersion were matched with 41 non-French Immersion students who attend the same high schools). For the analysis of PARCC Algebra 2 the matching of the sample is conducted from a sampling frame of 1,334 students who

attended the same elementary school from Kindergarten through Grade 5, attend PGCPS high schools and took PARCC Algebra 2 assessment in SY15 and SY16 (44 French Immersion students were matched with 44 non-French Immersion students who attend the same High Schools). For the analysis that used the Maryland college and career readiness report (MD CCR) as the outcome, the matching of the sample is conducted from a sampling frame of 1,473 students who attended the same elementary school from Kindergarten through Grade 5, attend PGCPS high schools and were included in the SY17 Maryland College And Career Readiness report (i.e. 54 French Immersion students were matched with 54 non- French Immersion who attend the same High Schools).

To estimate the ATET, we calculated the average difference in the students' proficiency rates for attending a French Immersion school and for attending another school. The difference in the average proficiency rates between treatment (attending French Immersion schools) and non-treatment (attending traditional schools) scenarios for each analysis is the ATET. The ATET is equivalent to the impact of French Immersion attendance for all treatment students. The analyses were conducted using Stata 14.

Research Question 2a: To answer research question 2a, we conducted a two-step analysis: 1) We started with the Grade 11 cohort data from SY15 and SY16 and merged in their achievement outcomes when they were in Grade 3, Grade 5 and Grade 8 and calculated probability of being proficient in reading and mathematics in each year of MSA assessment during the elementary and middle school years; and 2) determined if the this probability of being consistently proficient in reading and mathematics influenced college and career readiness. The first step of the analysis was conducted by estimating the predicted probability of being consistently proficient in Grade 3, 5 and 8 controlling for demographic characteristics for both former French Immersion students and their peers who did not attend a French Immersion school. These probabilities were calculated from a Population-Averaged Logistic Regression Model using the Generalized Estimating Equations (GEE) method in Stata 14. See the appendix for more on the Population-averaged model. In the second step, the probability of being consistently proficiency was used as a covariate in Grade 11 Average Treatment Effect on the Treated (ATET) model estimated to answer research question 2b. This ATT is equivalent to the impact of French Immersion enrollment in high school if the matched comparison group had the same proficiency rate in each year of MSA assessment as the French Immersion students.

II. FINDINGS

One goal of this study is to examine whether French Immersion students have better achievement compared to non-French Immersion students at the end of critical grades during the elementary and middle school years. Examining the effect of French Immersion while students are enrolled in the program is important because it provides a better understanding on the added value of a child attending French Immersion versus attending another type of school. Another goal of the study is to determine the post-French Immersion impact (i.e., impact over and above that obtained at the end of Grade 8) by examining whether students who completed French Immersion are better prepared for college compared to other students. Examining the long-term effect of French Immersion in Grade 11 will provide insight on whether the French Immersion effect sustains throughout high school. The results of the analyses conducted to address these goals are presented below by research question.

Results from the Grade 3, Grade 5, and Grade 8 Analyses

Research Question 1: Do third, fifth, and eighth grade students who are enrolled in French Immersion have better ELA, math, and science scores compared to similar students with other schooling experiences?

Table 2 displays the descriptive statistics for the achievement outcomes for the Grade 3, Grade 5, and Grade 8 samples. The table also includes the overall achievement for non-French Immersion (not including Montessori students) students for context. It is important to note that the data presented in Table 2 are purely descriptive and do not account for differences in student characteristics. In addition, the students used in the analysis attended the same school in elementary from kindergarten through Grade 5 (or Grade 3 for the Grade 3 sample).

According to Table 2, French Immersion students had higher achievement outcomes compared to non-French Immersion students throughout elementary and middle school regardless of subject. In addition, the proficiency rates for both French Immersion and non-French Immersion students were higher in higher grades for each subject, with the exception of math proficiency being lower in higher grades in some cases. As displayed, 33 to 72 percent of French Immersion students were proficient in ELA across the grades compared to between 22 and 28 percent of non-French Immersion students. Between 34 and 51 percent of French Immersion students (versus between 16 and 22 percent of other students) were proficient in math throughout elementary and middle school. About 60 percent of French Immersion students took an advanced math course in Grade 8 compared to 13 percent of other students. Finally, 68 and 80 percent of French Immersion students were proficient in science in

elementary and middle school, respectively, while 54 and 50 percent of non-French Immersion students were proficient in science in elementary and middle school, respectively.

