Charter School Performance in
Maryland
**2019**

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## Acknowledgements

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## List of Acronyms & Definitions

CREDO          Center for Research on Education Outcomes

ELLs           English Language Learners

EOC            End-of-Course Exam

TPS            Traditional Public School

VCR            Virtual Control Record

NAEP           National Assessment of Educational Progress

NCES           National Center for Education Statistics

Feeder         A feeder school is a traditional public school whose students have transferred to a given charter school. We use students attending feeder schools as potential matches for students attending charter schools.

Growth         The year-to-year change in academic performance relative to one's peers. Growth can be positive or negative.

# Charter School Performance in Maryland 2019

## 1. Introduction

Since the enactment of Maryland's public charter school law in 2003, more than 50 public charter schools in Maryland have offered parents and students choices in their education. Throughout the years, there have been controversies over charter schools. Charter school advocates hail the benefits of the sector, such as increasing parental choices and introducing new school models. Opponents decry the reallocation of funds away from district schools as an existential threat to district organizations and view the mismatch between district and charter student profiles as evidence of charters' neglecting hard-to-serve students. Only a fraction of that debate is grounded in well-researched evidence about charter schools, their practices, and their impact on student outcomes.

The data and analyses presented in this report cover the school years of 2013-14 through 2016-17 and can serve as a basis of evidence on the effectiveness of charter schools. The findings have particular relevance in informing legislative or regulatory decisions in the state. Recently proposed legislation, including the Public Charter School Expansion and Improvement Act of 2015 and the 2019 Public Charter School Facility Fund Act, pursued a variety of reforms in the charter school sector. While these bills ultimately have not passed, they serve as examples of how evidence-based research can provide concrete benefits in the policy making cycle. The benefits take two forms. First, it provides a rigorous and independent review of the performance of the state's charter schools. Second, the study design is consistent with CREDO's reports on charter school performance in other locations, making the results amenable to benchmarking both nationally and in other locations.

With cooperation from the Maryland State Department of Education (MSDE), CREDO obtained historical sets of student-level administrative records. The support of MSDE staff was critical to CREDO's understanding of the character and quality of the data we received. However, it is important to note that those interactions with the department dealt only with technical issues related to the data. CREDO has developed the findings and conclusions presented here independently.

In this report, we present the results from two related analyses. We first present findings regarding the effects of charter school enrollment on student-level academic performance for the period 2013-2014 to 2016-2017. These results are expressed in terms of the academic progress that a typical charter school student in Maryland would realize from a year of enrollment in a charter school. We compare the learning of a charter student to exact-match peers in nearby traditional public schools (TPS) that the

charter students did not choose to attend. To help the non-technical reader grasp the findings, we translate the findings into "days of learning" based on the foundation of a 180-day school year.

Both legislation and public policy operate to influence school-level decisions. Accordingly, the second set of findings looks at the performance of students by school and presents school average results. These findings are important to understand the range of performance at the school level.

The analysis shows that in a year's time, the typical charter school student in Maryland exhibits stronger growth in both reading and math compared to the educational gains that the student would have had in a traditional public school (TPS). Thinking of the quantity of learning that the typical Maryland public school student gains from one year to the next, we equate that amount of progress to 180 days of learning, which is the usual number of days in a school year. Against that standard of 180 days of learning, the average Maryland charter student experiences stronger annual growth in reading equivalent to 30 additional days of learning and in math equivalent to 35 additional days of learning. Further probing reveals greater academic progress for charter Black students and charter Hispanic students.

## 2. Study Approach

This study of charter schools in Maryland focuses on the academic progress (growth) of enrolled and tested students in Maryland's charter schools. Whatever else charter schools may provide their students, their contributions to students' readiness for secondary education, high school graduation, and post-secondary life remain of paramount importance. Furthermore, current data limitations prevent the inclusion of non-academic outcomes in this analysis.

To study academic performance in Maryland, we relied on scores students received on Maryland state standardized achievement tests. Achievement tests capture what a student knows at a point in time. These test results were fitted into a bell curve format enabling us to see how students moved from year to year in terms of academic performance. Two successive test scores allow us to see how much progress a student makes over a one-year period; this is also known as a growth score or learning gain. Growth scores allow us to zero in on the contributions of schools separately from other things that affect point-in-time scores. The parsed effect of schools in turn gives us the chance to see how students' academic progress changes as the conditions of their education transform. This is the analytic foundation for our examination of the academic impact of enrollment in charter schools.

We employ the Virtual Control Record (VCR) method developed by CREDO in our analysis.[1] We strive to build a VCR for each charter school student. A VCR, or a "virtual twin", is a synthesis of the actual academic experiences of up to seven students who share identical characteristics to the charter school student, except for the fact that the VCR students attend a TPS that each charter school's students

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[1] Davis, D. H., & Raymond, M. E. (2012). Choices for studying choice: Assessing charter school effectiveness using two quasi-experimental methods. *Economics of Education Review, 31*(2), 225–236.

would have attended if not enrolled in the charter school. This synthesized record is then used as the counterfactual condition to the charter school student's performance.

Our approach is displayed in Figure 1. We identify all the traditional public schools whose students transfer to a given charter school; each of these schools is designated as a "feeder school." [2] Using the records of the students in those schools in the year prior to the test year of interest ($t_0$), CREDO selects all of the available TPS students who match each charter school student.

Match factors include:

- Grade level
- Gender
- Race/Ethnicity
- Free or Reduced Price Lunch Status
- English Language Learner Status
- Special Education Status
- Prior test score on Maryland state achievement tests

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[2] Some students from Bluford Drew Jemison STEM Academy West and NACA Freedom and Democracy Academy II transferred to charter schools in the 2014-15 year. However, the Maryland State Department of Education staff pointed out that they were transformation schools in Baltimore and operated in distinct ways. So we do not include their students in the pool of candidates for VCRs. Further information about Baltimore transformation schools can be found from https://www.baltimorecityschools.org/school-types. Specifically, transformation schools are defined as "secondary schools operated by independent education entities, and each has a specific theme and a unique curriculum that focuses on college, career, or alternate programming."

*Figure 1: CREDO Virtual Control Record Methodology*
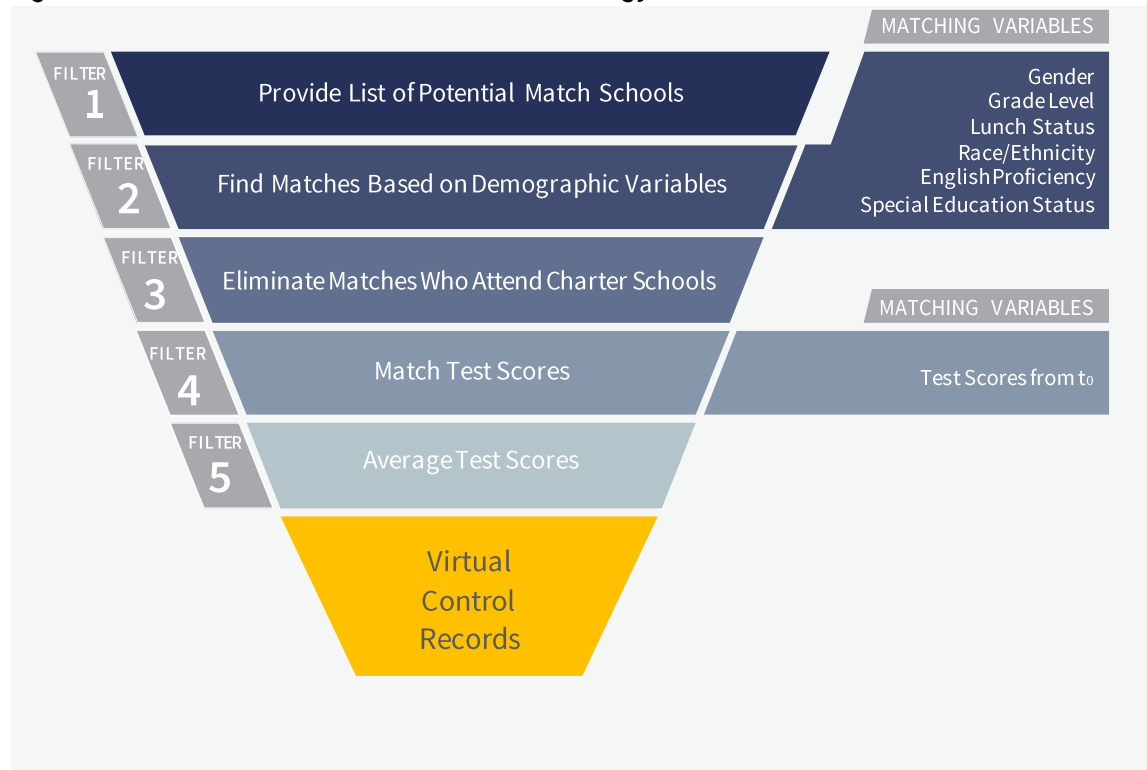


At the point of selection as a VCR-eligible TPS student, all candidates and the individual charter school student have identical traits and matching baseline test scores. The focus then moves to the subsequent year, $t_1$. The scores from this test year of interest ($t_1$) for as many as seven VCR-eligible TPS students are then averaged and a Virtual Control Record is produced. The VCR produces a score for the test year of interest that corresponds to the expected result a charter student would have realized had he or she attended one of the traditional public schools.

The above VCR method has been used in previous CREDO publications. We make two changes to the approach in this study. First, in our previous reports, if a charter student can be tracked for multiple periods in the study window, we matched the student for all the periods using the records in the year prior to the first growth period. In this study, we match the student period by period to conform to the new baseline equivalence criteria specified in *Procedures Handbook Version 4.0* of What Works Clearinghouse (WWC).[3] Altering the match in this way means that caution is advised when comparing findings in this study and previous reports. Second, the United States Department of Agriculture phased in the Community Eligibility Provision (CEP) to its free/reduced-price meal program regulations in Maryland and other states during the study period. The CEP allows schools and local education agencies with a minimum Identified Student Percentage (40 percent or higher) to provide free breakfast and lunch to all students. To minimize over-identification of students living in poverty in the analysis,

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[3] What Works Clearinghouse (2017). Procedures Handbook Version 4.0.
https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_procedures_handbook_v4.pdf.

we drop from the list of feeder schools a very small number of TPS if their share of the students identified as economically disadvantaged by the state was 100 percent *and* represented a jump by 35 percentage points or more from the previous year. It was possible to create virtual matches for 83 percent of tested charter students with growth scores in reading and matches for 79 percent of tested charter students with growth scores in math. The high match rates provide confidence that the scientific analysis delivers a true picture of charter school performance in Maryland.

Using statistical methods, we isolate the contributions of schools from other social or programmatic influences on a student's growth. Student growth data are analyzed in standard deviation units so that the results can be assessed for statistical differences. All the findings that follow are reported as the **average one-year growth** of charter school students relative to their VCR-based comparisons. With four years of student records in this study, it is possible to create three periods of academic growth.

To assist the reader in interpreting the meaning of growth, we include an estimate of the number of days of learning required to achieve growth of particular units of standard deviations. This estimate was calculated by Dr. Eric Hanushek and Dr. Margaret Raymond based on the 2017 National Assessment of Educational Progress (NAEP) test scores.[4] Using a standard 180-day school year, one standard deviation (s.d.) change in effect size is equivalent to 590 days of learning.

## 3.  Maryland Charter School Demographics

The total number of charter schools in the state of Maryland has remained stable since the beginning of the study period. Figure 2 notes the newly opened, continuing, and closed charters school campuses from the 2013-14 school year to the 2016-17 year according to the National Center of Education Statistics (NCES).[5] The figure presents the trend in the total number of charter schools in Maryland over four years.

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[4] Detailed information about the 2017 NAEP test scores can be accessed via
https://www.nationsreportcard.gov/reading_2017/?grade=4 and
https://www.nationsreportcard.gov/math_2017/?grade=4.
[5] The data were retrieved from "Public Elementary/Secondary School Universe Survey Data," National Center for Education Statistics, https://nces.ed.gov/ccd/pubschuniv.asp. "Opened schools" indicates schools opened as new schools in the fall of the displayed year. "Continuing schools" indicates schools that were opened prior to the fall of the displayed year and remain open into the next school year (i.e. a school listed as continuing in the 2014-15 column opened some time prior to 2014-15 and did not close in 2014-15) "Closed schools" indicates schools that ceased operation by the spring of the displayed year (i.e. a school listed as closed in the 2014-15 column had its last year of operation in 2014-15 and closed at the end of that school year).

*Figure 2: Opened, Continuing, and Closed Charter Campuses, 2013-14 to 2016-17*
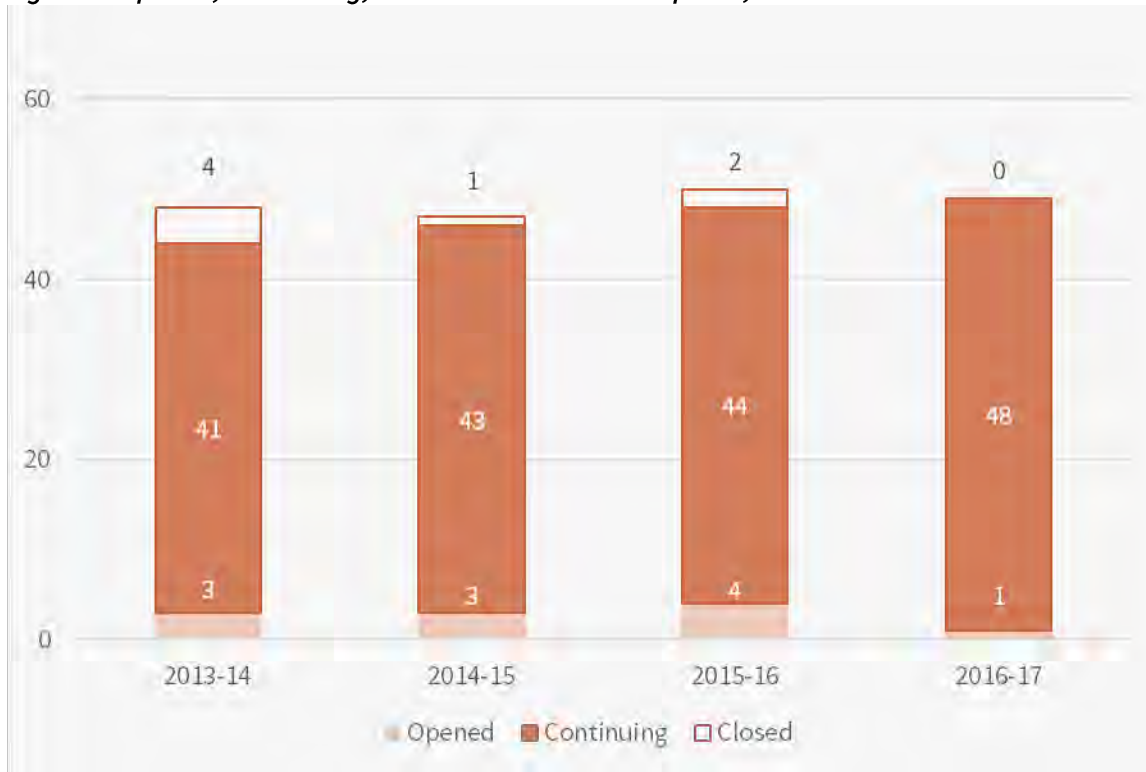


Our analysis begins with a total of 48 charter schools in the 2013-14 school year. There were three schools that opened and four schools closed at the end of the 2013-14 school year.[6] In 2014-15 three new schools opened and one school closed at the end of that school year. In 2015-16 we saw four new openings and two closures. In 2016-17 there was one new school opened, leaving the total number of charter schools at 49.

The demographics of the charter schools may not mirror those of the TPS of Maryland as a whole. This is because charter schools are not evenly distributed geographically. They also may attract students who differ demographically from the overall community profile. Furthermore, parents and students choose to attend charter schools for a variety of reasons, such as location, school safety, small school size, academic focus, or special interest programs. The cumulative result of all these factors is that the student populations at charter schools and their TPS feeders may differ.

