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CENTER FOR RESEARCH ON EDUCATION OUTCOMES

Online Charter School Study

2015

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CENTER FOR RESEARCH ON EDUCATION OUTCOMES

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CREDO, the Center for Research on Education Outcomes at Stanford University, was established to improve empirical evidence about education reform and student performance at the primary and secondary levels. CREDO at Stanford University supports education organizations and policymakers in using reliable research and program evaluation to assess the performance of education initiatives. CREDO's valuable insight helps educators and policymakers strengthen their focus on the results from innovative programs, curricula, policies and accountability practices.

Acknowledgements

CREDO gratefully acknowledges the support of the State Education Agencies and School Districts who contributed their data to this partnership. Our data access partnerships form the foundation of CREDO's work, without which studies like this would be impossible. We strive daily to justify the confidence you have placed in us.

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List of Acronyms & Definitions

CMOs	Charter School Management Organizations
CREDO	Center for Research on Education Outcomes
EOC	End-of-Course Exam
ELA	English Language Arts
ELLs	English Language Learners
FERPA	Family Education Records Privacy Act
NAEP	National Assessment of Educational Progress
TPS	Traditional Public School
VCR	Virtual Control Record
Asynchronous	Learning that occurs when students complete assignments and learning on their own time and schedule without live interaction with a teacher
Brick-district	A public school operated by a traditional school district which uses standard in-person learning as its primary means of curriculum delivery (aka – TPS)
Brick-charter	A public school operated under a charter as defined by the state which uses standard in-person learning as its primary means of curriculum delivery
Online charter	A public school operated under a charter as defined by the state which uses online learning as its primary means of curriculum delivery
Online district	A public school operated by a traditional public school district which uses online learning as its primary means of curriculum delivery
Growth	The year-to-year change in academic performance relative to one's peers. Growth can be positive or negative.
Network	A network is defined as a single organization which oversees the operation of at least three charter schools. Not all the schools in a network must be online for the schools to be considered part of a network.
Online School	A school which offers a full-time online curriculum to the majority of its students

Synchronous	Learning that occurs with all students in a class receiving instruction and completing work at the same time. Students do not necessarily have to be in the same location for synchronous work.

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1. Introduction

Purpose of Study

The Center for Research on Education Outcomes (CREDO), Mathematica Policy Research, and the Center on Reinventing Public Education (CRPE) have undertaken a collection of studies to contribute more extensive information on the landscape and operation of online charter schools and their impact on students' academic growth than has been available to date. Our aim was to deliver an unbiased, data-driven examination of online charter schools. The intent of this report is to present to lay-readers and policy decision makers information based on advanced statistical models of student growth in a manner which is accessible and useful for the promotion of deeper discussion of the role of online schools in the K-12 setting. This report presents the findings about impacts of online charter enrollment on the academic progress of students.

Need for the Study

Online schools, especially online charter schools, are a tiny, but rapidly growing sector in the education realm. Full-time online schools are still a relatively new phenomenon, and some states have seen enrollment growth which is literally exponential. While the overall percentage of students who attend online schools is small, only 0.5% of students in our data, based on increasing growth rates we should expect to see continued expansion of online educational services. The online schools within our 18 state data set have increased their tested student enrollment from 35,000 students in 2009-10 to over 65,000 students in 2012-13. Based on even modest funding levels of $6,000 per student, 65,000 students represents a public investment of $390,000,000 annually. With the number of students expected to continue to grow rapidly, good stewardship demands an examination of the outcomes of public investment.

Online schools may be a good investment of these millions of dollars if they can provide quality education to students, especially those students poorly served by the current education system. Online schooling options have the potential to provide students a flexible, student-centered educational option.

One of the desirable attributes of online schools is their adaptability for atypical students. Across the country, there are students who work to provide for their families. There are other students who are who are already active in their chosen professions such as actors, artists, or Olympic hopefuls. These students could also benefit from a flexible, portable means of receiving their education. For migrant students or those in unstable households, the ability to sustain a consistent schooling environment could greatly

boost educational outcomes. Likewise, students who learn at a greatly different rate from their age peers (both slower and faster) might benefit from the self-paced nature of many online programs.

Despite these potential benefits, online learning may not be a good fit for many students. Only high quality, rigorous research will provide the data necessary to address such policy questions.

In spite of the rapid growth of the online sector, there have been few detailed longitudinal analyses on the impact of online schools on academic achievement. Many states have little data on the number of online programs that operate within their state or who they serve. Basic identification data on online schools turns out to be a challenge to collect. Without reliable information on school performance, policy makers, school officials, and families risk the future learning and career opportunities of students in an uncharted arena. Since online learning at the K-12 level is still in its infancy, measures of the quality of the available online school options can provide feedback to educational stakeholders, including authorizers and providers, about program performance that can shape the field as it evolves.

Questions to Be Addressed

This report presents the findings of an ambitious scope of analysis about online charter schools and their performance. The findings look at performance at several levels: at the individual student level, at the student population level, at the organizational level of the online schools and at the state policy level. Each facet of the analysis offers its particular insights about the influence of online charter schooling on the students who attend them.

For this study, we examine the impact of attending an online charter school on the academic progress of students who attend them. We measure academic impact by comparing the annual academic growth of online students with the growth of equivalent students who attend schools with traditional settings, i.e. brick-and-mortar district schools. This question, "What is the average impact of attending an online charter school on the academic growth of students?" frames the analysis and drives the discussion of results throughout the report. We assess how academic growth in online charter schools differs for students with different student backgrounds including race-ethnicity, poverty status, and exceptional needs.

Online schools may be the best option for some students. Alternatively, it may not be the best option for every student. Are there students who are better suited to the online school experience? Looking at the characteristics of the students at the population level, we examine if success in online charter schools is more likely for some students than others.

Attributes of the schools are also new territory for study. We studied differences in the makeup and operation of the schools themselves. Descriptions of these organizations provide a useful chart of the current landscape. Where possible, those differences were incorporated into the impact analyses to discern if school attributes varied with student results. To explore this aspect of the education equation, Mathematica Policy Research developed and administered to school principals a survey of online school characteristics. The survey covered many aspects of school operations including a range of students

served, methods of curriculum delivery, teacher credentials, and parental involvement. In addition to direct analyses of responses, we combined survey responses with student testing data for mixed-methods analyses of these school characteristics. These analyses will allow providers to explore which services currently offered have stronger and weaker relationships with student outcomes.

Finally, under the terms of the Constitution, each state is free to implement public education policies as they wish, including the terms under which online schools operate. The Center on Reinventing Public Education (CRPE) conducted a review of state policies related to online schools. Their review included categorizing state policies and documenting policy changes which could be expected to have an impact on educational outcomes for online school students. The policy findings from CRPE were combined with student-level data for mixed-methods analyses of policy implications on student academic growth. Policy makers should explore these results for policies they may wish to implement or eliminate from their states to maximize to student benefits of online schools.