Table 2: Descriptive Statistics for the Grade 3, Grade 5, and Grade 8 Samples

Achievement Outcomes	French Immersion Students		All Other Students	
	Total # Tested	% Proficient	Total # Tested	% Proficient
Grade 3				
PARCC ELA Proficient	222	32.88%	9,962	21.57%
PARCC Math Proficient	221	43.44%	9,963	22.18%
Grade 5				
PARCC ELA Proficient	200	45.00%	6,845	24.89%
PARCC Math Proficient	200	33.50%	6,842	18.09%
MSA Science Proficient	188	68.09%	6,265	54.01%
Grade 8				
PARCC ELA Proficient	165	71.52%	9,090	28.34%
PARCC Math Proficient	165	50.64%	9,327	16.36%
Taking Advanced Math	165	59.39%	9,327	13.37%
MSA Science Proficient	126	80.16%	8,015	49.69%

We cannot simply attribute the difference in proficiency and advanced math taking rates to French Immersion enrollment without considering the socio-demographic characteristics of students. As discussed in the methods section, we estimated proficiency rates that take into account these observed differences to establish whether French Immersion students vs. non-French Immersion students performed differently in math, ELA, and science. The results are discussed in the following section.

We ran two sets of analyses to address the first research question. These models estimated the effects of French Immersion enrollment on Grade 3, Grade 5, and Grade 8 achievement using the treatment effect function in Stata (as explained in the Analysis section above). In both sets of analyses, we examined the impact of French Immersion enrollment on achievement for Grade 3, Grade 5, and Grade 8 students while matching French Immersion students with non-French Immersion students on gender, FARMS, and race/ethnicity. However, as entry into the French Immersion program was determined through lottery prior to the kindergarten year, we also adjusted or controlled for participation in the lottery for French

Immersion. The lottery participation variable was used as a proxy for parental motivation during their child's pre-school years. In other words, the first set of analyses examines differences in proficiency rates between French Immersion students and other students regardless of parental motivation, while the second set of analyses captures these differences while accounting for differences in parental motivation. Thus, each analysis addresses the research question differently. The first examines French Immersion students' achievement compared to the achievement of similar non-French Immersion students, and the second examines French Immersion students' achievement compared to similar non-French Immersion students' achievement with similarly motivated parents. Table 3 displays the results from the analyses, with the impacts displayed in bold.

Table 3: Impact of French Immersion Enrollment in Grades 3, 5, and 8

	ATET Analyses			ATET Analyses adjusting for Parental Motivation		
	Estimated Proficiency Rates			Estimated Proficiency Rates		
	French Immersion Students (A)	Non-French Immersion Students (B)	Impact of French Immersion (A-B)	French Immersion Students (C)	Non-French Immersion Students (D)	Impact of French Immersion (C-D)
Grade 3						
ELA	32.89%	26.96%	**5.93%†**	33.00%	35.02%	**-2.14%**
Math	43.44%	25.60%	**17.84%*** **	43.44%	31.21%	**12.23%** **
Grade 5						
ELA	45.00%	29.33%	**15.67%*** **	44.99%	34.44%	**10.55%***
Math	33.50%	19.59%	**13.91%*** **	33.50%	23.75%	**9.75%***
Science	68.08%	59.30%	**8.78%** **	68.08%	64.24%	**3.84%**
Grade 8						
ELA	71.51%	32.97%	**38.54%*** **	71.51%	45.41%	**26.10%*** **
Math	47.59%	16.74%	**30.85%*** **	47.60%	24.90%	**22.70%*** **
Advanced Math	59.39%	15.82%	**43.57%*** **	59.39%	23.31%	**36.08%*** **
Science	80.16%	54.74%	**25.42%*** **	80.16%	65.42%	**14.74%** **

Note. Match Variables: Gender, Race/Ethnicity, FARMS status. Significance levels: †$p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