Table 1 uses data for the 2015-16 school year to compare the characteristics of the student populations for three groups of students: all the Traditional Public Schools (TPS) in Maryland, those in the subset of TPS that have had some of their students move into charter schools (Feeders), and those in charter schools (Charters).

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[6] In the 2013-14 school year, Transformation Schools in Baltimore were flagged as charter schools in the "Public Elementary/Secondary School Universe Survey Data" of NCES. These schools are not included in the count of closed charter schools for 2013-14 in this analysis.

**Table 1: Demographic Comparison of Students in TPS, Feeders, and Charter: 2015-16**

| | TPS | Feeders | Charters |
|---|---|---|---|
| Number of schools | 1,388 | 405 | 50 |
| Average enrollment per school | 619 | 592 | 420 |
| Total number of students enrolled | 858,634 | 239,593 | 20,988 |
| Students in Poverty | 45% | 62% | 56% |
| English Language Learners | 8% | 10% | 2% |
| Special Education Students | 12% | 12% | 12% |
| White Students | 40% | 17% | 13% |
| Black Students | 33% | 58% | 76% |
| Hispanic Students | 16% | 18% | 6% |
| Asian/Pacific Islander Students | 7% | 3% | 2% |
| Native American Students | 0% | 0% | 0% |
| Multi-Racial Students | 4% | 3% | 2% |

The data in Table 1 show that the demographic profile of charter schools is very different from that of TPS as a whole. The percentage of Black students and students in poverty is higher in charter schools than for the state, while the percentage of White students and Hispanic students in charter schools is lower than the statewide TPS enrolls. The demographic profile of the feeder schools which charter students come from is also somewhat different from the charter schools themselves. Charter schools serve a higher percentage of black students than feeder schools, while serving a lower percentage of White students, Hispanic students, and students in poverty.

Policymakers and stakeholders continue to examine the degree to which students with special needs enroll in charter schools. The proportion of students in charter schools receiving special education services is a particular topic of debate. Table 1 shows charter schools serve the same percentage of students receiving special education services as TPS and feeders. The impact charters schools have on students with an English Language Learner (ELL) designation is also important to policymakers. The ELL student population represents eight percent of all TPS students while representing only two percent of the charter school population.

## 4. Analytic Findings of Charter School Impacts

### Overall Charter School Impact

The primary question of this study is whether charter schools differ overall from traditional public schools in how much their students grow academically. To answer this question, we estimate the one-year academic gains observed for charter school students in each of the three studied growth periods and compare their average performance with the same measure for their TPS peers, using our VCR comparisons.

Please refer to the sidebar titled *Graphics Roadmap 1* where guidance is provided to help readers understand the charts that follow.

As described in the Study Approach section, student growth data are analyzed in units of standard deviations so that the results can be assessed for statistical differences. To help the reader interpret our analysis results, we transform standard deviation units of growth into days of learning based on a standard 180-day school year (Table 2).[7] Interested readers can refer to the Study Approach section and Appendix B for detailed explanations of the computation of days of learning.

**Graphics Roadmap 1**

The graphics in this section have a common format.

Each graph presents the average performance of charter students relative to their **pertinent comparison students**. The reference group differs depending on the specific comparison being made. Where a graph compares student subgroup performance, the pertinent comparison students are the same for both subgroups. Each graph is labeled with the pertinent comparison group for clarity.

We show two axes on the graphs to help the reader get a sense of learning gains. The ***left axis*** indicates standard deviation units of learning gains of charter students relative to their comparison students. The ***right axis*** displays the same learning gains in days of learning. The statistical tests are performed on the values as they are enumerated on the left axis.

The **height** of the bars in each graph reflects the difference in the performance between charter school students and the comparison student.

**Stars** are used to reflect the level of statistical significance of the difference between the group represented in the bar and its comparison group of similar students in TPS. The absence of stars means that the schooling effect is not statistically different from zero.

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[7] The values in Table 2 are updated from past reports using the latest (2017) NAEP scores, which show slower absolute annual academic progress than earlier administrations. See Eric A. Hanushek, Paul E. Peterson, and Ludger Woessmann, "Achievement Growth: International and U.S. State Trends in Student Performance", *Education Next*, 12 (July 2012), 1–35.

**Table 2: Transformation of Average Learning Gains to Days of Learning**

| Standard Deviations | Days of Learning |
|:---:|:---:|
| 0.05 | 30 |
| 0.10 | 59 |
| 0.15 | 89 |
| 0.20 | 118 |
| 0.25 | 148 |
| 0.30 | 177 |
| 0.35 | 207 |

Figure 3 displays the overall charter school impact on student academic progress in Maryland. The performance benchmark is the average progress observed for the comparison VCRs from feeder TPS; their progress is set as 0.00 and the charter school student performance is indexed against it. Across the state of Maryland, in a year's time, charter students in Maryland experience higher academic progress than their TPS peers in both reading and math. Translating the standard deviation values into days of learning, this advantage for charter students is about the equivalent of 30 additional days of learning in reading and about 35 additional days of learning in math, given a 180-day school year.

*Figure 3: Average Learning Gains in Maryland Charter Schools Compared to Average Gains for TPS VCRs*
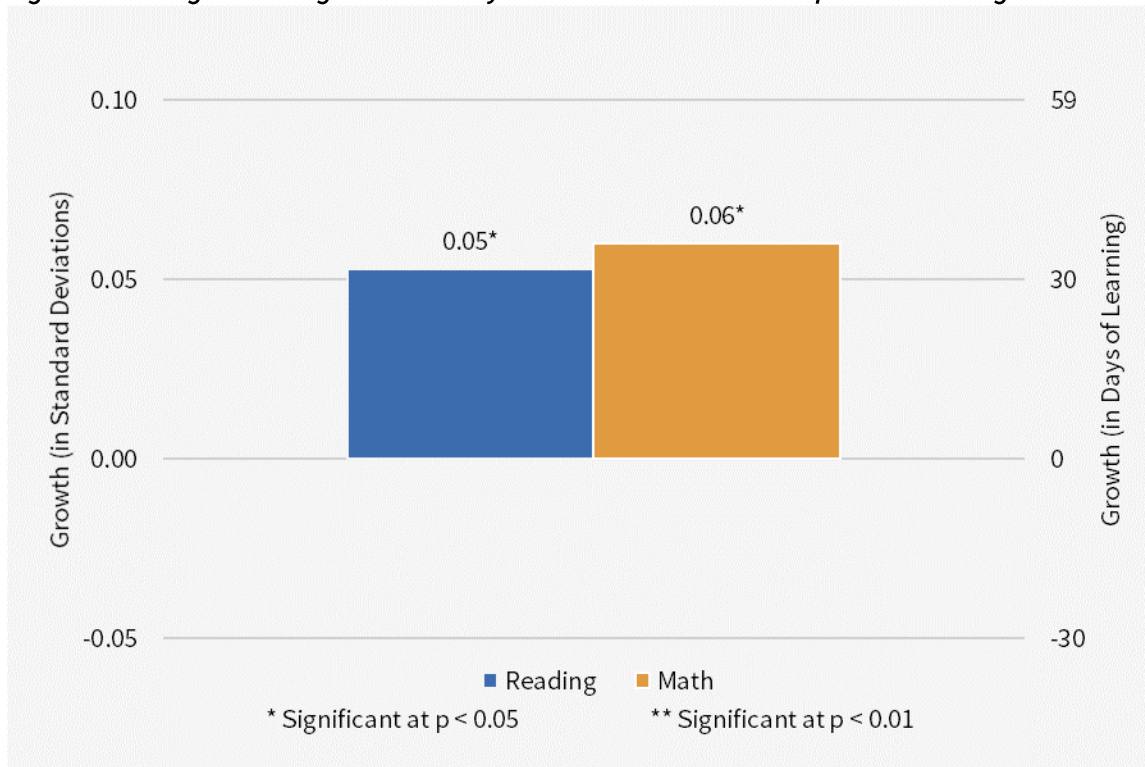
## Charter School Impact by Growth Period

To determine whether performance is consistent over the window of this study, the impact of attending a charter school on academic progress is examined separately for each of the three growth periods. Recall that a growth period is the measure of progress from one school year to the next. In the presentation of results in Figure 4, the denotation "2014-2015" covers academic growth that occurred between the end of the 2013-2014 school year and the end of the 2014-2015 school year. Similarly, the denotation "2016-2017" corresponds to the year of growth between the 2015-2016 and the 2016-2017 school years.

*Figure 4: Average Learning Gains in Maryland Charter Schools Compared to Gains for TPS VCRs by Growth Period: 2014-2015 to 2016-17*
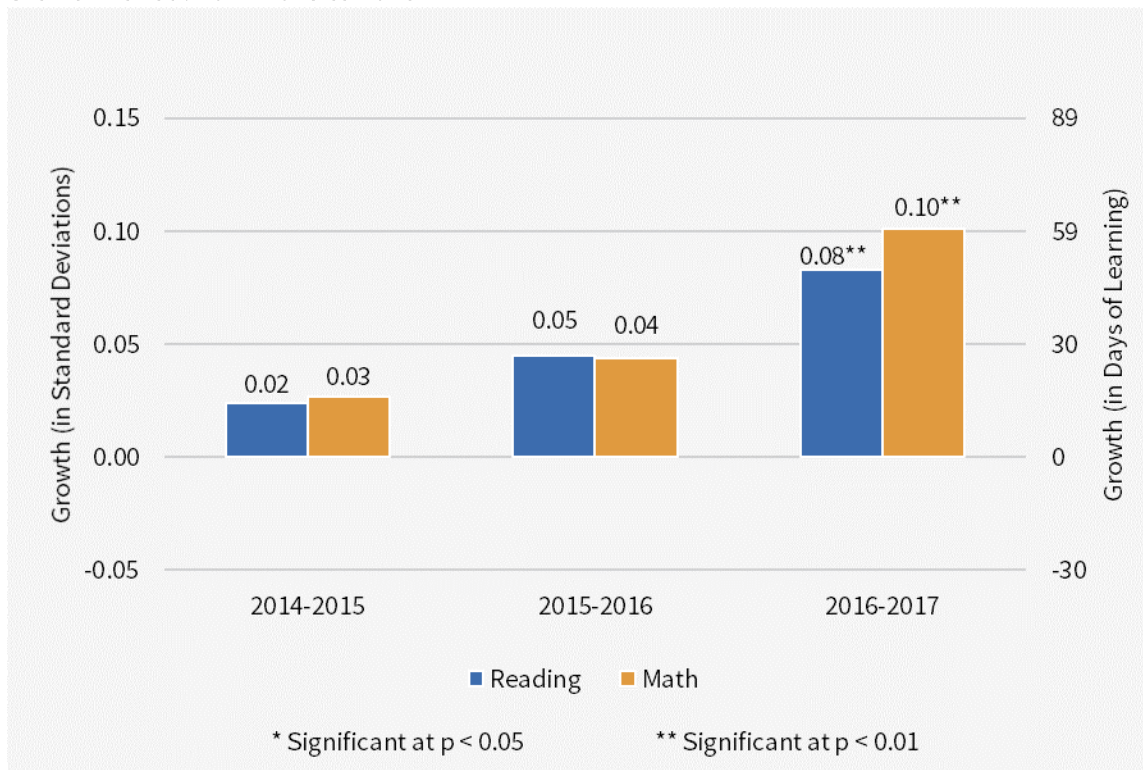


Figure 4 shows that in the 2014-2015 and the 2015-2016 growth periods, charter school students perform similarly to their VCR peers in both reading and math. However, in the 2016-2017 growth period, the gains of charter school students in Maryland are significantly stronger than the gains of their TPS counterparts in both subjects. The advantages of charter school students in 2016-2017 translate to approximately 47 additional days of learning in reading and about 59 additional days of learning in math. These strong results are the driving force behind the positive results for the entire study.

## 5. Charter School Analysis by School Attribute

### Charter School Impact by School Locale

Depending on their locales, charter schools may serve different student populations, face different levels of available human capital, or both. Though charter schools in urban areas receive the bulk of media attention, the performance of charter schools in other locales merits attention as well. In Maryland, within the four years of this study, there were no charter schools in town locales and there was one charter school in a rural area.[8] We limit the study of charter school impact by locale to only urban charters and suburban charters. Figure 5 illustrates the impact of charter schools in these two locales. In this breakdown, charter students in different locations are compared with their virtual twins in TPS.[9] For the following analysis, the comparison is relative to whatever actual progress each group of VCRs has realized. The reader should not assume that the transformation of each VCR group to 0.00 means that all the VCRs have equivalent academic growth.

*Figure 5: Average Learning Gains in Maryland Charter Schools Compared to Gains for TPS VCRs by School Locale*



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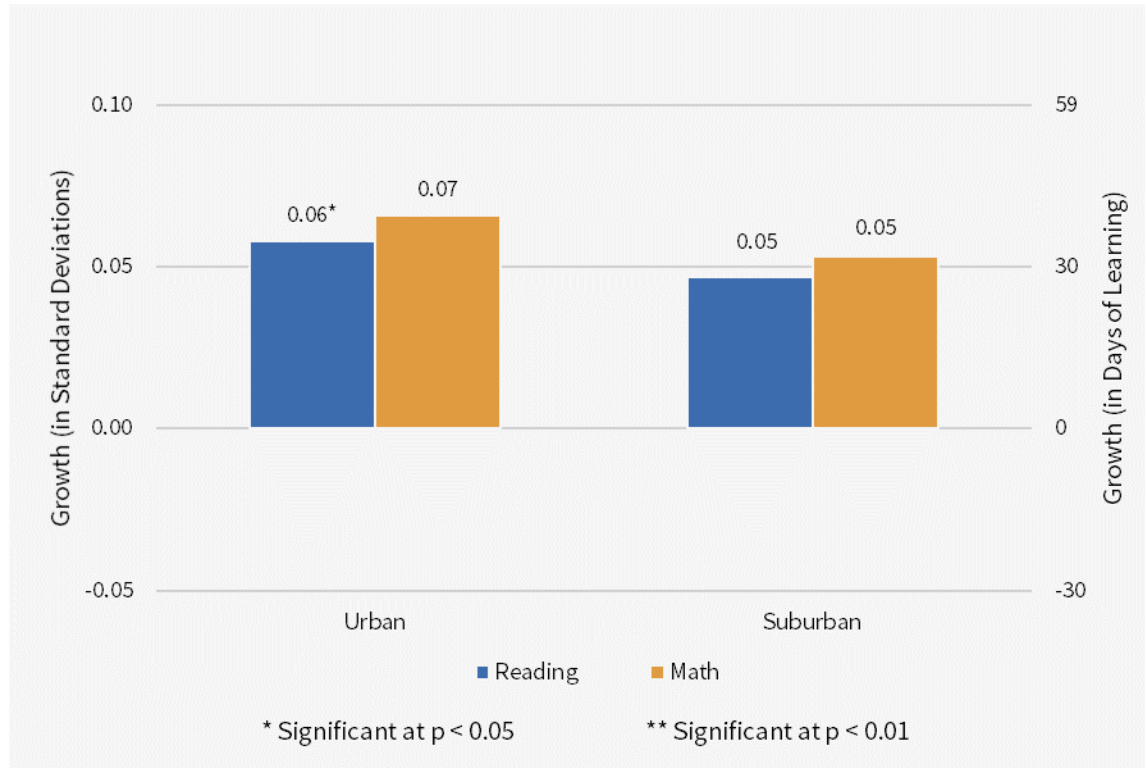
[8] We do not present results if it would be possible to identify the school or schools in the group.
[9] The National Center for Education Statistics (NCES) defines 12 urban-centric locales which are divided into four main locale types: city, suburb, rural and town. Each school's locale is coded by NCES in the annual Core of Common Data dataset; we use their classification for this analysis.