It is our intent that this study will serve as the foundation for constructive discussions on the role of online schools in the K-12 sector. The findings presented in the rest of the report are by no means exhaustive. There are more questions policy makers and stakeholders need to ask. Are online schools the solution for many of the educational challenges faced by families today or are they a niche option appropriate for only a small group of students with a specific set of characteristics? Is the current regulatory structure for online enrollment properly matching kids with services? Are online schools having a positive impact on students' educational experiences? What additional measures should be used to define "success" for online K-12 schools? Rather this report aims to build a solid evidence base as the first of many analyses.

The report provides a brief description of the approach to the analysis in the following section. The next chapter includes an analysis on the student-level, school-level, and network-level impact of attending an online charter school as well as a mixed methods analysis which combines impact data with school-level information gleaned from a survey of school leaders. The report concludes with a discussion of the implications of the study findings.

2. Methods and Data

Identifying Online Charter Schools

Identifying students enrolled in online charter schools was a challenge. States typically do not record an indicator for students attending an online school. Lists of the schools offering online enrollment in each state proved to be incomplete or non-existent.

CREDO searched for information about online schools and programs from across the country using multiple Internet searches. Information from the International Association for K-12 Online Learning (iNACOL) was the most complete directory we located. We extended the directory with additional contacts with known online providers such as K12. To identify additional potential online schools, we searched the National Center for Education Statistics (NCES) website, the websites of state departments of education, and completed Google searches for terms related to online schools. Our searches included terms such as "online", "virtual", "cyber", and "distance learning" among others.

In creating this list of potential online schools, we found many of the identified schools were not independent schools, but were instead virtual education programs operating under the umbrella of a traditional brick-and-mortar school setting. For several reasons, we decided to exclude these schools: it was impossible to isolate the records of students enrolled in online-programs which were part of a larger brick-and-mortar school and we were concerned that the influence of traditional enrollment of students might influence the behavior of either the operator or the students in the online setting. For the purposes of this study, a student was considered to be attending an online school if the

WHAT IS AN ONLINE CHARTER SCHOOL?

One of the challenges faced by organizations which push beyond the familiar boundaries is the absence of the common language needed to describe what it is they do. Online charter schools are not an exception to this problem. With the addition of online learning options in the K-12 setting has come a surplus of terms to describe these new types of learning. Most problematically, the virtual schooling sector is so new many of the terms used have differing definitions.

We found many schools using terms like online, virtual, digital, distance, etc. to describe very different types of services. In some locations, a distance learning school fit our definition of an online school, in others distance learning had nothing to do with online delivered education.

For the purposes of this study, an online school is a school which provides the majority of classes (everything except PE, band, or a similar elective) to full-time students through a computer via the internet. Lessons may be synchronous or asynchronous. Lessons may consist of videos, live chat, bulletin boards, or any other common means of electronic communication. But the primary delivery method must be online.

school's enrollment consisted of full-time, online students only.

CREDO contacted each of the identified online schools to verify the status of the program as a full-time online only school. The program also had to have a state school identification number which was unique from any brick-and-mortar school. This means this study does not include the majority of students who take one or more online course while enrolled in traditional brick-and-mortar schools.

Schools were also excluded as an online school if they reported offering a mixed or blended curriculum. As with brick-and-mortar school students taking online courses, the combination of classroom-based and online instruction creates a different educational environment from the one targeted in this study.

To be clear, our data set for online school students is restricted to those students attending public, full-time online schools. After the multiple screens described above, data from 158 online schools was included in the report.

Table 1: States with Online-Students

Arkansas	Colorado	Georgia	Minnesota	Ohio	Texas
Arizona	DC	Louisiana	New Mexico	Oregon	Utah
California	Florida	Michigan	Nevada	Pennsylvania	Wisconsin

Consolidating Student Data from Multiple States

In order to create a national data set for studies of this type, CREDO worked with the state departments of education in 17 states and the District of Columbia. Because each state used its own standards and tests to evaluate student academic achievement, it was necessary for CREDO to standardize the values to make them comparable. CREDO did this by creating a "Bell curve" for each test -- by subject, grade and year --where the average student score on the test becomes the central value, and all other scores are distributed around it. The transformation places each students' performance in relation to all other equivalent tested students, making it ready for comparison with other students. By comparing each student's performance relative to the other students from one year to that same student's relative performance in the next year, CREDO could estimate if the student was growing academically at a rate which was faster, similar, or slower than the rate of their peers.

CREDO was able to combine growth results from multiple grades, states, and years. Even though average academic performance in state A may represent a difference in achievement from the average academic performance in state B, a change in academic performance (growth) of .05 standard deviations in state A and .05 standard deviation change in performance in state B both represent the same level of improvement relative to their peers in the students' home state. This is one of the reasons measurement of academic growth is superior to simple measures of academic achievement; the level of which can vary greatly from state to state.

Multiple Datasets

Matched Data

CREDO conducted analyses using its Virtual Control Record (VCR) method. The first step in conducting a VCR analysis is to create a matched data set. The matched data set consists of treated students (in this case students attending an online charter school) and demographically identical students in the control group. CREDO established two control groups for this analysis. The first was a traditional control group of students who attend a brick-and-mortar school operated by a traditional school district (brick-district). These schools are those normally referred to in CREDO's studies as TPS. Due to the dual nature of the treatment group, both online and charter, it was beneficial to make comparisons between the treated students and brick-and-mortar traditional schools and treated students and brick-and-mortar charter schools. This necessitated the creation of a second matched comparison group with students attending brick-charter schools as the control group. This comparison group allowed CREDO to examine the "online-ness" of an online charter school as compared to physical charter schools.

Click here for an infographic about the Virtual Control Record method.

At the outset of the study, it was hoped a third comparison group would focus on the "charterness" of the online charter by creating a dataset with students who attended online schools operated by districts as the control group. Unfortunately, the number of students who attend online-district schools is too small to allow for an acceptable online charter/online-district matched dataset.