Overall, the results indicate that there is a significant impact, as measured by the difference in estimated proficiency rates, of French Immersion enrollment on achievement for each grade and subject, with one exception. This means that French Immersion students, regardless of grade, would have lower proficiency rates in ELA, math, and science if they had

did not attended a French Immersion school. Not surprisingly, accounting for lottery participation (i.e., parent motivation), as displayed in the last column, decreases the impact of French Immersion enrollment. However, the impact remains significant in most cases. In addition, the positive impact of French Immersion generally increases by grade level, being the highest for Grade 8 students. For example, while the impact for Grade 3 ELA achievement is only marginally statistically significant (becoming statistically insignificant when controlling for lottery participation), the estimated proficiency rate for Grade 8 French Immersion ELA achievement is six times higher than the Grade 3 ELA impact. The Grade 8 French Immersion student estimated proficiency rate was 39 percentage-points higher than non-French Immersion students. In addition, the Grade 8 French Immersion student estimated rates for math proficiency, taking advanced math, and science proficiency was 31, 44, and 25 percentage-points higher, respectively, than for non-French Immersion students. This indicates that attending French Immersion from kindergarten to Grade 8 has a very meaningful impact on student achievement.

Results from Grade 11 Analyses

Research Question 2: Are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?

Table 4 displays the descriptive statistics for the achievement outcomes for the Grade 11 sampling frame. It is important to note that the rates presented in Table 4 are purely descriptive and do not account for differences in student characteristics. The estimated rates, which do control for student characteristics, are discussed in the next section.

Table 4: Descriptive Statistics for Grade 11 Samples

Achievement Outcomes	French Immersion Students		All Other Students	
	Total # Tested	% Proficient	Total # Tested	% Proficient
Grade 11				
PARCC ELA 11	41	48.78%	1185	35.02%
PARCC Algebra II	44	6.82%	1296	4.01%
MD CCR ELA	54	79.63%	1444	51.59%
MD CCR Math	54	50.00%	1444	25.07%

Overall, high school students who had attended French Immersion schools had higher achievement outcomes compared to those who did not attend French Immersion schools. As reported in Table 4, 49 percent and 9 percent of the French Immersion students in the sample demonstrated proficiency in PARCC ELA and Algebra II, compared to proficiency rates of 35 and 4 percent for non-French Immersion students. Similarly, 80 percent and 50 percent of French Immersion students were designated as college and career ready on the MD CCR report in ELA and math, respectively, compared to the college and career readiness rates of 52 and 25 percent of non-French Immersion students. These rates indicate that former French Immersion students had higher level of college readiness compared to non-French Immersion students. However, we cannot simply attribute the difference in readiness for college to enrollment in French Immersion without considering the socio-demographic characteristics of students and the effect of enrollment in a particular high school. As discussed in the methods section, we estimated proficiency rates that take into account these observed differences and the results are discussed in the following section.

Impact of French Immersion Enrollment during High School

As in the analyses for the impact of attending French Immersion schools on Grade 3, 5 and 8, we ran two sets of analyses to assess the impact of French Immersion during high school. The treatment effect models for Grade 11 matched each French Immersion students with a demographically identical peer student who attended the same high school. Table 5 displays the results from the analyses.

Overall, the results indicate there is a significant impact of French Immersion enrollment on achievement on key indicators in 11th grade, with one exception. High school students who attended French Immersion had higher achievement in language arts than students who attended other elementary and middle schools in PGCPS. Compared to their matched peers, French Immersion students were better prepared for college and career on PARCC ELA (+16 percentage points) and the MD CCR ELA (+25 percentage points). While there was not a statistically significant difference on PARCC Algebra II, French Immersion students were significantly better prepared for college and career in math (+18 percentage points) according to the MD CCR math report.

The results of the analysis for the impact of French Immersion while adjusting for differences in parental motivation are reported in the last column of Table 5. As presented in Table 5, there is still a significant impact of French Immersion enrollment on achievement on key indicators in 11th grade after adjusting for differences in parental motivation. For all pairs of comparisons, accounting for differences in parental motivation did not substantially change the estimated rates for French Immersion students. Former French immersion students

performed as good as their matched peers in PARCC Algebra II and they outperformed than their peers in PARCC ELA, as well as in CCR ELA and in CCR math.