Figure 5 shows urban charter students post stronger growth in reading, equivalent to 35 more days of learning, and perform similarly in math compared to TPS peers. Students attending charter schools in the suburbs have growth similar to that of their suburban TPS VCRs in both reading and math. Appendix Table 1 displays the number of student observations in each locale-subject combination.

## Charter School Impact by School Grade Configuration

Charter schools often exercise their autonomy by choosing which grade levels to serve. Some charter operators focus on particular ages, some seek to serve a full range of grades, and others develop by adding one additional grade each year. The National Center for Education Statistics assigns schools the label of "elementary school", "middle school", "high school", or "multi-level school" based on their predominant grade pattern. The designation of "multi-level school" can apply to a school that serves elementary and middle grades, middle and high grades, or all K-12 grades.[10] Looking at performance by school grade configuration helps inform whether specialization in a specific range of grades produces better results. The outcomes of students by the grade configuration of the charter school they attend are reported in Figure 6. Again, the comparison is relative to whatever actual progress each group of VCRs has realized. The reader should not assume that the transformation of each VCR group to 0.00 means that the VCRs have nominally equivalent academic growth.

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[10] The National Center for Education Statistics (NCES) designates a school as an elementary, middle, high, or multi-level school. CREDO uses the designation by NCES. The sole exception is that CREDO considers a school to be a high school if the lowest grade served is ninth grade or above.

*Figure 6: Average Learning Gains in Maryland Charter Schools Compared to Gains for TPS VCRs by School Grade Configuration*
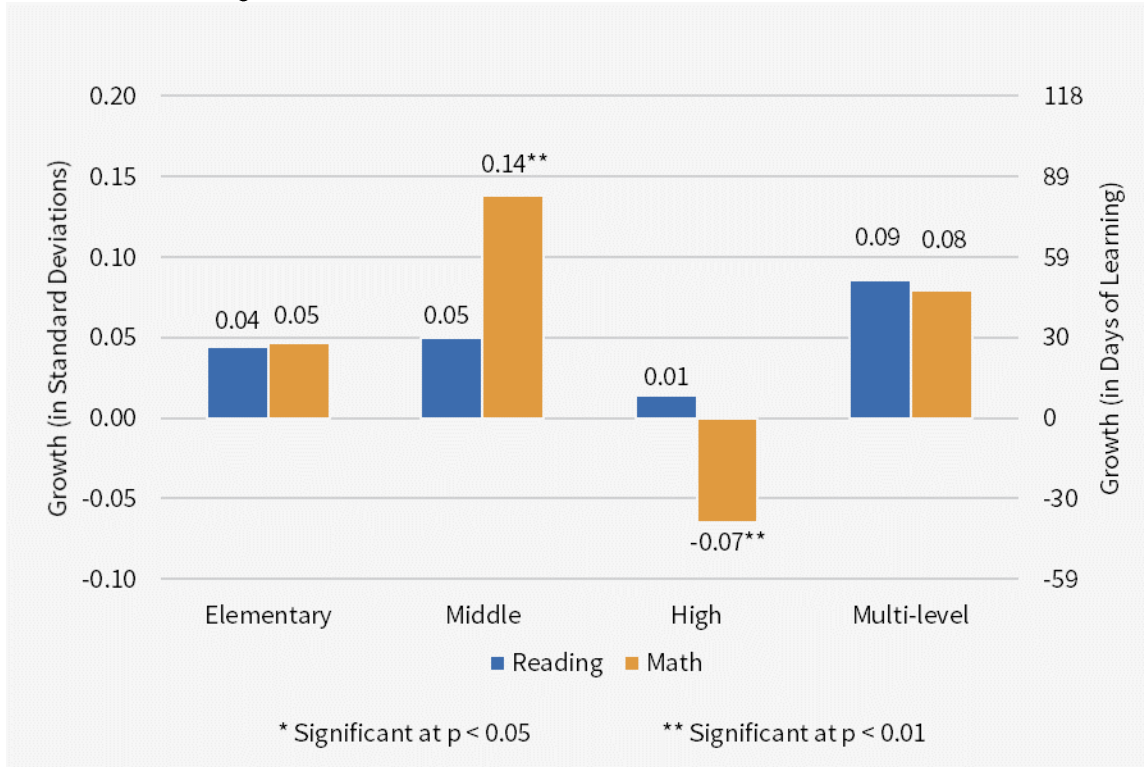


The results in Figure 6 show that, on average, students in charter elementary and multi-level schools perform similarly to their TPS peers in both reading and math. In charter middle schools, students post similar gains in reading but stronger gains in math compared to their TPS VCRs. The stronger math growth translates to 83 additional days of learning. Students attending charter high schools experience similar growth in reading while making weaker growth in math equivalent to 41 fewer days of learning compared to their TPS peers.

## 6. Charter School Analysis by Student Characteristic

### Charter School Impact by Race/Ethnicity

One of the enduring advances of the *No Child Left Behind Act* of 2001 and the subsequent *Every Student Succeeds Act* of 2015 is the recognition that average results may not be evenly distributed across all students. Attention to the differences in the performance of students of various racial/ethnic backgrounds and other attributes has become standard practice in most assessments of school performance. Maryland charter schools' ability to support the progress of disadvantaged students is an important policy goal in the state and a strong focus of this study. The effectiveness of charter schools across ethnic and racial groups is especially important given the significant shares of historically underserved students that charter schools enroll. This section investigates the impact of charter school attendance on learning gains of students of different racial backgrounds compared to their peers in the same group in traditional settings.

The impacts of charter schools on the academic gains of Black and Hispanic students are reported in Figures 7 through 8a. For each student subgroup, we present two related graphs. *Graphics Roadmap 2* in the sidebar provides guidance on how to interpret the graphs and their relation to each other. In short, the first graph depicts the growth of TPS students and charter students in the particular subgroup of interest as compared to the growth of the "average White TPS student". Graphs labeled "a" show whether the learning gains in the charter school student subgroup differ significantly from their VCRs in the same subgroup.

### Graphics Roadmap 2

Figures 7 through 8a show two important contrasts for Black and Hispanic student groups. For each student subgroup, we present two related graphs:

The **first graph** displays the growth of **TPS students and charter students in the particular subgroup** of interest compared to the growth of the "**average White TPS student**." In this comparison, the White TPS student is male and is not in poverty, special education, or designated as an English Language Learner and is not repeating his current grade. The graph sets the performance of the average White TPS student to **zero** and shows how learning of students in the subgroup compares.

The **stars** indicate the level of statistical significance. Thus, if there are no stars, we interpret the difference in learning gains as similar to the white TPS comparison student. The size and direction of the **bars** in the graph show the direction and magnitude of learning differences. If there is no difference in the learning gains, the bar would be missing entirely. If the learning of the student group in question is not as great as the comparison baseline, the bar is negative. If the learning gains exceed the comparison, the bar is positive.

**Graphs labeled "a"** display the results of a second comparison testing whether the learning gains in the **charter school student subgroup** differ significantly from **their VCRs in the same student subgroup**. In these graphs, the performance of the TPS peers in the subgroup is set to **zero** and the learning gains of the charter school students in the subgroup are measured against that baseline. As with the first graph, stars denote statistical significance.

Black students account for 76 percent of the charter school population in Maryland. As shown in Figure 7, Black students in both TPS and in charter schools in Maryland make significantly weaker annual academic progress in reading and math when compared to the average White student in TPS. Black students in TPS experience about 124 fewer days of learning in reading and 159 fewer days of learning in math compared to the average White VCR student. Black students attending charter schools in Maryland also show weaker gains compared to the average White student in TPS, amounting to about 83 fewer days of learning in reading and 112 fewer days of learning in math. We refer to these differences as learning gaps. They have a direct impact on achievement gaps over time.

*Figure 7: Learning Gains of Black Students Benchmarked against Learning Gains of White TPS Students*
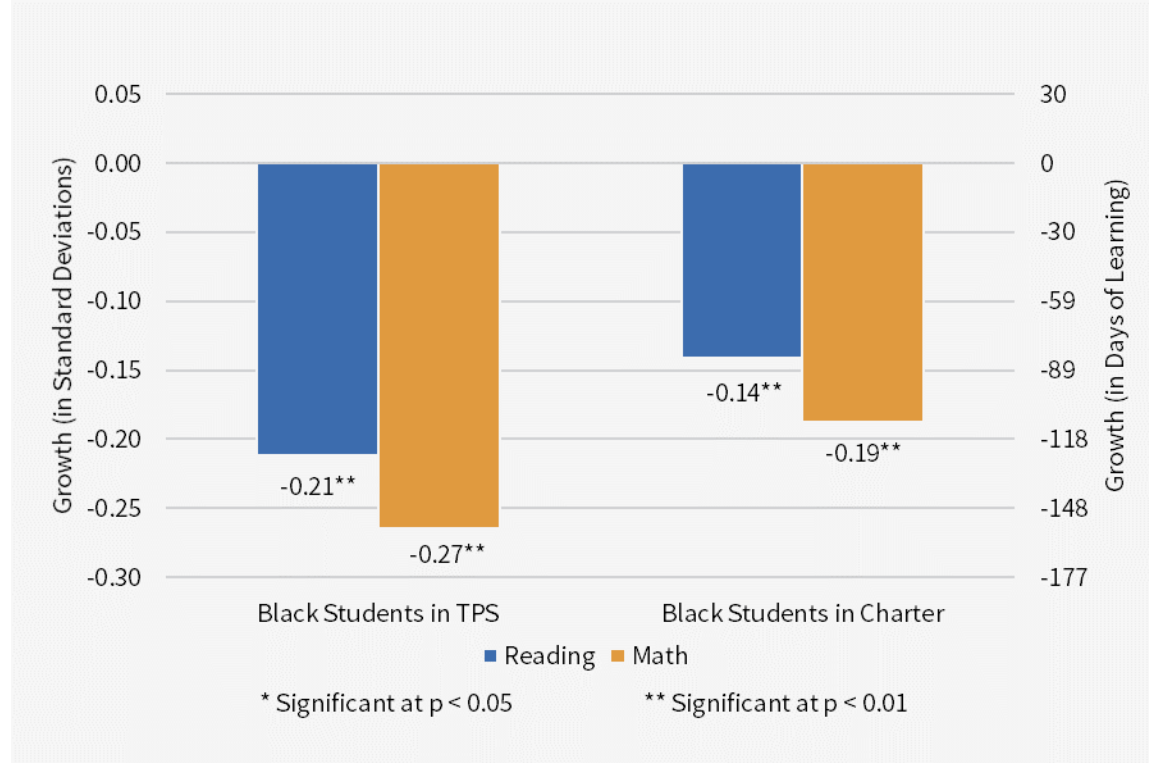
For the present study, the differences between the Black students in TPS and the Black students in charter schools is the salient comparison. The performance of Black students in TPS is used as the benchmark and set to 0.00; the performance of Black students in charter schools is indexed against that. Figure 7a shows the learning gains of Black students enrolled in charter schools compared to those of Black students enrolled in TPS. Black students in charter schools post stronger academic gains in both reading and math compared to their Black TPS peers. The stronger growth is about the equivalent of 41 additional days of learning in reading and about 47 additional days of learning in math.

*Figure 7a: Relative Learning Gains for Black Students Benchmarked against Their Black TPS Peers*
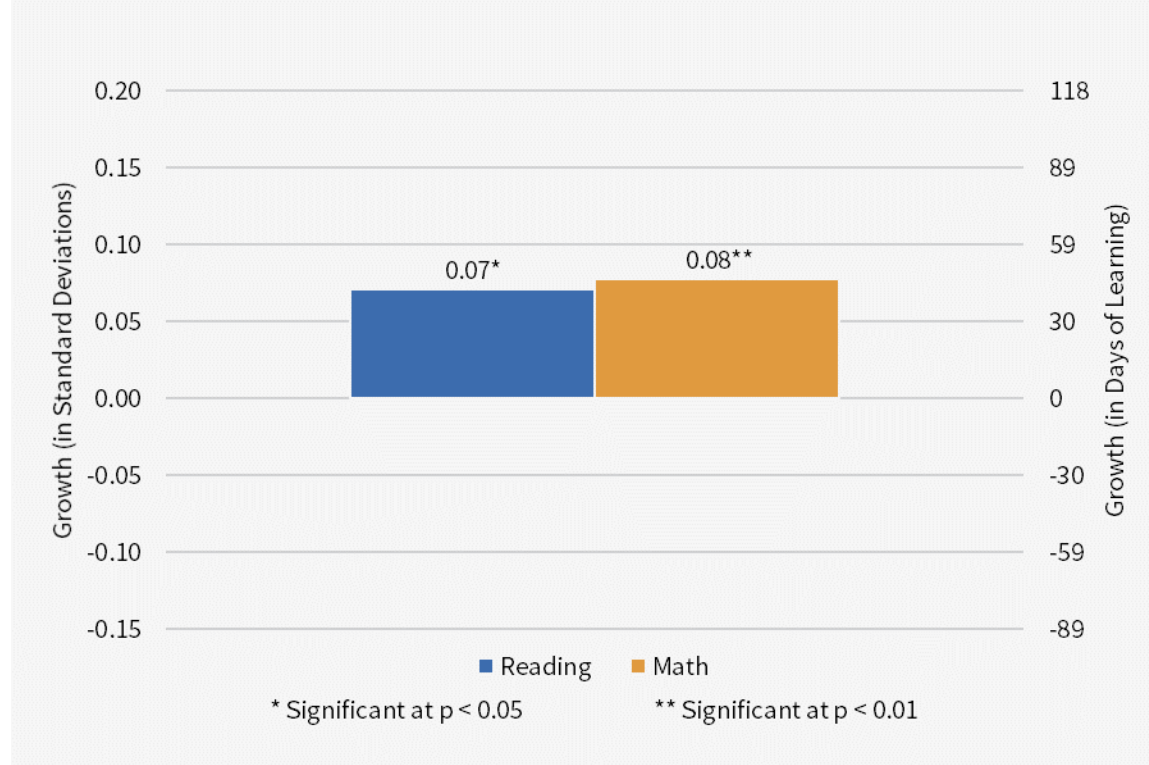
An equivalent analysis for Hispanic students is presented in Figures 8 and 8a. Hispanic students account for six percent of charter school students in Maryland. Figure 8 illustrates the difference in learning gains of Hispanic students in TPS and Hispanic students in charter schools compared to the learning gains of White students in TPS. Hispanic students in TPS exhibit weaker growth relative to the average White student attending TPS, in both subjects. This difference in growth is about 71 fewer days of learning in reading and about 94 fewer days of learning in math. Hispanic students in charter schools experience similar gains in reading and weaker gains in math compared to the average White TPS student. The weaker gains in math for Hispanic charter students translate to about 53 fewer days of learning.