Selection of Comparison Observations

A fair analysis of the impact of online charter schools requires a comparison group which matches the demographic and academic profile of online charter students to the fullest extent possible. As in previous CREDO studies, this study employed the virtual control record (VCR) method of analysis developed by CREDO. The VCR approach creates a "virtual twin" for each online charter student who is represented in the data. In theory, this virtual twin would differ from the online charter student only in that the student attended an online charter school. The VCR matching protocol has been assessed against other possible study designs and judged to be reliable and valuable by peer reviewers. [1]

Using the VCR approach, a "virtual twin" was constructed for each online charter student by drawing on the available records of traditional public school (TPS) students with identical traits and identical or very

[1] Forston, K. and Verbitsky-Savitz, N. et al. (2012). "Using an Experimental Evaluation of Charter Schools to Test Whether Nonexperimental Comparison Group Methods Can Replicate Experimental Impact Estimates," NCEE 2012-4019, U.S. Department of Education.

similar[2] prior test scores who were enrolled in TPS that the charter students would have likely attended if they were not in their online charter school. To better isolate the effect of attending an online charter school as opposed to just a charter school, a second VCR data set was created. For the second data set a "virtual twin" was constructed for each online charter student by drawing on the available records of brick-and-mortar charter school students with identical traits and identical or very similar prior test scores who were enrolled in brick-and-mortar charter schools that the charter students would have likely attended if they were not in their online charter school. The second VCR data set using brick-and-mortar charter school students to form the VCRs allowed CREDO to differentiate between the effects of online charter school attendance compared to just charter school attendance. If the effect sizes for online charter students compared to TPS VCRs was found to be similar to the effect sizes for online charter students compared to brick-and-mortar charter VCRs, the effect sizes would be primarily attributable to the online nature of the school.

Factors included in the matching criteria were:

- Grade level
- Gender[3]
- Race/Ethnicity
- Free or Reduced-Price Lunch Eligibility
- English Language Learner Status
- Special Education Status
- Prior test score on state achievement tests

Figure 1 shows the matching process used by CREDO to create the virtual twins linked to each online charter school student. In the first step, CREDO identifies all TPS with students who transferred to a given charter school. These schools are referred to as "feeder schools" for that particular online charter school. Students attending an online charter school are eliminated from the match pool for each charter student to ensure VCRs consist entirely of TPS students. The feeder school method provides a strong counterfactual as residential school assignment commonly used to place students in TPS has been shown to group demographically and socio-economically similar students into schools. This practice increases the likelihood that students assigned to similar schools have similar backgrounds, knowledge of school choice programs, and school choice options. Once a school is identified as a feeder school for a particular online charter, all the students in that TPS become potential matches for students in that particular charter school. All of the student records from all of a charter's feeder schools were pooled – this became the source of records for creating the virtual twin match[4].

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[2] Achievement scores were considered similar if they were within 0.1 standard deviations of the online charter student's pre-online charter achievement.

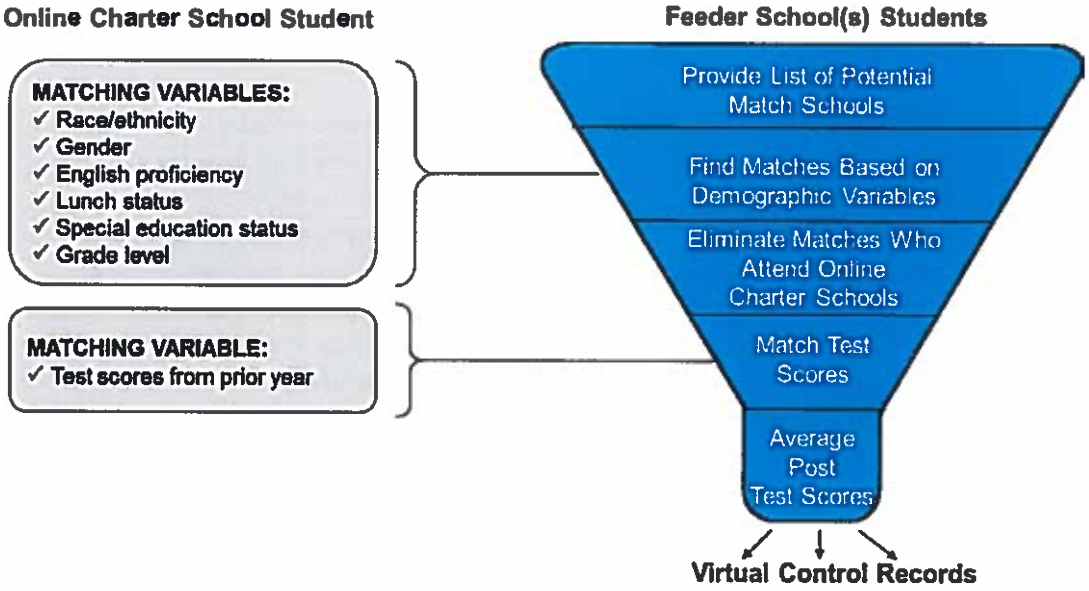
[3] Gender is used as a match factor for all states except Florida due to lack of data availability.

[4] Each charter school has its own independent feeder list, and thus a unique pool of potential VCR matches.

The VCR matching method then eliminates any of the TPS students from the match pool whose demographic characteristics do not match exactly to the individual online charter student. As part of the match process, we also drop from the TPS match pool any students who enrolled in an online charter school in subsequent comparison years.

Using the records of TPS students at feeder schools in the year *prior* to the first year of growth, CREDO randomly selects up to seven TPS students with identical values on the matching variables in Figure 1, including identical or very similar prior test scores. Students with similar test scores were used only when there were not enough TPS students with exact test score matches. The values for the selected TPS students are then averaged to create values for the virtual twin. As all other observable characteristics are identical, the only observable characteristic that differs between the online charter student and their VCR is attendance in an online charter school. The prior test score represents the impact on academic achievement of both the observable and unobservable student characteristics up to the time of the match, the year before the first growth measurement. Since we matched on observable characteristics and the prior test score, we concluded that any differences in the post-test scores are primarily attributable to online charter school attendance. The same process was used for the brick-and-mortar VCR match except feeder list was based on transfers from brick-and-mortar charter schools to online charter schools.

Figure 1: CREDO VCR Methodology



Brick-District VCR Matched Sample

As stated above, this report uses two VCR groups. The first VCR data set created for these analyses matched online charter students with students from traditional brick-and-mortar district-run schools (TPS). Due to the large number of feeder schools sending students to online schools, this data set had an

exceptionally high match rate[5]. The online charter to brick-district match rate was 96 percent. As a result, the sample included in this analysis is highly reflective of the full population of online charter students for the states included in the impact analysis.

Table 2 shows the characteristics of the student bodies in the online charter schools, the TPS feeder schools, and all TPS schools for the states included in the impact analysis. The major difference between the online charter students and the students attending feeder schools is the percentage of White students enrolled in the online charter schools (69%) is much higher than the feeder schools (45%). The difference in the percentage of White students if offset by a decrease in the percentage of Hispanic students. As would be expected, this also leads online charter schools to serve a much smaller percentage of English language learners (1%) than the feeder schools (9%). Since written communications are the major form of interaction between students and teachers in many online settings, it should not be surprising to find a lower percentage of English language learners (ELL) in online charter settings. We cannot determine whether lower ELL enrollment in online schools is the cause of lower Hispanic student enrollment or an effect of lower Hispanic student enrollment.