Table 5: Impact of French Immersion Enrollment during High School

	ATET Analyses			ATET Analyses adjusting for Parental Motivation		
	Estimated Proficiency Rates			Estimated Proficiency Rates		
	French Immersion Students (A)	Non-French Immersion Students (B)	Impact of French Immersion (A-B)	French Immersion Students (C)	Non-French Immersion Students (D)	Impact of French Immersion (C-D)
Grade 11						
PARCC ELA	48.78%	33.13%	**15.64%***	48.78%	30.59%	**18.18%***
PARCC Algebra II	6.81%	5.48%	**1.33%**	6.81%	1.01%	**5.80%†**
CCR ELA	79.62%	54.65%	**24.97%*****	79.62%	63.00%	**16.62%****
CCR Math	50.00%	31.67%	**18.33%****	50.00%	32.99%	**17.00%***

Note. Match Variables: Gender, Race/Ethnicity & FARMS status. Exact matched on high school attended. Significance levels: †$p < .10$; * $p < .05$; **$p < .01$; *** $p < .001$

Research Question 2a. After accounting for achievement in elementary and middle grades, are eleventh graders who completed French Immersion education more likely to be ready for college and career than eleventh graders of the same high school who attended non-French Immersion schools?

The Grade 11 results from research question 2 are interpreted as the average differences in readiness for college between demographically similar students who differ on whether they attended French Immersion program or not. This estimated impact, however, occurred several years after students have graduated from the French Immersion schools. It is important to demonstrate that it is indeed a result of the gains in reading and mathematics the French immersion students made during elementary and middle schools. Thus, we ran additional analyses that adjusted for the academic performance of the sample during elementary and middle school. These analyses used MSA assessment data when these students were in Grades 3, 5, and 8. For each student in the sample, based on longitudinal models a probability of proficiency in each year of MSA assessment (Grades 3, 5 and 8) was calculated controlling for French Immersion status and demographic characteristics. See the appendix for more on the longitudinal model. Table 6 displays the average predicted probability rates of consistently staying proficient for the sample.

Table 6: Average Probability of Being Consistently Proficient in MSA Assessments in Grades 3-8, Grade 11 Class of 2015 & 2016

		French Immersion Students		All Other Students in the Sampling Frame	
		Total #	**Prob.**	**Total #**	**Prob.**
PARCC sample	**MSA ELA** *	41	.869	1185	.804
	MSA Math *	41	.851	1185	.732
CCR sample	**MSA ELA** *	54	.871	1444	.808
	MSA Math *	54	.852	1444	.736

Note. Significance levels: †$p < .10$; * $p < .05$; **$p < .01$; *** $p < .001$

Overall, 87 percent of the sample who had attended French Immersion program were consistently proficient in MSA reading during elementary and middle school compared to 80 percent for the non-French Immersion sample. For MSA math, 85 percent of the French Immersion sample was consistently proficient compared to 73 percent for the sample who had attended other PGCPS schools. The differences in the estimated probability of being consistently proficient for French Immersion and non-French Immersions students were found to be statistically significant. Thus, it is clear that these former French Immersion students were better prepared academically before high school. Next, we explored if the observed higher proficiency rate in elementary and middle school explains the Grade 11 estimated impact of French Immersion presented above.

Table 7 displays the impact of French Immersion enrollment in high school if the matched comparison group had the same rate of being consistently proficient on MSA during elementary and middle school as the French Immersion students. The results from Table 6 showed that French immersion students had higher rates of being consistently proficient on the MSA compared to demographically similar non-French Immersion students. The analyses for research question 2a adjusted for the probability of being consistently proficient on MSA in elementary and middle grades and thus assume that both groups (i.e., French Immersion and non-French Immersion) in the sample had the same probability of MSA proficiency. In other words, the analyses assume that non-French Immersion students were as high achieving as French Immersion students when both groups were in elementary and middle school. If the estimated impact reported for research question 2 (reported in the first columns in Table 7) does not significantly change (i.e., in size and statistical significance) under this assumption, we cannot confidently conclude that the observed impact is associated with French Immersion education up to Grade 8. If the estimated impact changes, we can interpret the difference

between the adjusted and unadjusted impacts as the long-term impact of French Immersion education.