*Figure 8: Learning Gains of Hispanic Students in TPS and Charter Benchmarked against Learning Gains of White TPS Students*
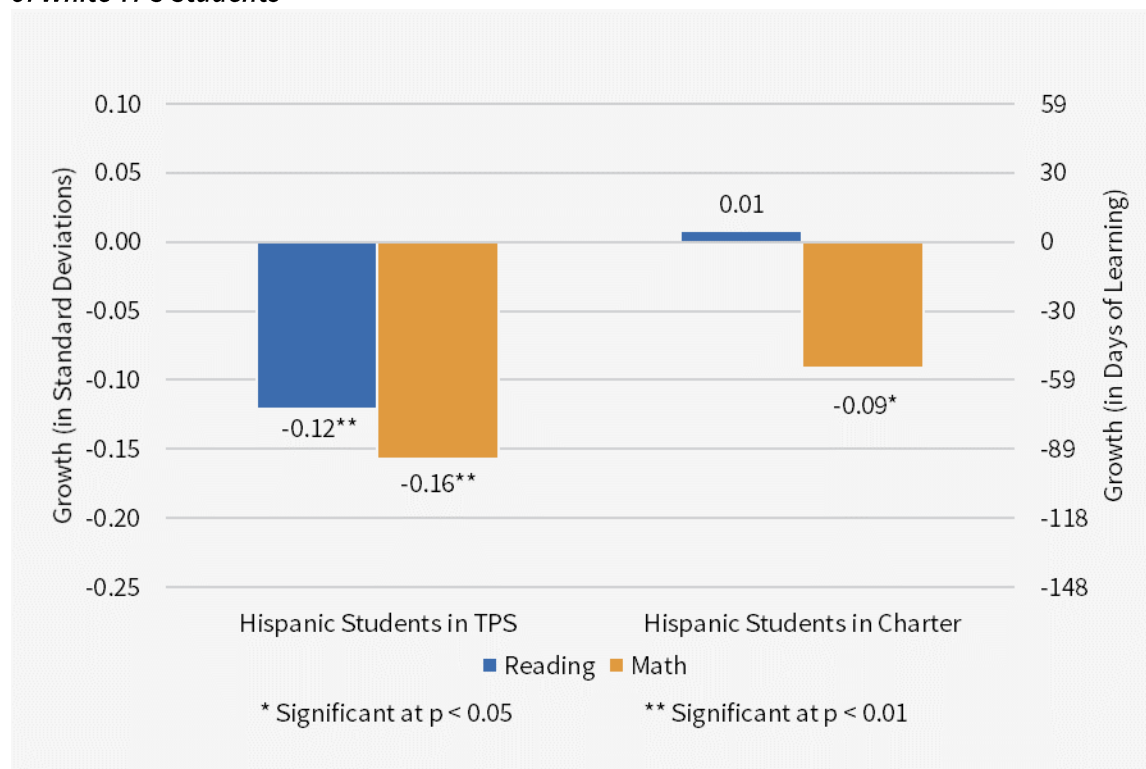


Figure 8a displays the differences in learning gains between Hispanic students in charter schools and Hispanic students attending TPS. In both subjects, Hispanic students enrolled in Maryland charter schools exhibit significantly stronger growth compared to their Hispanic peers attending TPS. In reading, the stronger growth can be realized as 77 additional days of learning. In math, the stronger learning gains are about the equivalent of 41 additional days of learning.

*Figure 8a: Relative Learning Gains for Hispanic Charter School Students Benchmarked against Their Hispanic TPS Peers.*
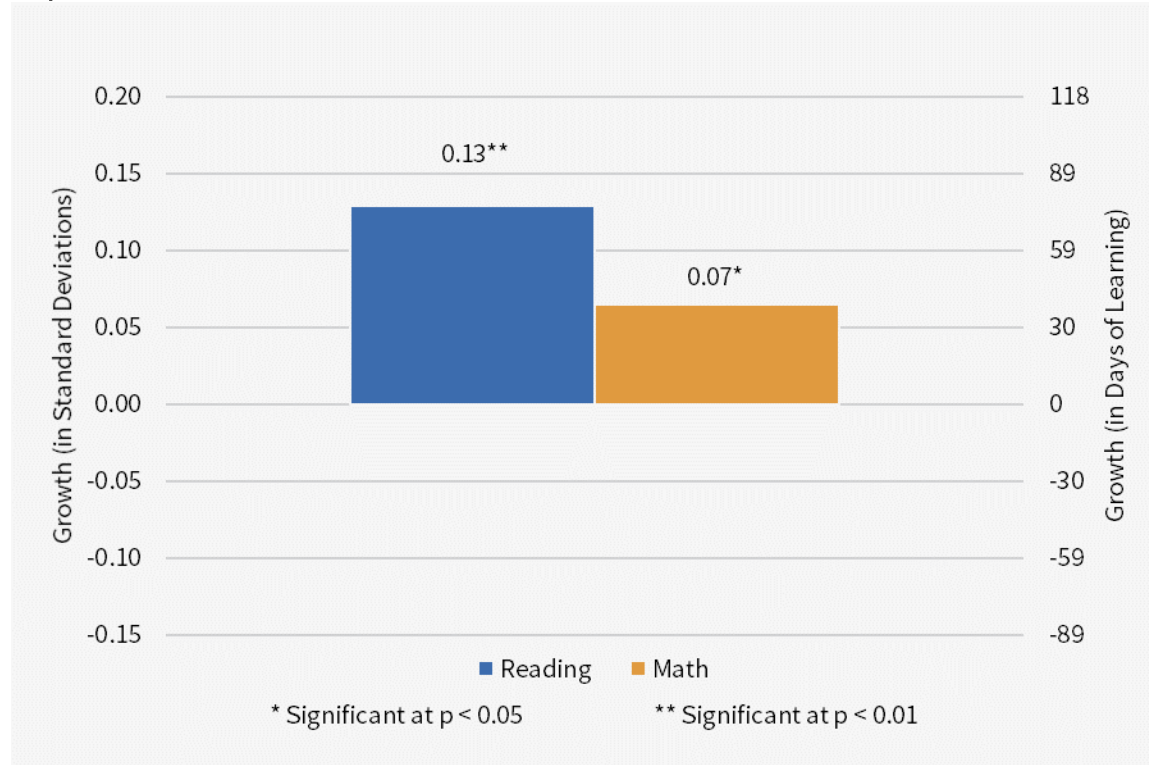


To summarize the race/ethnicity analyses, Black students in both TPS and charter schools experience weaker learning gains compared to white students in TPS in reading and math. When we compare the progress of Black students across sectors, Black charter students post stronger growth in both subjects compared to their Black peers in TPS. Hispanic TPS students post weaker gains in both subjects compared to the average White TPS student. Hispanic students in charter schools have similar reading growth and weaker math growth compared to White students attending TPS. When comparing the outcomes of Hispanic students by sector, Hispanic students enrolled in charter schools have stronger growth in both reading and math compared to Hispanic students in TPS. These results indicate that charter school enrollment yields significant advantages for both Black students and Hispanic students.

## Charter School Impact for Students in Poverty

Many charter school operators expressly aim to improve educational outcomes for traditionally underserved students, especially for students in poverty. In Maryland, 56 percent of charter school students are eligible for subsidized school meals, a proxy for low income households.

Figure 9 presents the annual academic growth for students in poverty. It is important to note that in this graph, the baseline differs from the race/ethnicity graphs presented earlier: it is a TPS student who does not live in poverty. This leaves a picture of the difference in the impact of charter attendance on students in poverty compared to similar students in TPS who are not in poverty. The set of bars on the left side of Figure 9 (-0.08 for reading and -0.06 for math) represent a TPS student in poverty. The set of bars on the right side of Figure 9 (-0.04 for reading and 0.00 for math) represent the impact of being a

student in poverty and attending a charter school.[11] Both are compared to TPS students who are not in poverty, represented by the .00 line.

*Figure 9: Overall Learning Gains for TPS and Charter Students in Poverty Compared to TPS Students Not in Poverty*
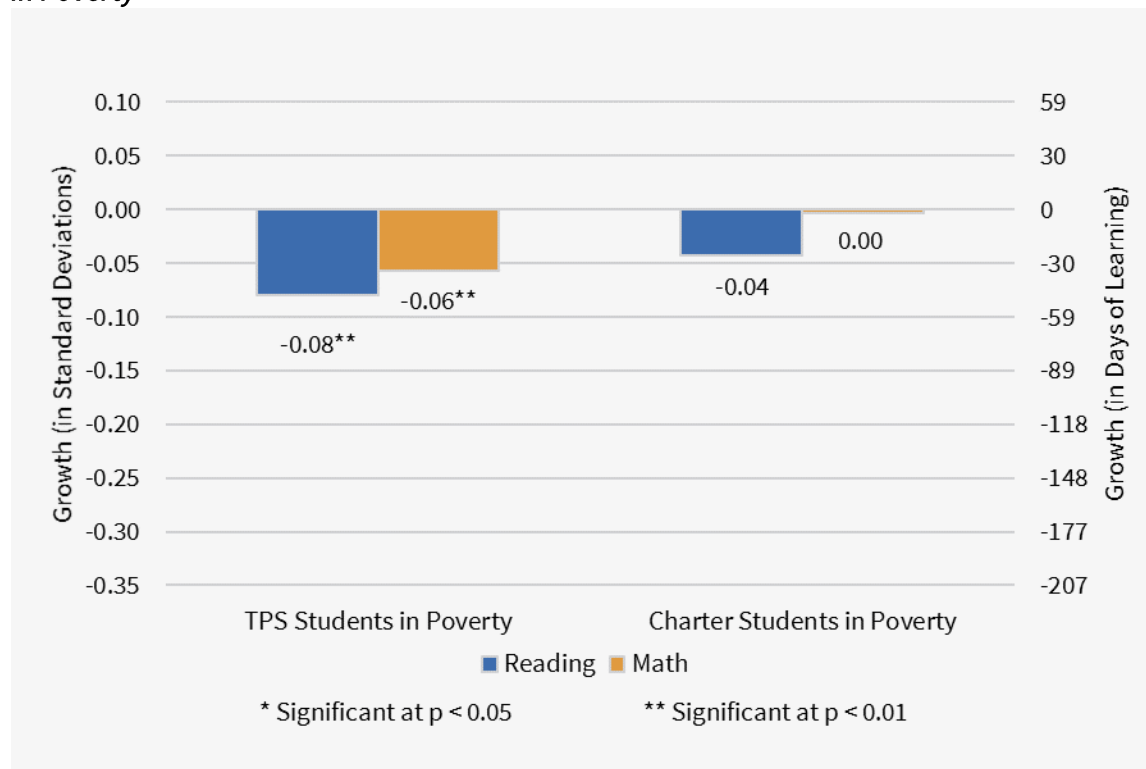


The results in Figure 9 suggest that students in poverty attending TPS significantly underperform TPS students not in poverty in both reading and math. The underperformance of TPS students in poverty compared to TPS students not in poverty translates into about 47 fewer days of learning in reading and 35 fewer days of learning in math. Charter school students in poverty do not perform differently in either reading or math compared to TPS students not in poverty. These results suggest that the learning gaps for TPS students based on socioeconomic status have persisted. However, learning gaps for charter students on the basis of socioeconomic status have diminished.

Figure 9a compares the growth of charter students in poverty versus their TPS peers. Charter school students in poverty perform similarly to their peers in reading and outperform their peers in math by about 30 days of learning.

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[11] The learning gains for a charter student in poverty include both the gains associated with charter attendance and the gains associated with being in poverty.

*Figure 9a: Relative Learning Gains for Charter School Students in Poverty Benchmarked against Their TPS Peers in Poverty*
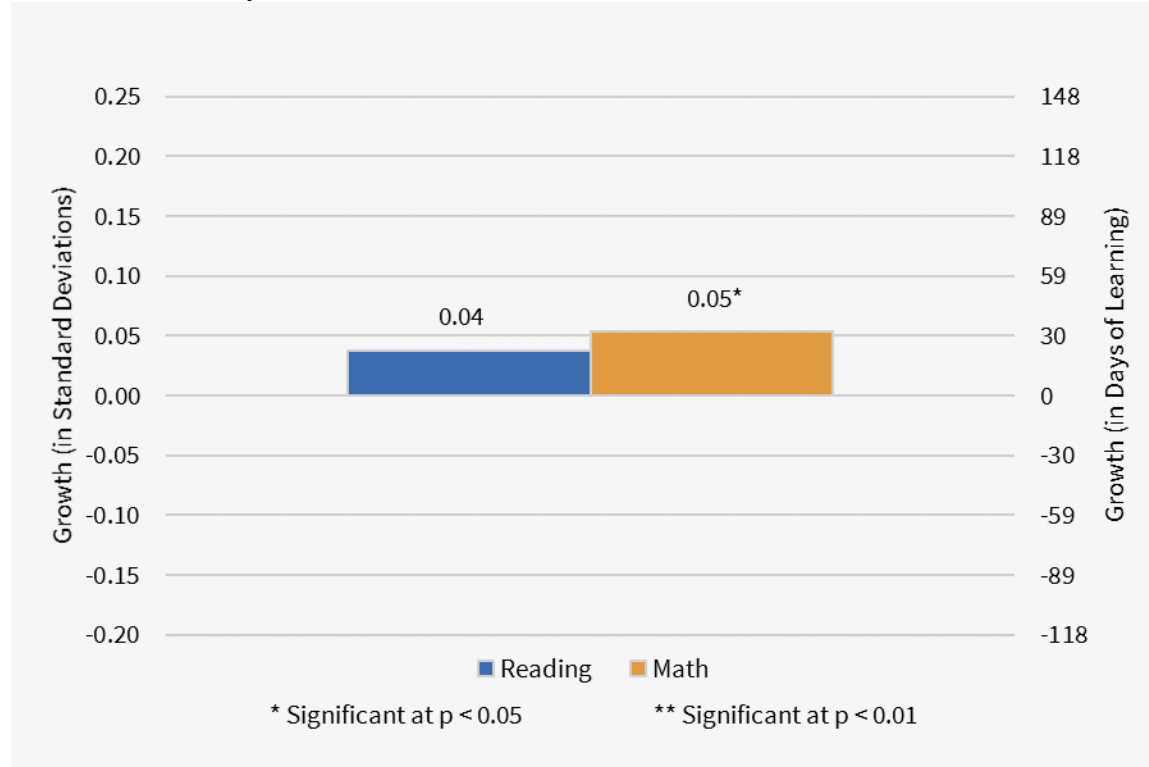


## Charter School Impact for Students in Poverty by Race/Ethnicity

In public education, some of the most academically challenged students are those who are both living in poverty and are also members of historically-underserved racial or ethnic minorities. These students represent a large subgroup, and their progress has been a long time focus of attention. To examine the extent to Maryland is addressing these gaps, we further disaggregate the charter school impact on students in poverty by different race/ethnicity groups.

Figures 10 and 10a show the learning gains of Black charter students living in poverty, benchmarked first against White students not in poverty and then against Black TPS students living in poverty. Figures 11 and 11a show the academic progress of Hispanic students living in poverty using the same comparisons.

*Figure 10: Learning Gains of Black TPS and Charter Students in Poverty Compared to Learning Gains of White TPS students Not in Poverty*
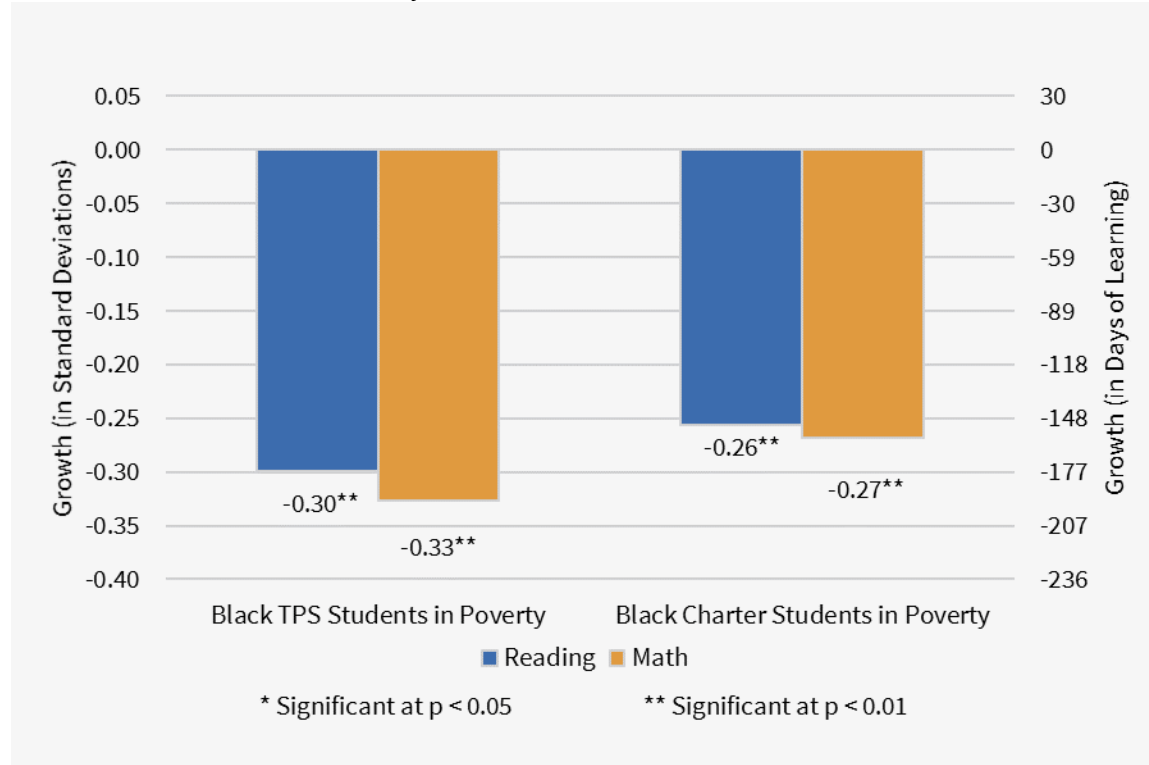


Figure 10 compares Black students living in poverty, enrolled in TPS or charter schools, with the average White TPS student who is not in poverty. The results show that Black students living in poverty, regardless of TPS or charter attendance, make less academic progress annually compared to white TPS students not living in poverty. Black TPS students in poverty experience about the equivalent of 177 fewer days of learning in reading and about 195 fewer days of learning in math than white non-poverty TPS students. The magnitude of these results is notable. These students show the aggravated negative effect of the dual disadvantage status of these students.