Table 2: Student Population Demographics by TPS Sector

	All TPS	TPS Feeder Schools	Online Charter Schools
Number of Schools	108,476	11,574	166[6]
Percent Students in Poverty	39%	51%	48%
Percent English Language Learner Students	8%	9%	1%
Percent Special Education Students	8%	11%	11%
Percent White	49%	45%	69%
Percent Black	15%	18%	18%
Percent Hispanic	27%	32%	11%
Percent Asian/Pacific Islander	5%	6%	2%
Percent Native American	1%	1%	1%
Percent Multi-Racial	3%	3%	4%
Average Total Enrollment per School	503	772	986
Total Enrollment	54,602,134	8,933,313	163,722

The brick-district VCR population had a special education student rate identical to the feeder schools. This rate is slightly higher than the rate of special education students enrolled in all TPS schools across the states included in the study. Online charter schools serve a slightly smaller percentage of students in poverty, those eligible for free or reduced lunches, than the feeder schools, but a higher percentage than all TPS schools. The average total enrollment for online charter schools is larger than all TPS feeder schools.

[5] Match rate was the percentage of online charter students with at least a student in the comparison school who was an exact match on demographics and a close/exact match on prior achievement.
[6] Includes some multi-campus schools with separate IDs, but one administration.

Some states have a large number of students who supplement their course work by taking one or more classes via online methods. These students were **not** included in the treatment group as the impact of their online education could not be separated from their traditional class work. Additionally, students from schools which offer online study in addition to other forms of distance education were not included unless the school had a separate school identifier for just the online students.

Mobility Study Data Set

One of the analyses included in this report focused on student mobility. The data set for the mobility portion of the report consists of all of the online charter students' available records from the 2007-2008 school year through the 2012-2013 as well as all of the records for all the TPS students included in the VCR for any online charter student. The data set was constructed by appending the data for each year of the study for each state included in the study. Within each state, all students who were either an online charter student or selected to be part of any online student's VCR were flagged based on the records from the VCR match process. Once all the student records were properly marked, the files from each state were appended together to form a national panel data.

As should be expected, the characteristics of the VCR students and the online charter students are similar (see Table 3). The only reason the two samples are not identical as they are in a standard matched VCR data set is because the VCR students are not combined in a single value. In the traditional VCR matched data set, the TPS students who make up the VCR are combined into one value. This means for each Hispanic student charter student, there is one Hispanic VCR. However, in the mobility data set, the VCR students are not combined. There could be five Hispanic VCR students for one Hispanic charter student. The differing number of VCR students assigned to each charter student allows for some variance between the percentages of students by demographic categories. As part of the VCR match process, online students are matched multiple times based on the number of years the student appears in the data set. For analysis, only the matches from the longest time period are included in the VCR. For this data set, the students who make up the VCR from each match are included. This is why the ratio of VCR students to online charter students is higher than the 7:1 maximum ratio used for the standard VCR matched data set.

Table 3: Student Record Demographics for Mobility Study

	All TPS	VCR Students	Online Charter Students
Percent Students in Poverty	39%	56%	53%
Percent English Language Learner Students	8%	3%	2%
Percent Special Education Students	8%	8%	10%
Percent White	49%	73%	69%
Percent Black	15%	12%	12%
Percent Hispanic	27%	11%	13%
Percent Asian/Pacific Islander	5%	2%	2%
Percent Native American	1%	0%	1%
Percent Multi-Racial	3%	1%	2%
Total Enrollment	54,602,134	4,697,266	500,836

The mobility data set includes a record for each year a student has a test score. Students may remain in the data set for a different number of years based on their grade in a given year, the testing regimen of the state of residence, and the students' interstate mobility patterns. The records for a single student are labeled by period. The first period record for a student is the earliest record chronologically. In the mobility data set, it was possible for students to have up to six individual year records. Table 4 includes the number of records in each period and what percentage of the data set is encompassed by each period.

Table 4: Number and Percentage of Records per Period

Period	N of Students	Percentage of Total Students
1	1,135,139	22%
2	1,134,562	22%
3	1,044,064	20%
4	881,526	17%
5	630,200	12%
6	294,949	6%

Basic Analytic Model

The primary question for this study is "How did enrollment in an online charter school affect the academic growth of students?" To answer this central question, we need to address multiple lines of inquiry around enrollment in an online charter school. For example, we explore, "How did the academic growth of online charter school students compare to students who are just like them but instead attended traditional public schools (TPS)?" As there has been little work in this research area, we believe

our work will support the policy discussions about this rapidly expanding educational trend by extending the pool of knowledge on online charter school effectiveness.

Appendix A includes a more detailed descriptive analysis with the demographic make-up of the tested students who were enrolled in the online charter sector. We include analyses of the demographics of students in the data set. This discussion provides information on the percentage of students representing each race/ethnicity, eligibility for free or reduced priced lunches, English language learners, and special education students.

The primary methodological challenge associated with any study of charter schools is selection bias. Even after controlling for student characteristics such as gender, poverty, race, and ethnicity, the fact that some students choose to enroll in charter schools and other students do not may indicate the existence of some unobserved difference between the two groups of students. The ideal solution to this problem is a randomized experiment that creates a control group that is identical to the treatment group before entering the online charter school. Several charter school studies have used admissions lotteries in oversubscribed charter schools to conduct randomized experiments. The approach is not applicable to most charter schools and especially not online charter schools as enrollments in online charter schools are not constrained by physical space, thus they usually have no need to allocate seats by a lottery.[7]

In the absence of a randomized experiment, several recent studies have demonstrated that it is possible to successfully address selection bias by accounting for students' prior academic achievement levels before entering charter schools (Gleason et al. forthcoming; Furgeson et al. 2012; Fortson et al. 2015). The three previous studies of the achievement effects of online charter schools used variations on this approach. Unfortunately, however, it is not clear that the approach can succeed in eliminating all selection bias in the context of online schools. Because online schools differ radically from brick-and-mortar schools, the students who enroll might be quite different from those enrolling in conventional schools. For example, some students might enroll in online schools because they have had significant academic, behavioral, or social problems in conventional schools, which may, in turn, affect their later achievement trajectories. If so, prior scores might not be predictive of future scores, regardless of whether a student stays in a conventional school or moves to an online school.

Given the uncertainties about whether online schools are subject to unique kinds of student selection, we used several different analytic approaches to test the sensitivity of findings to modeling approaches. The first approach uses virtual control records (VCRs) method developed by CREDO (Davis and Raymond 2012), involving virtual controls that closely mirror the matched charter school students on known demographic attributes, eligibility or participation in special support programs (free or reduced-price lunch, English language learners, or special education), and prior academic achievement. In order to determine the impact of attending an online charter school on student academic growth (the change in

[7] Although a small number of online charter schools have enrollment constraints and hold admissions lotteries, it would be impossible to generalize from a study of the few online schools in such circumstances.

academic achievement), we employ statistical models which compare online charter students to their virtual twins. The virtual twins represent the expected performance of charter students had they not enrolled in online charter schools. Due to the dual nature of online charter schools, we include in this study findings for online charter students compared to brick-district VCRs and online charter students compared to brick-charter VCRs. The VCR method has been shown to produce results similar to those obtained with randomized control trials and student fixed-effects approaches (Davis and Raymond 2012), such as those used in several published studies of charter-school impacts (for example, Bifulco and Ladd 2006; Booker et al. 2007; Zimmer et al. 2003, 2009).