Table 7: Impact of French Immersion Enrollment without Adjusting and Adjusting for Pre-high school Achievement Trajectory

	ATET Analyses			ATET Analyses adjusting for Gr 3-8 Achievement Trajectory		
	Estimated Proficiency Rates			Estimated Proficiency Rates		
	French Immersion Students (A)	Non-French Immersion Students (B)	Impact of French Immersion (A-B)	French Immersion Students (C)	Non-French Immersion Students (D)	Impact of French Immersion (C-D)
Grade 11						
PARCC ELA	48.78%	33.13%	**15.64%***	48.78%	45.26%	**3.51%**
PARCC Algebra II	6.81%	5.48%	**1.33%**	6.81%	27.16%	**-20.3%*****
CCR ELA	79.62%	54.65%	**24.97%*****	79.62%	67.04%	**12.58%***
CCR Math	50.00%	31.67%	**18.33%****	50.00%	58.16%	**-8.17%**

Note. Match Variables: Gender, Race/Ethnicity & FARMS status. Exact matched on High School attended. Significance levels: †p < .10; * p < .05; **p < .01; *** p < .001

The results from the PARCC ELA model without adjusting for student academic performance during elementary and middle school show that the estimated impact of French Immersion at the end of Grade 11 was 16 percentage points (i.e., 49% for French Immersion and 33% for non-French Immersion students) but the impact is reduced to 4 percentage points and is not statistically significant under the assumption of equal rate of proficiency in MSA reading for the sample. That is, if it were not for the higher academic performance of French Immersion students in reading prior to high school, their 11th grade PARCC reading proficiency would not have been different from their matched peers, as the proficiency rate for the non-French immersion group would have increased to 45 percentage points. We can then conclude that a 12 percentage points advantage (the difference between the two impact estimates) in readiness in reading is associated with the higher academic performance achieved in elementary and middle grades as a result of enrollment in French Immersion program. For PARCC Algebra II, the result shows that former French Immersion students were as good as their matched peers without adjusting for student academic performance during elementary and middle grades; however, students who attended French Immersion school would have been out-performed by their peers in Algebra II by about 20 percentage points if they had not had higher rates of MSA proficiency during their elementary and middle grades. The analyses from the models that used the Maryland CCR math as outcome show similar results to the

Algebra II, as the non-French Immersion students would have performed better if they had the same rate of MSA proficiency during their elementary and middle grades as the French Immersion students. The analyses from the models that used the Maryland CCR ELA as an outcome, however, demonstrated that students who attended French Immersion school would have out-performed their peers by about 13 percentage points even if both groups had the same rate of MSA proficiency during their elementary and middle grades

In sum, students who had attended French Immersion schools performed as well as their matched high school peers in Algebra II and they were better prepared for college than their matched peers in PARCC ELA, CCR ELA and in CCR math. Moreover, the overall higher performance of students who attended French Immersion schools on the 11th grade outcomes is due primarily to the higher academic performance they achieved during the elementary and middle grades. As shown in the findings reported earlier in research question 2a, this higher academic performance during the elementary and middle grades is a result of attending French Immersion schools during these grades. The adjustment for students' trajectory (i.e., being consistently proficient in elementary and middle school) confirmed that the estimated program impact in high school is a result of the higher academic achievement attained during elementary and middle grades as a result of enrolling in French Immersion schools.

IV. CONCLUSIONS

The present study identifies a consistent pattern of positive impact of French Immersion enrollment across grade levels in reading, mathematics, and science. The results demonstrate that the size of the impact progressively increased as students moved though elementary and middle school. In reading, estimates range from six percentage points in Grade 3 to about 38 percentage points in Grade 8. Previous evaluations of French Immersion programs found out that students often score significantly lower in English than non-immersion students in the early grades but the gap typically disappears within one year of receiving instruction in English (Lindholm-Leary and Genesee, 2014). The findings in this study are consistent with these previous findings in that by the end of Grade 3 (after one full year of instruction English Language and Arts), French Immersion students are as proficient as their peers in English language-only schools. Moreover, French Immersion education resulted in long-term reading impact of 16 and 25 percentage points of readiness for college and career in Grade 11 as measured by PARCC ELA 11 and MD CCR ELA, respectively. In mathematics, French Immersion students outperform their peers by 14 to 39 percentage points, while in science, they outperform by nine to 25 percentage points. At the end of 11th grade, students who attended French Immersion program were better prepared for college and career than similar students who attended traditional elementary and middle schools in PGCPS. These findings are important given that French Immersion students study mathematics and science in French through Grade 8 and they do not start learning in the English language until Grade 2.