When comparing Black students in poverty attending charter schools to Black students in poverty attending TPS, there is no significant difference in learning gains for either reading or math. The results for this comparison are presented in Figure 10a.

*Figure 10a: Relative Learning Gains for Black Charter School Students in Poverty Benchmarked against Their Black TPS Peers in Poverty*
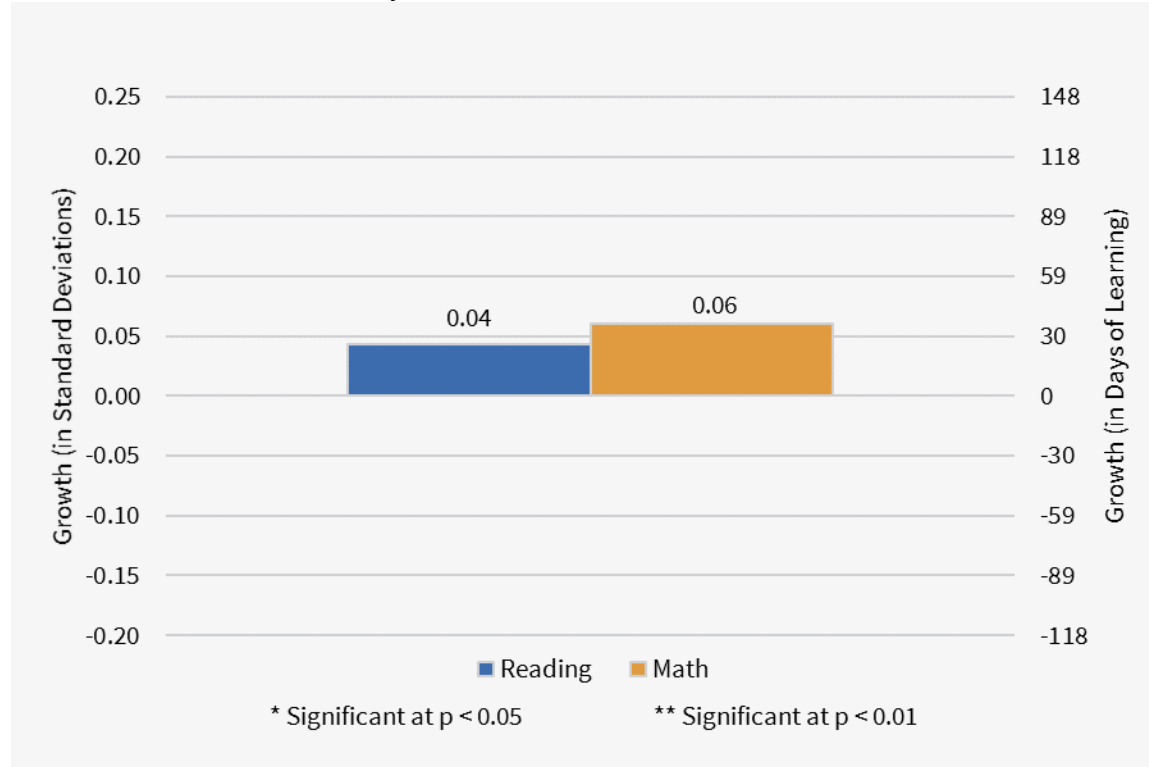
As shown in Figure 11, Hispanic students in poverty attending TPS have significantly weaker growth in both reading and math compared to White non-poverty students in TPS. The weaker growth can be realized as 112 fewer days of learning in reading and 142 fewer days of learning in math. Hispanic charter school students in poverty exhibit similar reading growth and weaker math growth, equivalent to 94 fewer days of learning compared to White TPS students not in poverty.

*Figure 11: Learning Gains of Hispanic TPS and Charter Students in Poverty Compared to Learning Gains of White TPS Students Not in Poverty*
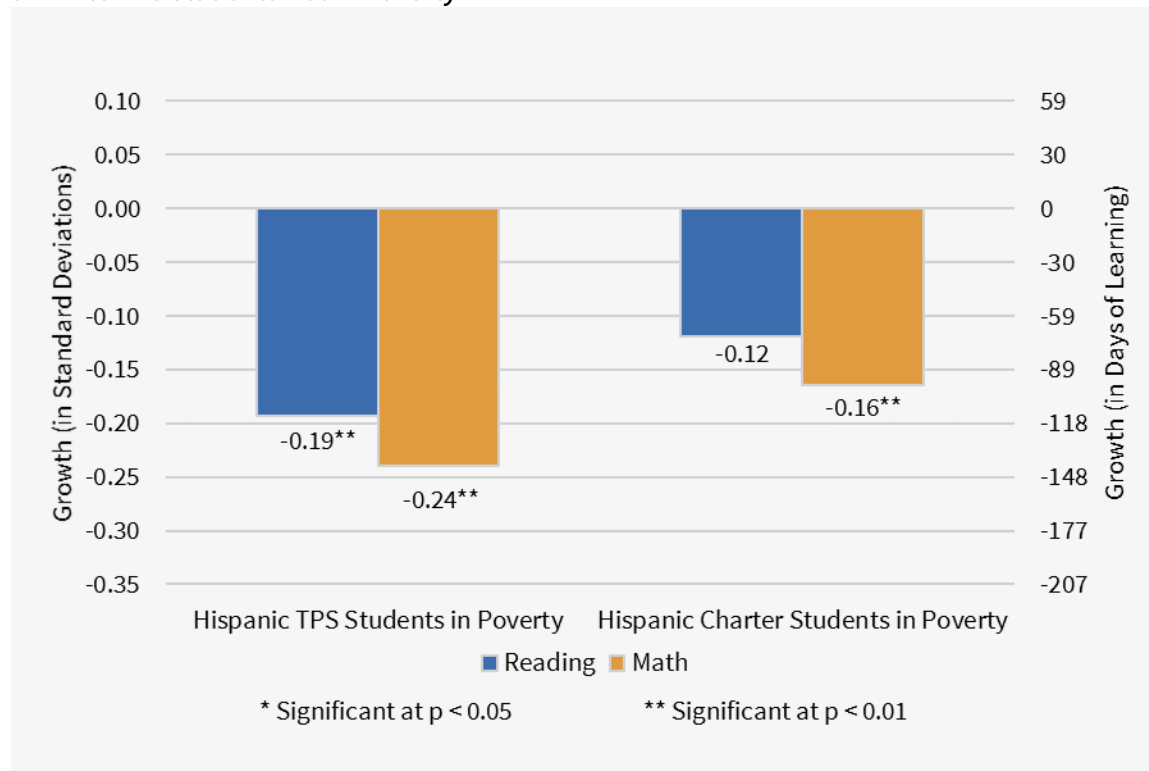


In Figure 11a, we find that Hispanic charter students living in poverty make similar reading gains relative to their Hispanic TPS peers in poverty. In math, Hispanic charter students living in poverty experience about the equivalent of 47 additional days of learning compared to the Hispanic TPS peers in poverty.

*Figure 11a: Relative Learning Gains for Hispanic Charter School Students in Poverty Benchmarked against Their Hispanic TPS Peers in Poverty*
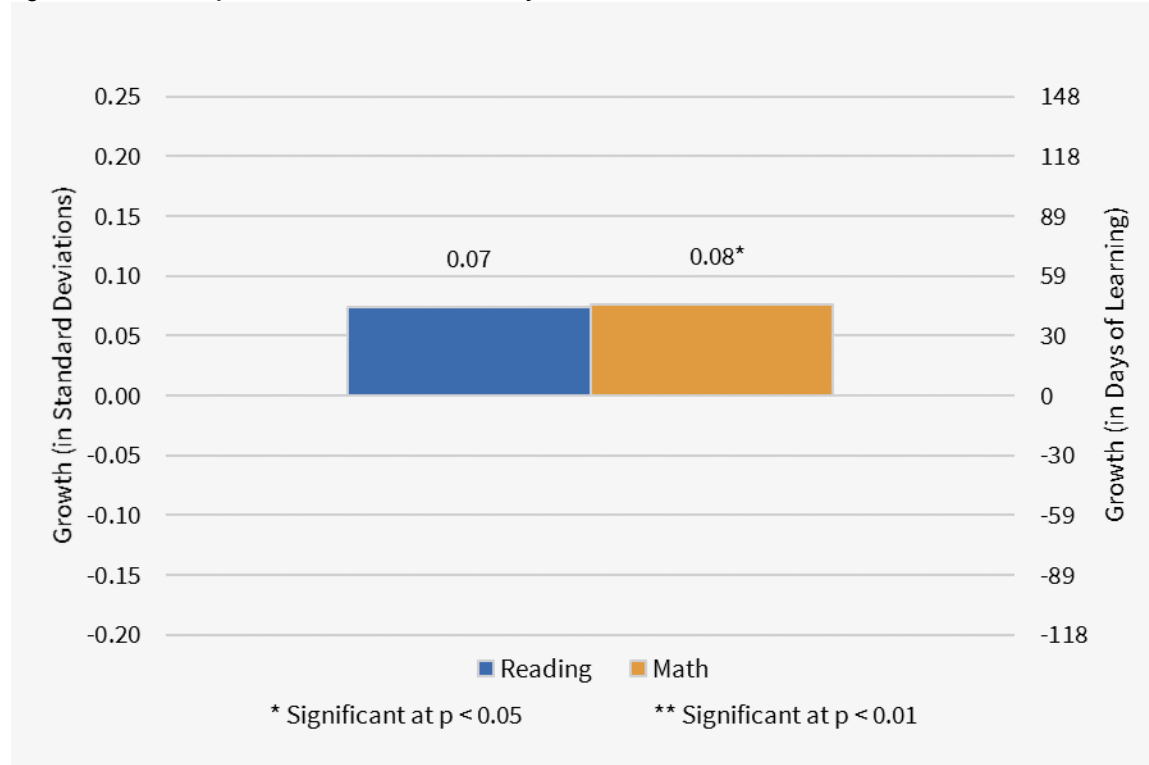


To summarize the findings illustrated in Figures 10 through 11a, we find that Black students in poverty, regardless of whether they attend TPS or charter schools, experience weaker reading and math learning gains compared to White TPS students not living in poverty. Black charter students in poverty do not differ significantly in their learning gains from Black TPS students in poverty. Hispanic TPS students in poverty exhibit weaker learning gains in both reading and math compared to White TPS students not in poverty. Hispanic charter students in poverty show similar reading gains and weaker math gains compared to White non-poverty students in TPS. When comparing Hispanic charter students in poverty to their similar peers in TPS, we find that they experience similar learning gains in reading and stronger learning gains in math.

## Charter School Impact for Special Education Students

Because of the differences in individual needs, comparing the outcomes of special education students is difficult, regardless of where they enroll. In the ideal world, we would only compare students with the same Individual Education Program (IEP) designation, matching for IEP designation along with the rest of the matching variables. That approach surfaces real challenges because of the large number of designations. The finer distinction leads to very small numbers of matches between charter schools and their feeder schools, which hinders the analysis. To obtain any estimates of charter school impacts for students with special education needs, it is necessary to aggregate across all IEP categories. It is important to consider this when viewing the results in Figure 12 and Figure 12a.

*Figure 12: Overall Learning Gains for TPS and Charter Students in Special Education Compared to TPS Students Not in Special Education*
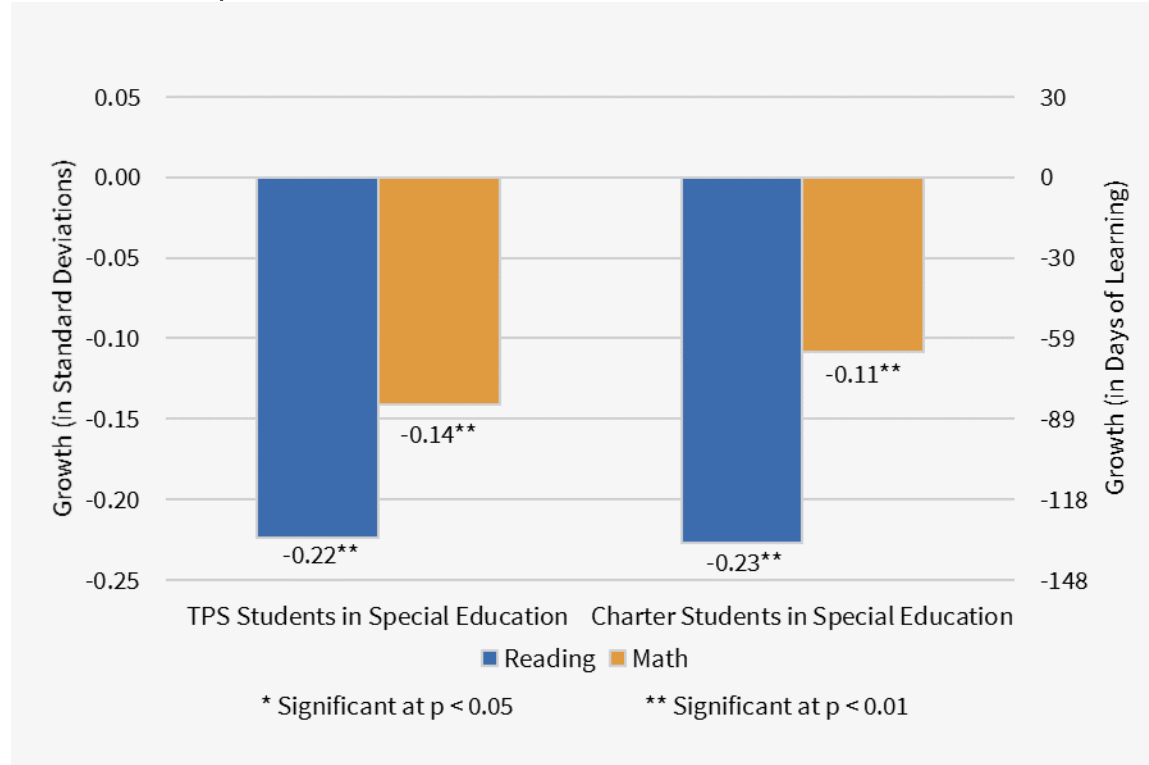


In Figure 12, the baseline for comparison is the TPS student who is not receiving special education services. In Maryland, students receiving special education services have significantly weaker academic growth than students in TPS who do not receive special education services. TPS students in special education programs experience about 130 fewer days of learning in reading and 83 fewer days of learning in math compared to TPS students not in special education. In charter schools, students in special education experience 136 fewer days of learning in reading and 65 fewer days of learning in math.