The second approach uses a method that has been validated experimentally in a study of charter management organizations (CMOs) (Furgeson et al. 2012). That study demonstrated that an ordinary least squares (OLS) regression that controls for demographic characteristics and prior academic achievement before entering a charter school produces results that are nearly identical to the results of randomized experimental analyses using admissions lotteries.

In addition, we use two parallel analytic approaches designed to address the student selection that is unique to online schools. Both of these approaches use comparison groups consisting of students who enrolled in online schools at some point in their academic careers. These models recognize the key conclusion from the nonexperimental evaluation literature that the validity of a comparison group depends on its similarity on key characteristics (Cook et al. 2008). In the context of online schooling, an important characteristic is the student's willingness to enroll in an online school. Selecting a comparison group of students who have enrolled in an online school at some point in time is one way to account for this characteristic. We describe these models as "chooser-matched" designs.

The first chooser-matched design employs a method that has previously been used to measure charter-school effects on students' academic attainment (Booker et al. 2011). This approach identifies the effect of online schools by comparing the difference in achievement trajectories of two groups of students who are enrolled in online schools in the same grades and years. The difference occurs after one group subsequently switches to brick-and-mortar schools and the other does not. We identify the effect of online schools by comparing the achievement trajectories of students who switched to brick-and-mortar (the comparison group) and students who remain in online charter schools (the treatment group), while controlling for any observable differences between the groups in the year before the switch.

The second "chooser-matched" designs uses a comparison group of students who are enrolled in brick-and-mortar schools during the period of treatment, but who are known to enroll in online schools later in the data set. This method, in essence, compares the achievement trajectories of current online students (the treatment group) with those of future online students (the comparison group), again controlling statistically for any observable differences between the groups. This method has been used in the past in an evaluation of after-school programs conducted for the U.S. Department of Education (Zimmer et al. 2007). As with the first chooser-matched method, this approach has the virtue of

identifying a comparison group of students who have also chosen to enroll in online schools, only at a different point in time.

The main body of the report contains results for the brick-district VCR analysis. Results for each set of additional analyses are explained in a separate subsection of Appendix B.

Mixed Methods Analysis

For this portion of the study, we merged information obtained from the online charter school survey administered by Mathematica Policy Research (Mathematica) with student-level test data and school-level effect sizes. These processes allow for the analysis of the relationship between school characteristics and student academic growth for the schools which have both student data and survey responses. The models used for this section are not causal models, so we are describing a relationship between two factors rather than claiming one factor causes the other. The Mathematica survey covers a wide variety of school practices. These practices, described in detail in Volume 1, include pedagogical concerns such as the method of curricula delivery, family issues such as expected parental participation, and school practices such as providing equipment or internet connectivity to students' homes.

This report includes two levels of mixed-methods analyses. The first correlates school-level average effect sizes with data from the survey conducted by Mathematica. The second mixes student growth data with school-level characteristics gleaned from the survey.[8] The survey includes data on school characteristics such as size, location, operational practices, expectations for parents and students, and expectations for teachers.

Some of the questionnaire items are restricted to students of a certain grade. Other items are general and applied to all schools regardless of grades served. Because a particular educational practice might have differentiated impacts for younger students compared to older students, the survey includes a set of responses for 4th grade students, 7th grade students, and high school students. These grade levels were picked to be representative of elementary school, middle school, and high school respectively. Using this system enables the researchers to tease out the differing relationships of a particular school-wide procedure on students of different ages. It also allows for schools which have differing procedures for students based on the students' ages. The survey question with the smallest number of students contains responses from schools which collectively serve over 13,000 individual students.

The number of schools with average effect sizes and data responses was small. Only 60 schools had both school-level effects and data responses. Further, some questions were not applicable to some schools because of the grade range of the students in that school. This greatly limits the generalizability of the findings.

[8] By including the student-level analysis, we were able to increase the analytic power of the statistical models. Additionally, using student-level analyses allowed us to control for the differing characteristics of the students within each school.

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. 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 effects sizes, one equal to .001 and the other equal to .01, would both be treated as nil 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 is based on findings by Hanushek, Perterson, and Woessman (2012) that "student growth is typically about 1 full standard deviation on standardized tests between 4th and 8th grade, or about 25 percent of a standard deviation from one grade to the next."[9] This transformation is approximate and dependent on estimates of average annual academic growth. Another study on the topic (Hill, Bloom, Black, and Lipsey, 2008) derived differentiated rates of growth by grade which would result in a lower number of days of learning for our estimates. While we evaluate the use of a more sensitive measure for computing days of learning, we continue to use the values from Hanushek et al. to maintain consistency with previous CREDO reports.

[9] Using a standard 180 day school year, each 0.01 sd change in effect size is equivalent to 7.2 days of learning.

3. Student Mobility

Because students generally do not start school in an online setting, it is clear that students attending online charter schools may have a higher mobility rate than students in a traditional public school. The mobility rates of students matter because high mobility can be correlated with lower academic growth (Hanushek, Kain, & Rivkin, 2004) as well as higher likelihood of dropping out of school (South, Haynie, and Bose, 2007). Mobility can be a tricky variable to follow because many states report a student's enrollment at specific times of the year such as beginning of school and testing day, but do not report changes which occur between those times. To estimate mobility, CREDO linked student records longitudinally across the years of this study. Students were identified as being mobile if they experienced a non-structural school change from one testing year to the next. A non-structural school change is one which does not occur because the student aged out of their previous school. This method likely underestimates the number of students who voluntarily changed schools because it does not capture students who wait until a structural change to move to a new district or a school other than the one they would have attended. However, those students were going to experience a school change no matter the choices they made, so the impact of the voluntary school change may not be greater than the forced school change the student was going to have to make anyway.

As part of the discussion on mobility, CREDO also examined the characteristics of new online students in charter schools. Our view is constrained by the testing patterns of the various states which typically exclude the early elementary grades and are sporadic in the high school years.

In addition to straightforward comparisons of mobility rates between online charter students and brick-and-mortar students, we were also able to investigate questions such as:

1. How many years do online students remain in online charter schools?
2. What is the percentage of online students who return to brick-and-mortar schools after attending an online school?
3. What grades are students in when entering an online school?
4. What grade are students in when they leave an online school?