The study also explored the role of parental motivation in moderating the impact of French Immersion. This was an important variable to consider as entry into the program required application into a lottery and enrollment as early as kindergarten. Parents' motivation may have lasting effect on the academic achievements of students. If parents of those who enrolled in the French Immersion program were more motivated than other parents, then the estimated impact represent the upper bound of the estimated impact and the adjustment for parental motivation shows the effect of education in French irrespective of parental factors. After controlling for parental motivation, we also found positive and statistically significant impacts in reading, mathematics, and science at each observed grade level.

Finally, the study conducted additional analyses to ascertain if the observed advantage for former French students at the end of Grade 11 is the result of their enrollment in the French Immersion program from Kindergarten through Grade 8. Even though French Immersion students have been shown to post higher rates of readiness for college and career, it was necessary to determine if this higher readiness rates were associated with factors other than the higher academic performance French Immersion students attained during the elementary

and middle grades. We were able to test this by matching each French Immersion student with a demographically identical student in the same high school and by controlling for each student's probability of being consistently proficient on MSA in elementary and middle grades. The analysis of being consistently proficient in each year of MSA assessment indicates that French Immersion students were between 6 to 11 percentage points more likely to consistently be proficient in reading and mathematics in grades 3 through 8. In addition, the analysis showed that the higher rate of being consistently proficient (i.e., higher academic performance during the elementary and middle grades) was primarily responsible for the observed higher rate of readiness for college and career among former French Immersion students in Grade 11. Thus, the study confirmed that the impact of French Immersion sustained long after the students graduated from the program.

References

Bournot-Trites, Monique and Unrike Tallowit. 2002. Report on the Effects of Second Language Learning on First Language Literacy Skills. A report commissioned by the Atlantic Provinces Educational Foundation. Halifax, Nova Scotia: The Printing House.

Lindholm-Leary, Kathryn and Fred Genesee. 2014. *Journal of Immersion and Content-Based Language Education* 2:2 (2014), 165–180.

Lindholm-Leary, Kathryn and Elizabeth Howard. 2008. Language Development and Academic Achievement in Two-Way Immersion Programs. In T.W. Fortune & D.J. Teddick (Eds) Pathways to Multilingualism: Evolving Perspectives on Immersion Education. Clevedon, UK: Multilingual matters.

Thomas, Wayne, Virginia Collier and Martha Abbott. 1993. Academic Achievement through Japanese, Spanish, or French: The First Two Years of Partial Immersion. The Modern Language Journal, 77, ii(1993).

Appendix

Panel Data Analysis for Grade 11 Cohorts:

Dependent Variable: Whether or not a Student was proficient on MSA state assessment on Math and Reading in Grades 3, 5 and 8.

Treatment Variable: Attendance in French Immersion school through eighth grade vs. eight graders who attendance the same elementary school Kindergarten through Grade 5 and participated in MSA state assessments.

Control Variables: Gender, Race/Ethnicity and FARM status (time-Varying).

Time/Panel: Grades 3, 5 and 8

Regression Model: The population-average logistic regression model. The Population-averaged model is estimated using generalized estimating equations (GEE) method and allows us to make inference on average for the entire population accounting for between subject correlations in the dependent variable. The odds-ratio, $\exp(B_1)$, is interpreted as the odds of proficiency in the average French Immersion students compared with the average non-French Immersion student.

Result: The longitudinal models demonstrate that, on average, French immersion students were more likely to stay proficient in reading (75% higher) and math (130% more) during their elementary and middle school enrollment.

Table: Results from the GEE Population- averaged model on MSA proficiency Grades 3 through 8.

	Odds-ratio	P-Value
MSA Reading(n=2986)		
French Immersion Enrolled	1.75*	.021
Male	.49***	.000
Black	.48***	.000
Hispanic	.49**	.001
White	1.39	.305
FARMS	.81***	.001
Constant	12.9***	.000
MSA Math(n=2986)		
French Immersion Enrolled	2.31***	.000

Male	.79**	.001
Black	.38***	.000
Hispanic	.49***	.000
White	1.47	.157
FARMS	.74***	.000
Constant	8.12***	.000

The reference group for Race/Ethnicity is 'Other'

Note. †$p < .10$; * $p < .05$; **$p < .01$; *** $p < .001$