Figure 12a illustrates the difference in learning gains between students in special education attending charter schools and students in special education attending TPS. The figure shows that the learning gains of special education students in charter schools does not differ from the learning gains of special education students in TPS.

*Figure 12a: Relative Learning Gains for Charter Students in Special Education Benchmarked against Their TPS Peers in Special Education*
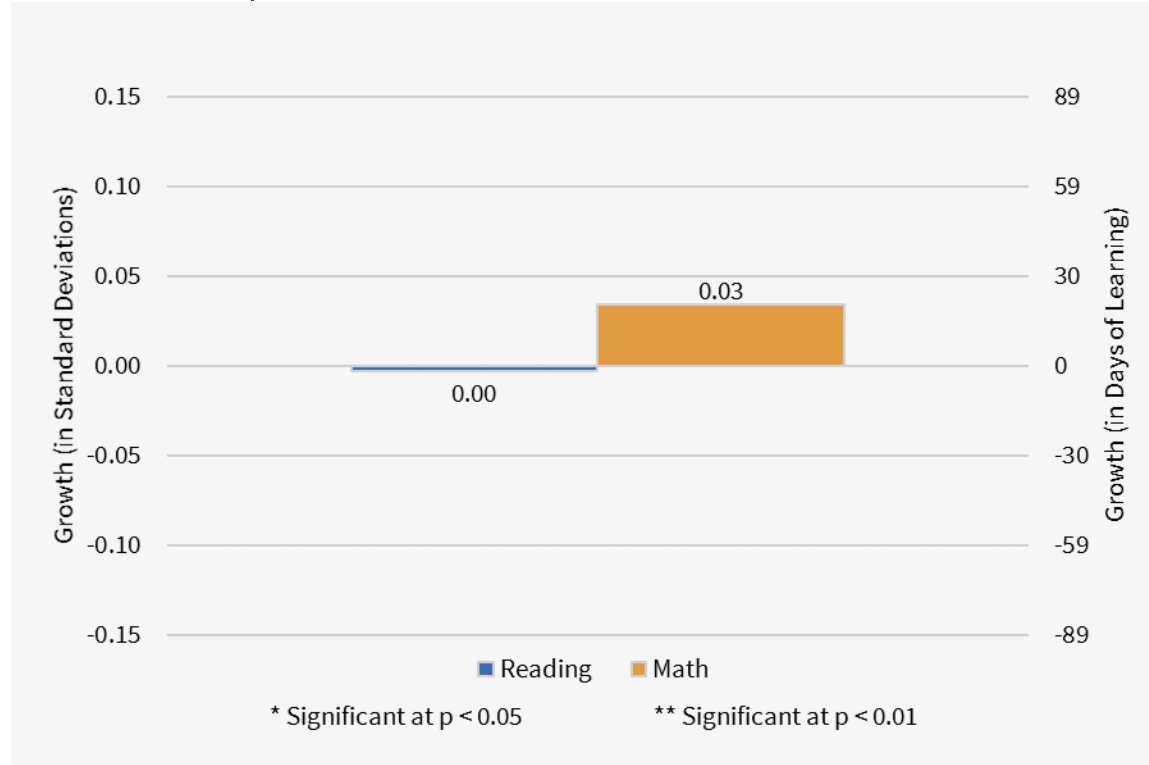


## Charter School Impact for English Language Learners

There is a growing population of students enrolled in the public school system with a primary language other than English. The 2017 National Assessment of Education Progress (NAEP) documented the performance gap between English language learners (ELL) and their English proficient peers, with ELL students having weaker performance.[12] Even though the share of charter school students with ELL designation in Maryland is only two percent, demographic trends in the country point to the likelihood of Maryland schools serving a larger share of ELL students over time. The analyses in Figure 13 and Figure 13a can provide important baselines for comparisons over time.

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[12] "National Student Group Scores and Score Gaps," NAEP Mathematics Report Card, https://www.nationsreportcard.gov/math_2017/nation/gaps/?grade=4#?grade=4

*Figure 13: Learning Gains for TPS and Charter Students with ELL Designation Compared to Non-ELL TPS Students*
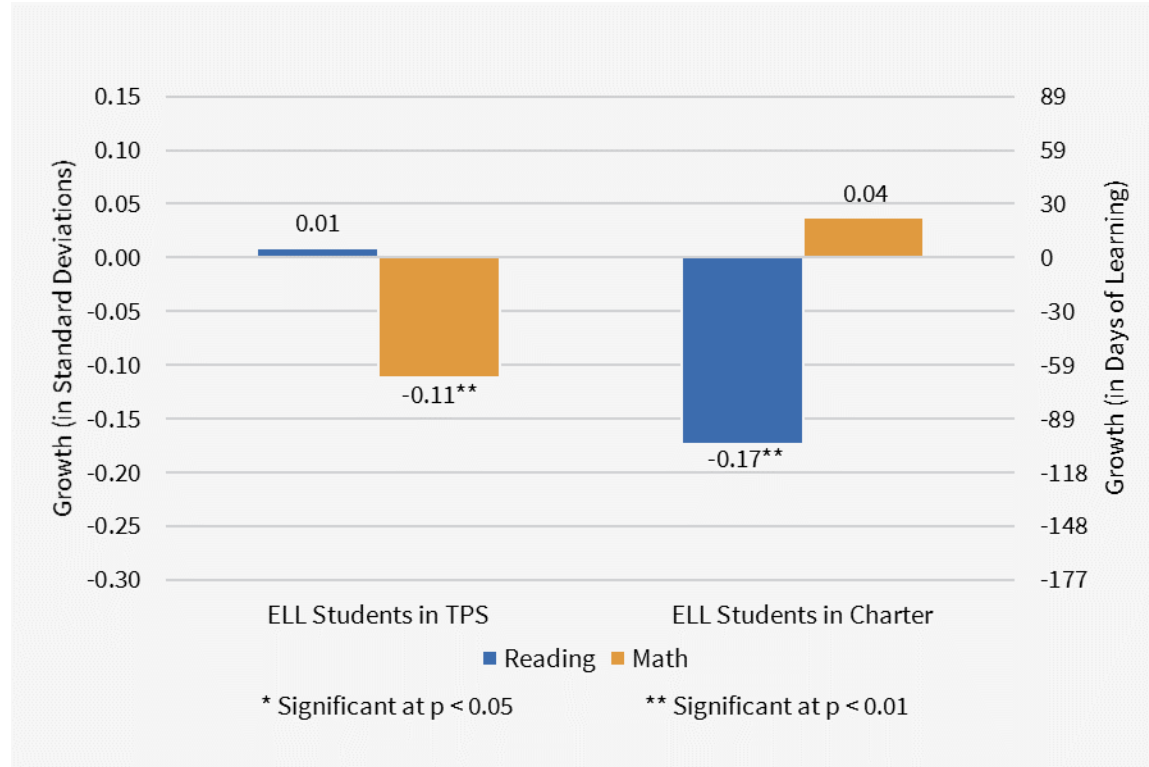


Figure 13 compares ELL TPS and charter students to TPS students who are English proficient. English language learners in TPS exhibit similar gains in reading and weaker gains in math compared to non-ELL TPS students. The weaker math gains are the equivalent of about 65 fewer days of learning. In charter schools, ELL students experience weaker reading growth and similar math growth compared to non-ELL TPS students. The weaker reading growth for ELL students in charter schools is about 100 fewer days of learning.

Figure 13a shows the difference in academic growth of ELL charter students and ELL TPS students. The findings reveal charter ELL students show no significant difference in reading growth and stronger math growth, about 89 additional days of learning, compared to ELL students in TPS.[13]

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[13] It is important to note that although the absolute value of the magnitude in results comparing charter ELL students to TPS ELL students is large; it is not significant. This is most likely due to the small number matched ELL charter school students (69 observations) in reading.

*Figure 13a: Relative Learning Gains for Charter School Students with ELL Designation Benchmarked against Their TPS Peers with ELL Designation*
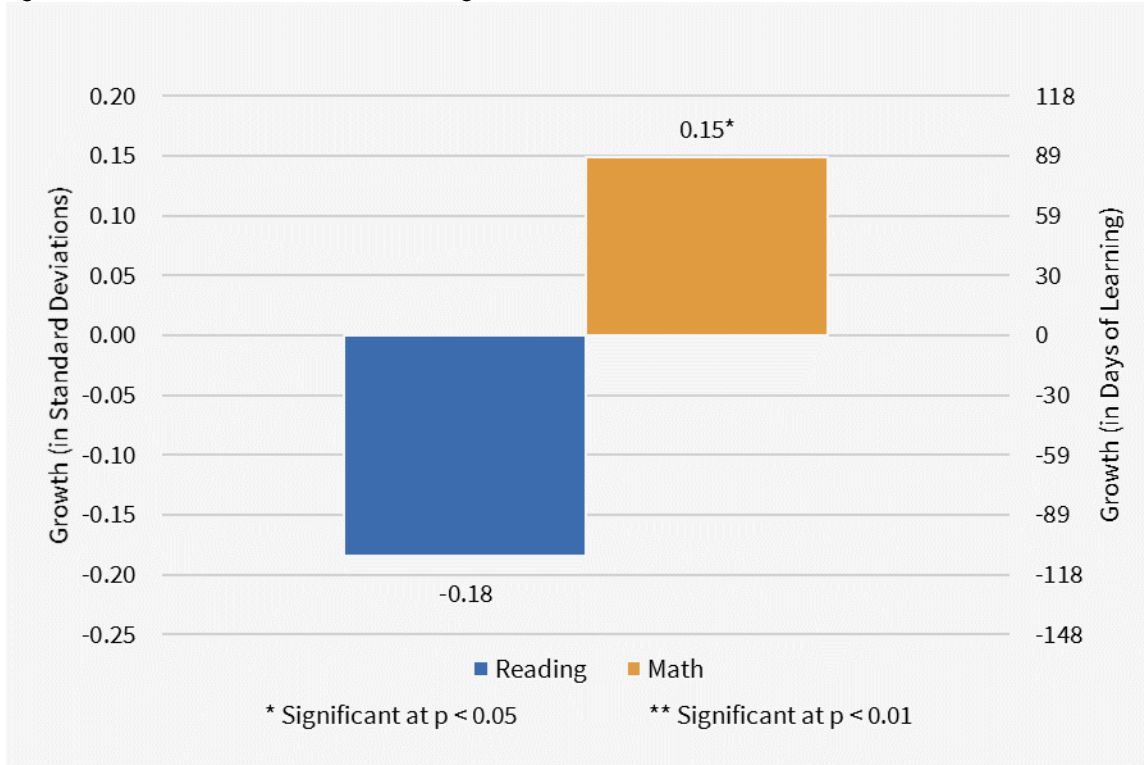


Table 3 summarizes the effect that charter schools have on student group populations. The coefficients represent the growth of each group relative to their counterpart group in TPS.

**Table 3: Charter School Impact on Student Subgroup Performance**

| Student Group | Charter School Effect on Student Groups Benchmarked against their TPS Peers | |
|---|---|---|
| | Reading | Math |
| Overall Charter School Effect | 0.05* | 0.06* |
| Charter School Students in Poverty | 0.04 | 0.05* |
| Black Charter Students | 0.07* | 0.08** |
| Black Charter Students in Poverty | 0.04 | 0.06 |
| Hispanic Charter Students | 0.13** | 0.07* |
| Hispanic Charter Students in Poverty | 0.07 | 0.08* |
| Special Education Charter Students | 0.00 | 0.03 |
| English Language Learner Charter Students | -0.18 | 0.15* |

* Significant at the 0.05 level, ** Significant at the 0.01 level

## Charter School Impact by Students' Years of Enrollment

Students' academic growth may differ depending on how many years they enroll in a charter school. To test the relationship between progress and the length of enrollment in a charter school, we group test scores from students in the first year of charter enrollment, scores from students in the second year of charter enrollment, and scores of students in the third year in a charter school. In this scenario, the analysis is limited to the charter students who enroll for the first time in a charter school between the 2014-15 and 2016-17 school years and their TPS VCRs. Although this approach reduces the number of students included, it ensures an accurate measure of the effect of continued enrollment over time. The results for this subset of the full study sample should not be directly compared with other findings in this report. Figure 14 shows these results.

*Figure 14: Learning Gains of Charter Students Compared to Gains for Average TPS VCRs by Students' Years of Enrollment in Charter Schools*
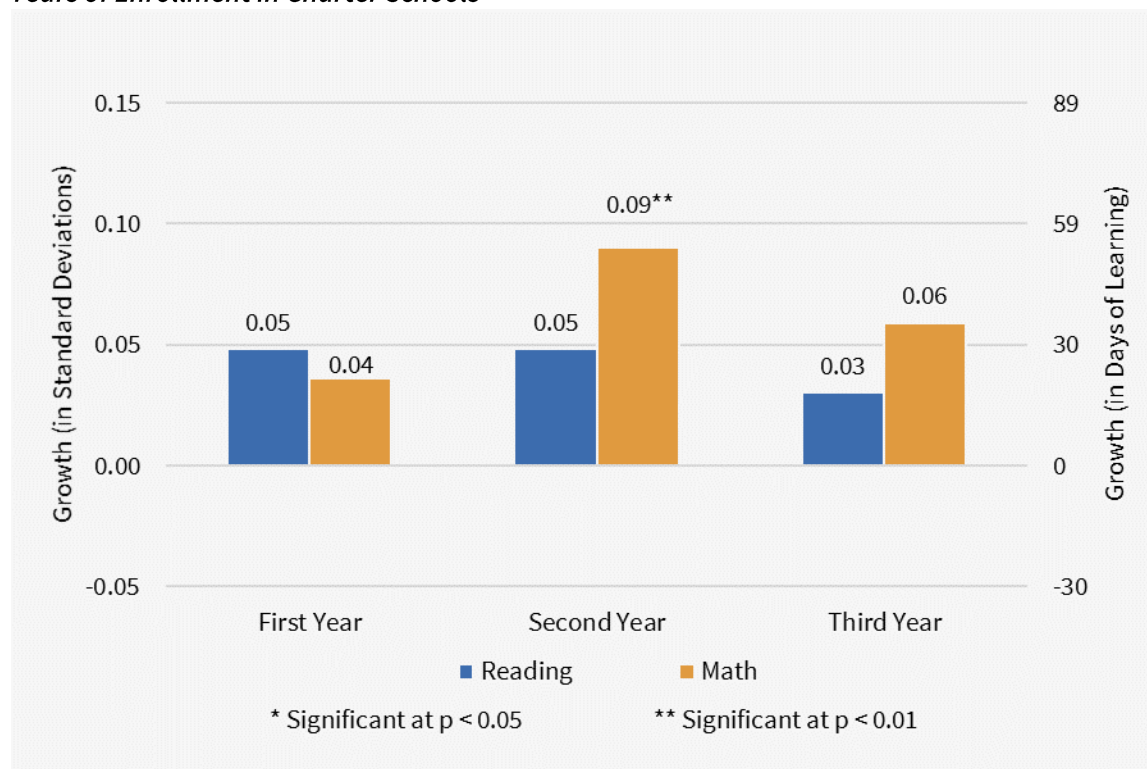


Our analysis reveals that Maryland students in their first year of charter enrollment do not differ significantly in academic growth from their TPS peers in either reading or math. In students' second year of attending a charter school, their reading gains do not differ significantly from that of their peers in TPS. However, students in their second year of charter attendance experience the equivalent of about 53 additional days of learning in math compared to the TPS counterparts. In the third year of charter attendance, we see no significant difference in academic growth in either reading or math compared to their peers in TPS.

## 7. School-level Analysis

The numbers reported in the previous sections represent the typical learning gains at the student level across the state; they reveal what would be the likely result if a typical student were enrolled in any of the Maryland charter schools. The prior results do not let us discern whether some charter schools are responsible for larger academic gains than others. Since school-level results are of interest to policymakers, parents, and the general public, we aggregate charter student performance to the school level for each charter school in the state. This view is necessarily limited to charter schools with sufficient numbers of tested students to make a reliable inference about performance.