These questions further the understanding of the experience of online charter students.

Characteristics of Online Charter Mobility

Some online charter school operators state that their students come to them with additional academic deficits beyond the typical student. Often they cite the students' history of mobility as a cause for these deficits. If it were true that students arrive at online schools with academic deficits created by high mobility, we would expect to find online students experienced higher mobility before switching to the online school than the comparison students. In fact, students who switched to online schools have a pre-online school mobility rate of nine percent compared to eight percent of the comparison students. These findings place doubt on the argument that higher pre-online mobility creates widespread, systematic academic deficits for students who eventually switch to online charter schools.

The data in Table 5 shows the entry grade of students who transitioned to an online charter school. Students enroll in online charter schools at different points in their academic careers. Since all the states included in the analysis require students to test from grades 3 – 8, these grades are comparable and show the relational pattern between student age and online charter enrollment. There is a steady increase in the number of students enrolling in online charter schools as students age into middle school. The large drop off in enrollments in 9th grade is likely an under estimate due to state testing patterns.

Table 5: Grade at Initial Enrollment in Online Charter School for New Entrants

Grade	N	Percentage
K-3	13,815	11.8%
4	12,587	10.8%
5	13,380	10.9%
6	17,691	14.4%
7	21,943	17.9%
8	18,147	14.8%
9	5,248	4.3%
10	13,669	11.2%

Nearly one-half of students in our study (47 percent) are enrolled in an online charter school for one year. This number must be tempered with the fact 19 percent of the individuals in the study enrolled in an online charter school for the first time in 2012-2013. Students whose first entry into an online school is 2012-2013 can only have one year in an online charter school. On average, online charter students in our study spend two years in online schools. Table 6 includes information on the percentage of students who remained in an online charter school categorized by the students' entry year into an online charter school.

Table 6: Duration of Student Enrollment in Online Charter Schools by Entry Year

Entry Year	1 Year	2 Years	3 Years	4 Years	5 Years
2008-2009	100%	65%	43%	29%	16%
2009-2010	100%	63%	39%	23%	
2010-2012	100%	58%	34%		
2011-2012	100%	56%			
2012-2013	100%				

Obviously, the students first entering an online charter school in 2012-2013 school year cannot be included in a discussion of persistence trends as many of those students may be shown to continue on past one year once more data is available. An examination of the first four years shows a decreasing percentage of students are remaining in online charter schools for a second year. This decrease has coincided with an increase in the number of students enrolling in online charter schools.

Table 7 includes the percentage of individual students in each state who remained enrolled in online charter schools for a given number of years. In some states, online schools have not existed long enough for students to have accumulated more than a few years in an online school.

Table 7: Percentage of Online Students Remaining in Online Charter Schools by State

State	1 Year	2 Years	3 Years	4 Years	5 Years
AR	100%	64%	32%	16%	6%
AZ	100%	37%	16%	7%	3%
CA	100%	57%	29%	16%	8%
CO	100%	48%	21%	9%	4%
DC	100%	72%	28%	11%	3%
FL	100%	19%	1%	1%	0%
GA	100%	60%	23%	11%	4%
IL	100%	83%	42%	20%	7%
LA	100%	39%	-	-	-
MI	100%	54%	14%	-	-
MN	100%	51%	23%	13%	5%
NM	100%	50%	15%	9%	-
NV	100%	50%	22%	9%	4%
OH	100%	57%	32%	17%	8%
OR	100%	46%	19%	10%	4%
PA	100%	60%	32%	19%	10%
UT	100%	43%	15%	4%	1%
WI	100%	35%	14%	-	-
Total	**100%**	**53%**	**25%**	**13%**	**6%**

- Duration not possible in given state

Twenty-three percent of online charter student test scores in the data set were from a year in which the student experienced a non-structural school change. For TPS students, the rate was only eight percent. Of course, one of those moves for online charter students would be for the student to enter the online charter school. This mandatory additional move inflates the mobility rate for online students. Even after we remove the initial move to the online school from the estimate, students who attend an online charter school still have a mobility rate of 15 percent, almost twice the rate of the VCR students. As we did not find higher mobility for online charter students before transferring to an online charter, the conclusion is that online charter students have more mobility after transferring to an online charter school. Table 8 shows the mobility rates for online and traditional students by state. The full online results include the switch to the online school. The limited online percentages include all school switches for online students except the initial switch to an online school. The full traditional values are the rates for the comparison students. In most states even after removing the triggering school switch to an online charter school, students attending online charter schools still have mobility rates of at least 1.5 times the rates of the comparison students in that state (column 5 of Table 8).

Table 8: Mobility Rates for Students by Sector and State

State	Full Online	Limited Online	Full Traditional	Comparison Ratio[10]
AR	14%	8%	5%	1.60
AZ	28%	21%	10%	2.10
CA	23%	16%	8%	2.00
CO	29%	20%	8%	2.50
DC	23%	18%	11%	1.64
FL	29%	17%	10%	1.70
GA	20%	12%	9%	1.33
IL	16%	10%	6%	1.67
LA	23%	11%	8%	1.38
MI	22%	16%	10%	1.60
MN	24%	15%	5%	3.00
NM	23%	19%	7%	2.71
NV	24%	15%	8%	1.88
OH	18%	12%	7%	1.71
OR	26%	16%	7%	2.29
PA	22%	13%	6%	2.17
UT	26%	17%	7%	2.43
WI	21%	10%	2%	5.00
Total	23%	15%	8%	1.88

A portion of the difference in mobility stems from the return of many online students to traditional schools after a period of time. Using testing data, online students were flagged as returning to the traditional sector if they have a test in a non-online school after they complete a test in an online charter school. The rate of return for unique students from the online charter setting to a traditional setting is 22 percent. One-in-five students who use online education eventually return to a traditional setting within the data window. Table 9 shows the percentage of online students who return to traditional settings remains steady as the number of students enrolling in online charter schools increases. Please note the rates in Table 9 of students returning from an online charter to a traditional setting is lower than the 22 percent figure given. This is because the 22 percent figure is for unique students; whereas the annual figures include multiple records for students with multiple years in an online school. Since 2009-2010, the annual percentage of students returning to the traditional setting has remained steady.

[10] Comparison ratio=limited online mobility rate/full traditional mobility rate

Table 9: Annual Rates of Return from Online School to Traditional Schools

Year	Online Charter Enrollment	Percent Returning to Traditional Setting
2008-2009	16,102	‡
2009-2010	32,620	16%
2010-2011	35,984	16%
2011-2012	43,471	16%
2012-2013	52,843	17%

‡Prior online charter status not available for all students.