### Comparative School-Level Quality

It is important to understand the counterfactual used in this section. As shown in Table 1 earlier in the report, the student populations within the typical charter school and their feeder schools differ, making whole-school to whole-school comparisons unhelpful. Here instead, we pool each school's VCRs to simulate the "apples to apples" TPS to serve as the control condition for testing the performance of charter schools. This simulated TPS reflects a precise estimate of the alternative local option for the students actually enrolled in each charter school.

To determine the range of charter school performance, we estimate the annual learning impact of each Maryland charter school over the two most recent growth periods (2015-2016 and 2016-2017).[14] The estimated learning impact for each charter school can be positive (statistically different from zero with a positive sign), negative (statistically different from zero with a negative sign), or zero. We use this estimate to infer how the academic quality of a charter school compares to the quality of traditional public schools which students in that charter school would have potentially attended if they had not attended a charter school.

A statistically positive learning impact for a charter school suggests the charter school has stronger learning growth than the alternative TPS options for its students. A statistically negative learning impact for a charter school implies the school makes less progress than the traditional schools its students would have attended. A zero learning impact means that the charter school and the TPS alternatives for its students have similar performance.

Our total sample consists of 44 schools with reading scores and 43 schools with math scores in the 2015-2016 and 2016-2017 growth periods. [15] Table 4 below shows the breakout of the performance for the included Maryland charter schools.

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[14] We chose to include only the two most recent growth periods in this analysis in consideration of the dynamic growth within some charter schools and to provide the most contemporary picture of performance possible.
[15] As noted in Table 1, charter schools are smaller on average than their corresponding feeder schools. Furthermore, some charter schools elect to open with a single grade and mature one grade at a time. Consequently, care is needed when making school-level comparisons to ensure that the number of tested students in a school is sufficient to provide a fair representation of the school's impact. Our criterion for inclusion is at least 60 matched charter student records over the two growth periods or at least 30 matched charter records for schools with only one growth period.

**Table 4: Performance of Charter Schools Compared to TPS Alternatives in Maryland**

| Subject | Significantly Worse | | Not Significantly Different | | Significantly Better | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| Reading | 7 | 16% | 19 | 43% | 18 | 41% |
| Math | 6 | 14% | 19 | 44% | 18 | 42% |

Table 4 shows the performance of charter schools in Maryland relative to traditional public schooling options in reading and math, respectively. In reading, 18 out of 44 Maryland charter schools, or 41%, perform significantly better than the traditional schooling environments the charter students would have otherwise attended. In math, 42 percent of charter schools perform significantly better than TPS alternatives. The results for both reading and math are superior to the national average in our 2013 national study, where 25 percent of charter schools outperform the traditional schooling alternatives in reading and 29 percent do so in math.[16]

At the other end of the distribution, seven of 44 Maryland charter schools, or 16 percent, have reading performance that is significantly weaker than the traditional public schooling option as compared to the national figure of 19 percent. In math, six out of 43, or 14 percent, post growth results weaker than the traditional public schooling option compared to the 2013 national figure of 31 percent.

In reading, 43 percent of Maryland charter schools have results that do not differ significantly from TPS options in their communities. In math, 44 percent of charter schools have growth performance that is indistinguishable from the TPS alternatives. It is important to emphasize that "no difference in growth" does not reflect the actual level of growth, as it is possible for charter schools to have high levels of growth that are similar to that of the traditional schooling alternative, and the reverse is also true.

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[16] Cremata et al., National Charter School Study 2013.

## Growth and Achievement

While the impacts of charter schools on academic growth relative to their local competitors are informative, we are also interested in how well students perform in absolute terms. Since many of the students served by charter schools start at low levels of achievement, the combination of absolute achievement and relative growth is vital to understanding student success overall.

For each school, the tested achievement of their students over the same two periods covered by the academic growth analysis (2015-2016 and 2016-2017) is averaged and transformed to a percentile within the statewide distribution of achievement.[17] The 50th percentile indicates statewide average performance for all public school students (traditional and charter). A school achievement level above the 50th percentile indicates that the school's overall achievement exceeds the statewide average. We use standard deviations discussed above to measure growth. We display each school's achievement and growth in a two-dimensional plot, displayed in Tables 5 and 6.

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[17] Average achievement was computed using students' z-scores from the end of the growth period (e.g., spring 2016 and spring 2017). The resulting school-level mean was then converted into a percentile.

**Table 5: School-Level Reading Growth and Achievement in Maryland Charter Schools**

| | Low Growth, High Achievement | | High Growth, High Achievement | | |
|---|---|---|---|---|---|
| | *-0.15* | *0* | *0.15* | | |
| | 0.0% | 0.0% | 0.0% | 4.5% | |
| | | 4.5% | | 15.8% | *70th Percentile* |
| | 0.0% | 4.5% | 6.8% | 4.5% | |
| | | | | | *50th Percentile* |
| | 4.5% | 18.2% | 15.9% | 13.6% | |
| | | 36.3% | | 43.2% | *30th Percentile* |
| | 0.0% | 13.6% | 11.4% | 2.3% | |

*Achievement* (vertical axis label)

*Growth (in Standard Deviations)*

Low Growth, Low Achievement

High Growth, Low Achievement
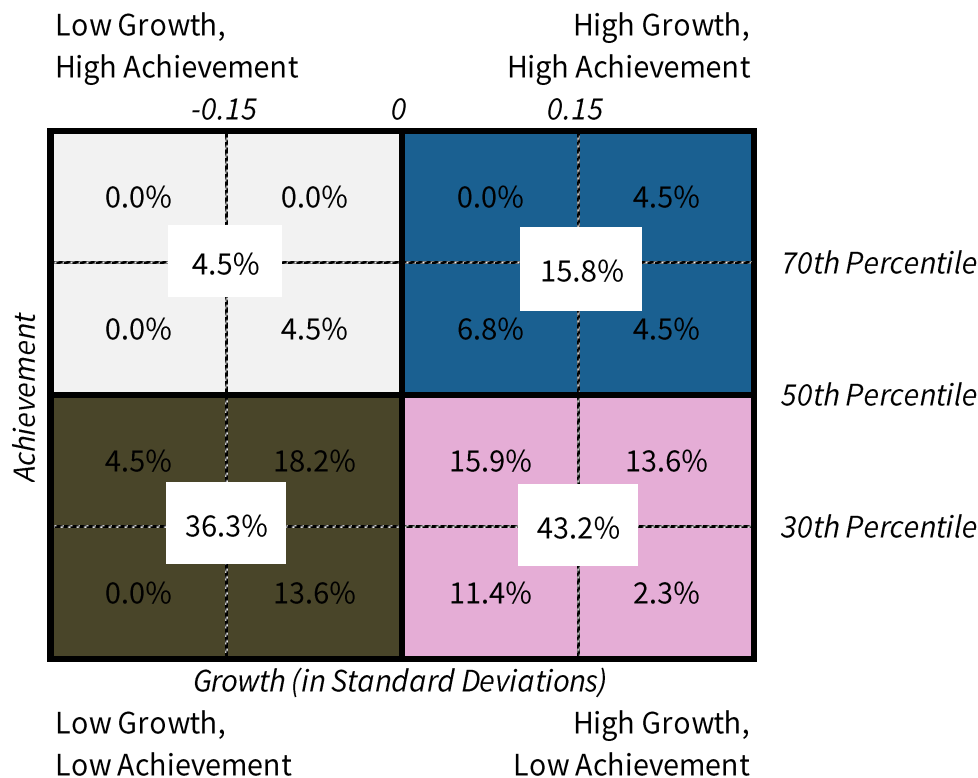
Table 5 presents the reading achievement and growth results for the Maryland charter schools included in this analysis. In the table, 26 of the 44 Maryland charter schools (59 percent) have positive average growth compared to their peer schools. (This percentage is the sum of the eight squares in the blue and pink quadrants in the right half of the table). Sixteen percent of charters have positive growth and average achievement above the 50th percentile of the state (i.e., the total for the blue quadrant on the top right). A total of 43 percent of charter schools in the pink box (bottom right) post above-average growth but remain below the state average in absolute achievement. Over time, if the 43 percent of charter schools in the pink box maintain or improve their average growth, their achievement would increase, eventually moving them into the blue box.

Nearly 41 percent of schools post smaller learning gains than their peer TPS (the sum of gray and brown quadrants on the left half of the table). If their growth remains steady or worsens, they will fall in the overall distribution of achievement as other schools pull away. Approximately 80 percent of charters perform below the 50th percentile of achievement (the sum of the brown and pink cells in the lower portion of the table). The area of the greatest concern is the 36 percent of schools that fall into the lower left quadrant of the table. These schools are characterized by both low achievement and low growth.

**Table 6: School-Level Math Growth and Achievement in Maryland Charter Schools**

| | Low Growth, High Achievement | | High Growth, High Achievement | |
|---|---|---|---|---|
| | *-0.15* | *0* | *0.15* | |
| | 0.0% | 0.0% | 0.0% | 2.3% |
| | | 4.7% | 11.6% | | 70th Percentile |
| | 0.0% | 4.7% | 2.3% | 7.0% |
| | | | | | 50th Percentile |
| | 2.3% | 7.0% | 23.3% | 18.6% |
| | | 30.2% | 53.5% | | 30th Percentile |
| | 2.3% | 18.6% | 9.3% | 2.3% |

*Achievement* (vertical axis label)

*Growth (in Standard Deviations)*

Low Growth, Low Achievement

High Growth, Low Achievement
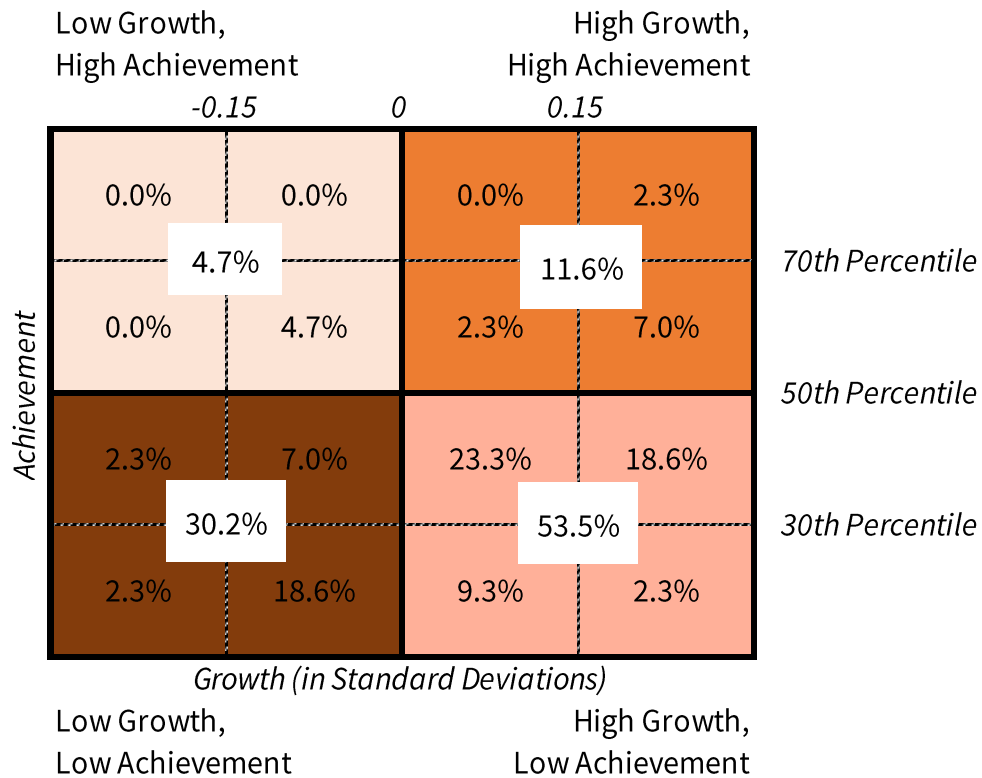
In math, 28 of the 43 Maryland charter schools (around 65 percent) have positive average growth in math, as seen in the combined orange and pink quadrants on the right half of Table 6. About 12 percent of Maryland charter school exhibit stronger than average growth, and post achievement above the 50th percentile (the orange quadrant in the upper right of the table). Almost 84 percent of charter schools in Maryland post below-average achievement (sum of the cells in the lower half of the table). As in the previous table, the schools of the greatest concern are those schools in the lower left (brown) quadrant that demonstrate both low achievement and low growth; they account for 13 schools (approximately 30 percent) of the charter schools in Maryland.

## 8. Synthesis and Conclusion

### Summary of Findings

In this study, we examine the academic progress of students in Maryland charter schools compared to the gains of identical students in the traditional public schools the students otherwise would have attended. The study employs four years of annual data ending in the 2016-2017 school year, which are used to create three year-to-year measures of progress. The year-to-year measure is referred to as growth or gains. Table 7 presents a summary of the results from the various analyses in this report.

**Table 7: Summary of Analysis Findings for Maryland Charter School Students Benchmarked Against Comparable TPS Students**

|  | Reading | Math |
|---|---|---|
| Maryland Charter Students | Positive | Positive |
| Students in Charters in 2014-2015 | Similar | Similar |
| Students in Charters in 2015-2016 | Similar | Similar |
| Students in Charters in 2016-2017 | Positive | Positive |
| Students in Urban Charter Schools | Positive | Similar |
| Students in Suburban Charter Schools | Similar | Similar |
| Students in Elementary Charter Schools | Similar | Similar |
| Students in Middle School Charter Schools | Similar | Positive |
| Students in High School Charter Schools | Similar | Negative |
| Students in Multi-level School Charter Schools | Similar | Similar |
| Black Charter School Students | Positive | Positive |
| Hispanic Charter School Students | Positive | Positive |
| Charter School Students in Poverty | Similar | Positive |
| Black Charter School Students in Poverty | Similar | Similar |
| Hispanic Charter School Students in Poverty | Similar | Positive |
| Special Education Charter School Students | Similar | Similar |
| English Language Learner Charter School Students | Similar | Positive |
| Students in First Year Enrolled in Charter School | Similar | Similar |
| Students in Second Year Enrolled in Charter School | Similar | Positive |
| Students in Third Year Enrolled in Charter School | Similar | Similar |

On average, students in Maryland charter schools experience stronger learning gains in both reading and math compared to their TPS peers. The stronger learning gains experienced by charter students are equivalent to 30 additional days of learning in reading and 35 additional days of learning in math, given a 180-day school year. Over the three growth periods, the annual gains of students in Maryland charter schools steadily increased, becoming significantly positive in the last growth period in the study.

Beyond the overall results, the analysis probed the consistency of charter school performance in Maryland over many dimensions. In our analysis of charter school impact by school locale, we are limited to reporting results for urban and suburban charter schools. Urban charter school students post

significantly stronger growth in reading and similar growth in math compared to their TPS peers. Students in suburban charter schools post growth similar to their TPS VCRs in both reading and math.

The analysis by school grade configuration shows that charter students in elementary schools or multi-level schools experience growth similar to their TPS peers in both reading and math. Charter students in middle schools post similar reading gains and stronger math gains compared to their TPS counterparts. Students attending charter high schools post similar reading growth and weaker math growth compared to their peers in TPS.

The learning gains associated with charter school attendance vary across different demographic subgroups. Stronger growth is found for both Black and Hispanic students attending charter schools in reading and math. For Black students, the stronger growth amounts to about 41 additional days of learning in reading and 47 additional days of learning in math. Hispanic students gain the equivalent of about 77 additional days of learning in reading and 41 additional days of learning in math compared to their TPS counterparts. These results show that Black and Hispanic students are better off attending charter schools than local TPS alternatives.

For students in poverty, attendance in charter schools produces similar reading gains and stronger math gains, about 30 additional days of learning. Black students in poverty attending charter schools show gains similar to their TPS counterparts in both reading and math. Hispanic charter students in poverty exhibit similar reading growth and stronger math growth, about 47 additional days of learning, compared to their virtual twins. Charter students with ELL designation perform similarly to their TPS VCRs in reading and outperform them in math. Charter students receiving special education services perform similarly to their TPS counterparts receiving special education services in both reading and math. Among these different subgroups, there is not a single result in which charter school attendance yields weaker learning gains benchmarked against comparable TPS peers. Of note in particular, is the stronger math growth for students with ELL designation.

Looking at the results at the school level, over 40 percent of Maryland charter schools outpace their local TPS peers in learning in reading and math. Still, 16 percent of charter schools have results that are significantly worse than TPS for reading and 14 percent of charter schools are underperforming in math relative to their local TPS peers.

The student-to-student and school-to-school results show charter schools to be either ahead or on a par with TPS. The complementary question of whether charter schools are helping students achieve at high levels is also important. More than 75 percent of charter schools in Maryland fall below the 50th percentile in achievement in both reading and math. These outcomes are of course influenced by locational decisions and the starting points of the students they serve. In addition, 59 percent of charter schools have positive academic growth in reading and 65 percent of charter schools have positive academic growth in math irrespective of achievement level. Some schools below the 50th percentile of achievement have positive growth in reading and math.  With positive and sustained growth, these schools will likely post higher achievement gains over time. However, the outlook for a considerable

proportion of charter schools with below-average growth and low achievement (36 percent for reading and 30 percent for math) is a source of great concern in Maryland. Students in these schools will fall further behind their TPS peers in the state academically over time if their negative growth persists.

## Implications

The analyses presented in this study have several implications. Overall performance trends of Maryland charter schools are positive over the years of this study. Throughout the student-level findings, we only observe a single finding, charter high schools in math, that yields a negative result for charter students benchmarked against comparable TPS peers; the array of positive and significant findings is notably larger.  The analysis shows that the charter sector in Maryland is building a positive academic trajectory for many of its students.

The school-level analyses reveal varying performance within the Maryland charter landscape. Results showing 40 percent of charter schools posting significantly positive growth for their students are evidence of successful practices in improving student outcomes. Further research is necessary to understand why we see positive results for such schools. Practices found in these schools that prove to be successful in improving student outcomes can be disseminated and replicated.

The study also reveals areas of needed attention.  Approximately one third of charter schools are still posting low growth and low achievement in reading or math. The collective impact of these results on student's academic careers and later life outcomes remains of deep concern. The negative results yielded by those schools signal opportunities to strengthen authorizer practice.

Stakeholders in Maryland can see charter schools in the state demonstrate promise in improving academic growth. This study surfaces important positive trends that can be used as evidence in discussing further legislative reform and avenues for further research. The Maryland Alliance of Charter Schools and the Maryland State Department of Education can continue to emphasize the successful practices utilized by high performing charter schools that lead to improved student outcomes.

## Appendix A. Number of Observations for All Results

The numbers in the table below represent the number of charter observations associated with the corresponding results in the report. An equal number of VCRs were included in each analysis.

**Appendix Table 1: Number of Observations for All Results**

| Student Group | Matched Charter Student Records | |
|---|---|---|
| | Reading | Math |
| Maryland Charter Students Tested & Matched | 25,394 | 24,633 |
| Students in Charters in 2014-2015 | 6,991 | 7,200 |
| Students in Charters in 2015-2016 | 9,203 | 8,540 |
| Students in Charters in 2016-2017 | 9,200 | 8,893 |
| Students in Urban Charter Schools | 15,132 | 15,451 |
| Students in Suburban Charter Schools | 9,805 | 8,743 |
| Students in Town Charter Schools | - | - |
| Students in Rural Charter Schools | 457 | 439 |
| Students in Elementary Charter Schools | 16,396 | 16,176 |
| Students in Middle School Charter Schools | 2,862 | 2,754 |
| Students in High School Charter Schools | 652 | 827 |
| Students in Multi-level School Charter Schools | 5,484 | 4,876 |
| Students in First Year Enrolled in Charter School | 5,047 | 5,023 |
| Students in Second Year Enrolled in Charter School | 2,608 | 2,396 |
| Students in Third Year Enrolled in Charter School | 966 | 986 |
| Black Charter School Students | 21,006 | 20,829 |
| Hispanic Charter School Students | 1,074 | 1,048 |
| White Charter School Students | 2,608 | 2,307 |
| Charter School Students in Poverty | 11,814 | 11,866 |
| Black Charter School Students in Poverty | 10,755 | 10,862 |
| Hispanic Charter School Students in Poverty | 571 | 585 |
| Special Education Charter School Students | 2,514 | 2,622 |
| English Language Learner Charter School Students | 69 | 90 |
| Grade Repeating Charter School Students | 94 | 90 |

## Appendix B. Technical Appendix

### Demographic Composition of Charter Students in the Study

This study examines the performance of students in charter schools who participated in annual accountability testing in Maryland, occurring in grades 3-8 and in whatever grade the end-of-course (EOC) assessments were taken. The test scores allow us to use a common measure of performance across schools and over time. However, in each growth period of the study, students who are enrolled in non-tested grades are not included in the analysis of performance. This partially accounts for the differences in school and student counts in our analysis data compared to other published figures about the charter school population in Maryland.

As discussed in the Study Approach chapter, we match tested charter students by period if they can be tracked for two or three periods in the study to conform to the new baseline equivalence requirement in the *Procedures Handbook Version 4.0* of What Works Clearinghouse. The following three tables present the student profiles of all of the tested charter students and the subset of matched tested charter students in math in each matching period.

**Appendix Table 2: Demographic Composition of Charter Students in the Study: Period 1**

| Student Group | All Charter Students Tested | | Matched Charter Students | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Maryland Charter Students | 17,228 | | 13,516 | |
| % Matched | 78% | | | |
| Black Students | 13,671 | 79% | 11,449 | 85% |
| Hispanic Students | 964 | 6% | 547 | 4% |
| White Students | 1,876 | 11% | 1,250 | 9% |
| Students in Poverty | 8,145 | 47% | 6,651 | 49% |
| Special Education Students | 2,207 | 13% | 1,503 | 11% |
| English Language Learners | 135 | 1% | 58 | 0% |
| Grade Repeating Students | 193 | 1% | 55 | 0% |

**Appendix Table 3: Demographic Composition of Charter Students in the Study: Period 2**

| Student Group | All Charter Students Tested | | Matched Charter Students | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Maryland Charter Students | 9,851 | | 7,764 | |
| % Matched | 79% | | | |
| Black Students | 7,739 | 79% | 6,559 | 84% |
| Hispanic Students | 571 | 6% | 361 | 5% |
| White Students | 1,130 | 11% | 720 | 9% |
| Students in Poverty | 4,360 | 44% | 3,694 | 48% |
| Special Education Students | 1,194 | 12% | 790 | 10% |
| English Language Learners | 65 | 1% | 26 | 0% |
| Grade Repeating Students | 96 | 1% | 29 | 0% |

**Appendix Table 4: Demographic Composition of Charter Students in the Study: Period 3**

| Student Group | All Charter Students Tested | | Matched Charter Students | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Maryland Charter Students | 4,256 | | 3,353 | |
| % Matched | 79% | | | |
| Black Students | 3,273 | 77% | 2,821 | 84% |
| Hispanic Students | 260 | 6% | 140 | 4% |
| White Students | 527 | 12% | 337 | 10% |
| Students in Poverty | 1,797 | 42% | 1,521 | 45% |
| Special Education Students | 495 | 12% | 329 | 10% |
| English Language Learners | 27 | 1% | 6 | 0% |
| Grade Repeating Students | 25 | 1% | 6 | 0% |

**Comparison of Starting Scores of Matched Students and VCRs**

The VCR method used in this study of Maryland provided matches for 83 percent of tested charter students with growth scores in reading and matches for 79 percent of tested charter students with growth scores in math. To assess the quality of the matches, we compare the starting scores of matched charter students and the Virtual Control Records obtained from the matches in both reading and math. The statistical tests of equality of means are shown in Appendix Figures 1 and 2 for math and reading, respectively. We find that the starting scores of matched students and the "virtual twins" used as point of comparison are almost identical. As matched students and their "virtual twins" have identical starting points in terms of learning in the beginning of a growth period, we can be confident that any difference in their final scores and therefore their learning growth can be attributed to charter school attendance, as the only observed way in which matched students and VCRs differ is that the former attend a charter school, while the latter consist of students attending a traditional public school.

*Appendix Figure 1: Comparison of Starting Reading Scores of Matched Charter Students and VCRs*

```
Two-sample t test with unequal variances
---------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.    Std. Dev.   [95% Conf. Interval]
---------+-----------------------------------------------------------------
 Matched |  25,394   -.3020795    .0055292     .8811007    -.312917    -.291242
     VCR |  25,394    -.302301    .0055183     .8793609    -.313117   -.2914849
---------+-----------------------------------------------------------------
combined |  50,788   -.3021902    .0039058     .8802226   -.3098457   -.2945348
---------+-----------------------------------------------------------------
    diff |             .0002215    .0078117                -.0150896    .0155325
---------------------------------------------------------------------------
    diff = mean(Matched) - mean(VCR)                              t =    0.0284
Ho: diff = 0                            Welch's degrees of freedom =   50787.8

    Ha: diff < 0                 Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.5113       Pr(|T| > |t|) = 0.9774           Pr(T > t) = 0.4887
```

*Appendix Figure 2: Comparison of Starting Math Scores of Matched Charter Students and VCRs*

```
Two-sample t test with unequal variances
---------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.    Std. Dev.   [95% Conf. Interval]
---------+-----------------------------------------------------------------
 Matched |  24,633   -.4085622    .0051919     .8148593   -.4187386   -.3983858
     VCR |  24,633   -.4088025    .0051796     .8129333   -.4189548   -.3986502
---------+-----------------------------------------------------------------
combined |  49,266   -.4086824    .0036668     .8138886   -.4158694   -.4014953
---------+-----------------------------------------------------------------
    diff |             .0002403    .0073337                -.0141339    .0146145
---------------------------------------------------------------------------
    diff = mean(Matched) - mean(VCR)                              t =    0.0328
Ho: diff = 0                            Welch's degrees of freedom =   49265.7

    Ha: diff < 0                 Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.5131       Pr(|T| > |t|) = 0.9739           Pr(T > t) = 0.4869
```

### Measuring Academic Growth

With four years of data, each subject-grade-year group of scores has slightly different mid-point averages and distributions. For end-of-course assessments (EOCs) there are only subject-year groups because EOCs are not grade specific. This means a student takes this assessment after completing the course, no matter what grade she is in. In our study, scores for all these separate tests are transformed to a common scale. All test scores have been converted to standardized scores to fit a "bell curve", in order to allow for year-to-year computations of growth.[18]

When scores are standardized, every student is placed relative to their peers in the entire state of Maryland. A student scoring in the 50th percentile in Maryland receives a standardized score of zero, while a standardized score of one would place a student in the 84th percentile. Students who maintain their relative place from year to year would have a growth score of zero, while students who make larger gains relative to their peers will have positive growth scores. Conversely, students who make smaller academic gains than their peers will have negative growth scores in that year.

### Models for Analysis of the Charter School Impact

After constructing a VCR for each charter student, we then set out to develop a model capable of providing a fair measure of charter impact. The National Charter School Research Project provided a very useful guide to begin the process[19]. First, it was useful to consider student growth rather than achievement. A growth measure provided a strong method to control for each student's educational history as well as the many observable differences between students that affect their academic achievement. The baseline model included controls for each student's grade, race, gender, poverty status, special education status, English Language Learner status, and whether he was held back the previous year. The literature on measuring educational interventions[20] found that the best estimation techniques must also include controls for baseline test scores. Each student's prior year test score is controlled for in our baseline model. Additional controls are also included for year and period (1st year in charter, 2nd year in charter, etc.). The study's baseline model is presented below.

$$\Delta A_{i,t} = \theta A_{i,t-1} + \beta X_{i,t} + \rho Y_t + \gamma C_{i,t} + \varepsilon_{i,t}$$

where the dependent variable is

$$\Delta A_{i,t} = A_{i,t} - A_{i,t-1} \qquad (2)$$

---

[18] For each subject-grade-year set of scores, scores are centered around a standardized midpoint of zero, which corresponds to the actual average score of the test before transformation. Then each score of the original test is recast as a measure of variation around that new score of zero, so that scores that fall below the original average score are expressed as negative numbers and those that are larger receive positive values.

[19] Betts, J. and Hill, P. et al. (2006). "Key Issues in Studying Charter Schools and Achievement: A Review and Suggestions for National Guidelines." National Charter School Research Project White Paper Series, No. 2.

[20] Betts, J. and Tang, Y. (2011) "The Effect of Charter Schools on Student Achievement: A Meta-Analysis of the Literature." National Charter School Research Project.

And $A_{it}$ is the state-by-test z-score for student i in period t; $A_{it-1}$ is the state-by-test z-score for student i in period t – 1; $X_{i,t}$ is a set of control variables for student characteristics and period, $Y_t$ is a year fixed effect, $C$ is a vector of variables for whether student i attended a charter school and what type of charter school in period t, and $\varepsilon$ is the error term. Errors are clustered around charters schools and their feeder patterns as well.

In addition to the baseline model above, we explored additional interactions beyond a simple binary to indicate charter enrollment. These included both "double" and "triple" interactions between the charter variable and student characteristics. For example, to identify the impact of charter schools on different racial groups, we estimate models that break the charter variable into "charter_black," "charter_hispanic," etc. To further break down the impact of charters by race and poverty, the variables above were split again. For example, black students in charter schools are split further into students who live in poverty ("charter_black_poverty") and those that do not ("charter_black_nonpoverty").

## Presentation of Results

In this report, we present the impacts of attending charter schools in terms of standard deviations. The base measures for these outcomes are referred to in statistics as z-scores. A z-score of 0 indicates the student's achievement is average for his or her grade. Positive values represent higher performance while negative values represent lower performance. Likewise, a positive effect size value means a student or group of students has improved relative to the students in the state taking the same exam. This remains true regardless of the absolute level of achievement for those students. As with the z-scores, a negative effect size means the students have on average lost ground compared to their peers.

It is important to remember that a school can have a positive effect size for its students (students are improving) but still have below-average achievement. Students with consistently positive effect sizes will eventually close the achievement gap if given enough time; however, such growth might take longer to close a particular gap than students spend in school.

While it is fair to compare two effect sizes relationally (i.e., 0.08 is twice 0.04), this must be done with care as to the size of the lower value. It would be misleading to state one group grew twice as much as another if the values were extremely small such as 0.0001 and 0.0002.

Finally, it is important to consider if an effect size is significant or not. In statistical models, values which are not statistically significant should be considered as no different from zero. Two effect sizes, one equal to .001 and the other equal to .01, would both be treated as no effect if neither were statistically significant.

To assist the reader in interpreting the meaning of effect sizes, we include an estimate of the average number of days of learning required to achieve a particular effect size. This estimate was calculated by Dr. Eric Hanushek and Dr. Margaret Raymond based on the latest (2017) 4th and 8th grade test scores from the National Assessment of Educational Progress (NAEP). Using a standard 180-day school year, each one standard deviation (s.d.) change in effect size was equivalent to 590 days of learning in this

study. The values in Table 2 are updated from past reports using more recent NAEP scores, which show slower absolute annual academic progress than earlier administrations.[21]

In order to understand "days of learning," consider a student whose academic achievement is at the 50th percentile in one grade and also at the 50th percentile in the following grade the next year. The progress from one year to the next equals the average learning gains for a student between the two grades. That growth is fixed as 180 days of effective learning based on the typical 180-day school year.

We then translate the standard deviations of growth from our models based on that 180-day average year of learning, so that students with positive effect sizes have additional growth beyond the expected 180 days of annual academic progress while those with negative effect sizes have fewer days of academic progress in that same 180-day period.

[21] Hanushek, Eric A. P.E. Peterson, & L. Woessmann (2012). Achievement Growth: International and U.S. State Trends in Student Performance. *Education Next*, Vol. 12, 1–35.