Table 10 includes data for online charter students who leave an online charter school and return to TPS. As would be expected, grades in which students return to TPS has a similar but slightly lagged pattern as the grades when students enter online charter schools. Online charter students who return to TPS are most likely to do so in their 8th grade year.[11]

Table 10: Grade on Return to TPS from Online Charter School

Grade	N	Percentage of Total Returns
4	2,889	11.3%
5	3,490	13.7%
6	4,568	17.9%
7	5,524	21.7%
8	6,240	24.5%

The mobility rate for students' post-online school years are extremely high. Even after eliminating the switch from the online school to the traditional setting, former online students have a mobility rate of 36%. This suggests students who leave online schools have a more chaotic school experience post online.

Mobility and Student Characteristics

Another question related to mobility is whether student demographic characteristics are related to mobility. To examine this, CREDO compares mobility rates for students separated by race-ethnicity, poverty status, ELL status, and special education status.

Mobility by Race-Ethnicity

Mobility varies greatly by the race-ethnicity of the student. Minority students, black students especially, have a history of high mobility between schools. High levels of mobility, or the life issues causing high levels of mobility, are likely related to lower academic performance. Among the VCR students in the mobility data, this same pattern holds true. White and Asian VCR students have an average mobility rate

[11] It should be noted the drop off in students returning to TPS in the upper grades could be due to fewer tests being given in those grades. Students who return to TPS after 8th grade may not be included since the lack of upper grade tests would mean those students would not be in the data set.

of just 6 percent. Hispanic, Native American, and Multi-racial students have mobility of 10 percent. Black students have the highest mobility rate among the VCR students at 13 percent. The Black VCR mobility rate is twice that of the White and Asian students.

The patterns are quite different for the students in online charters. In addition to being higher overall, 23 percent for online charter students vs. 8 percent for VCR students, the disparity between white students and minority students is much smaller for online charter students. This shift in the differences between groups is being driven primarily by the higher mobility rates for white students enrolled in online charter schools. The mobility rates for each group of students is shown in Table 11. The comparison ratio is the relative difference between online charter student rates and VCR student rates. The results indicate that White students, and to a lesser extent Asian students, in online charter schools have much less stable educational histories as compared to their VCR counterparts.

Table 11: Mobility Rates by Race-Ethnicity and Sector

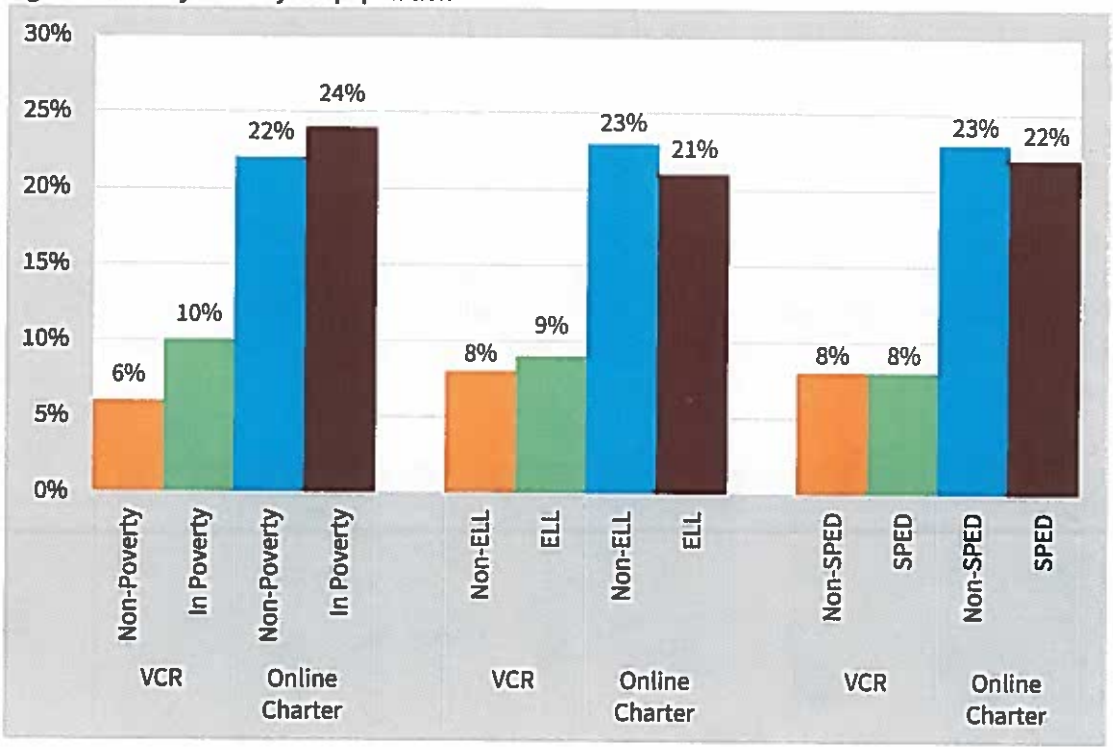
Group	VCR Students	Online Charter Students	Comparison Ratio
White	6%	22%	3.4
Asian	6%	19%	3.2
Black	13%	25%	2.0
Hispanic	10%	26%	2.7
Native American	10%	25%	2.6
Multi-Racial	10%	25%	2.5

Mobility by Student Sub-populations

Another set of student characteristics which have been shown to have an impact on educational attainment are students with exceptional needs. These are students who live in poverty, students who are English language learners, and special education students. Being a member of one of these sub-populations often comes with additional educational deficits. These deficits may be impacted by higher rates of mobility. Additionally, disaggregating mobility rates by membership in these sub-populations can provide additional insight to the unique characteristics of the online charter population.

Being an ELL student or special education student should have little direct impact on mobility. There are few direct factors with those characteristics which motivate a student's family to more frequently relocate to a different school zone. While migrant families do tend to have a higher rate of ELL students, most ELL students are not from migrant families. Poverty, however, has been shown to be highly correlated with high student mobility. Families of students in poverty often live in rental properties rather than owning their homes. This results in a lower transaction cost for moving within a community, so we tend to see many more moves for students in poverty. Students not in poverty generally have more stable home lives with less relocation. Figure 2 includes data for mobility rates of students from the various subpopulations.

Figure 2: Mobility Rates by Subpopulation



For online charter students, the mobility rates for ELL and special education students are approximately two-and-a-half times the rate of mobility for the same groups of students in TPS. In fact, the mobility rates are slightly lower for both online charter ELL students and special education students compared to the non-ELL and non-special education students in online charters. But the difference between students in poverty and non-poverty students who attend online charter schools is only two percentage points compared to a four percent difference in the VCR comparison group.

Overall, students who enroll in an online school demonstrate higher overall levels of mobility than VCR students. However, the mobility of online charter school students before they transfer to the online charter is similar to the rate of VCR students. Twenty-two percent of online charter school students eventually return to TPS schools.

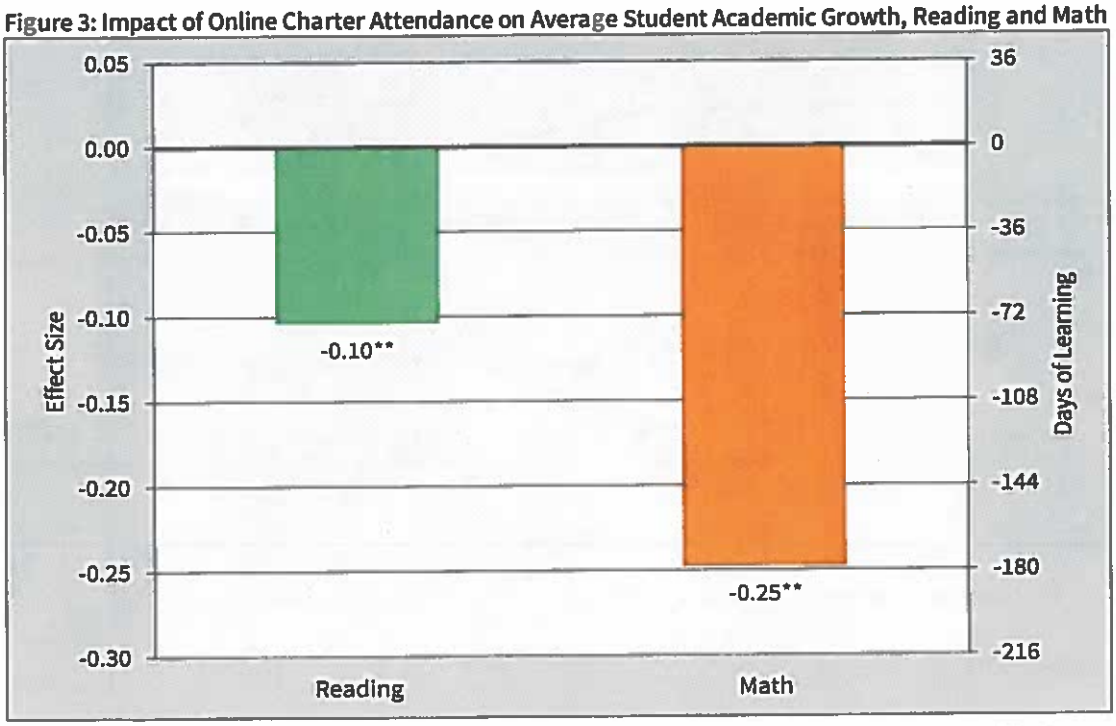
4. Impact Analysis

For the impact analyses, we compare the growth of students in online charter schools to that of their VCRs. This type of analysis provides information about the year-to-year change in achievement relative to that of the rest of the students in the sample. On average, the effect sizes for students attending online charter schools are negative. A negative effect size does not mean the student did not increase in academic achievement. A negative effect size means the student did not advance as much as expected based on the student's characteristics.

Online Charter Students Compared to Brick-District Students

The first set of analyses examines the academic growth of online charter students compared to the matched VCRs made up of students who attended brick-and-mortar district-run schools. These schools are typically referred to as traditional public schools (TPS). Compared to their VCRs in the TPS, online charter students have much weaker growth overall. Across all tested students in online charters, the typical academic gains for math are -0.25 standard deviations (equivalent to 180 fewer days of learning) and -0.10 (equivalent to 72 fewer days) for reading (see Figure 3). This means that compared to their twin attending TPS, the sizes of the coefficients leave little doubt attending an online charter school leads to lessened academic growth for the average student.

Figure 3: Impact of Online Charter Attendance on Average Student Academic Growth, Reading and Math



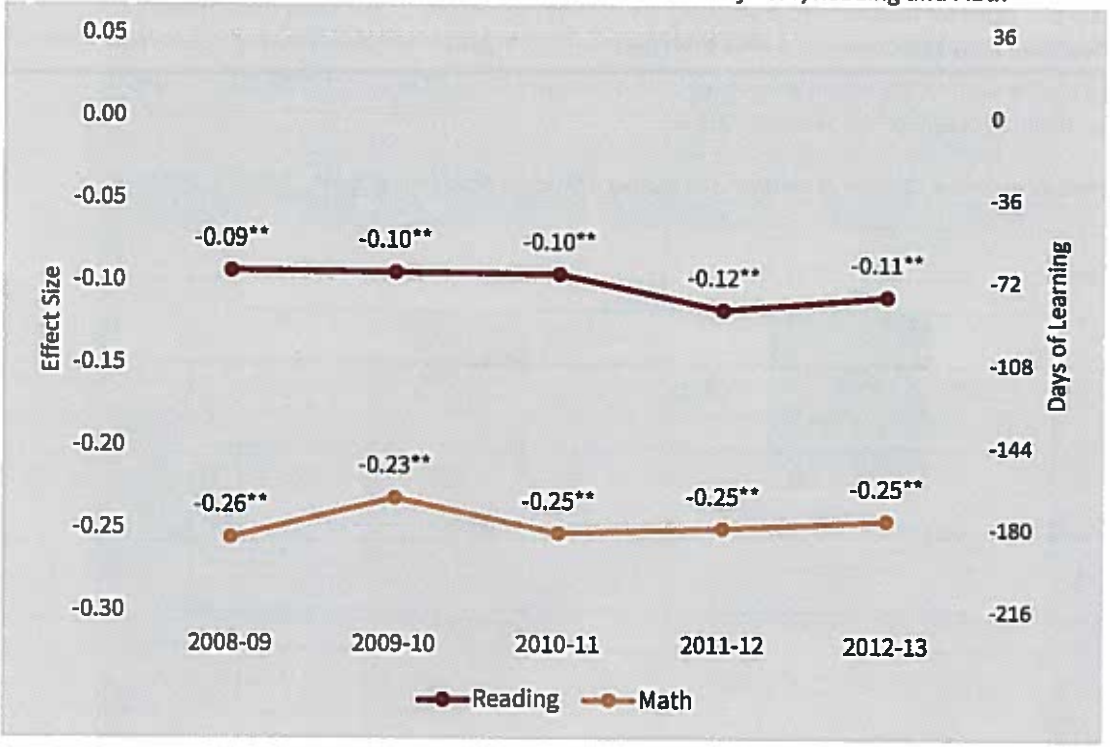
The 0.00 line for this graph represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

** Denotes significant at the .01 level.

These results cover all students with a growth measure (i.e., at least two years of tested performance) in all the states in all the periods. Accordingly these average measures of academic growth reveal that the general case for online charter students is not a positive one. The all-in figures, however mask the story of the underlying distribution. Around the average, some online charters will perform better and some will perform worse than the average. While overall results establish a baseline for discussion, these results are not subtle enough to provide insight for policy implications. A clearer picture of the more granular distribution around the averages along with the student or school factors that are associated with the distribution will add to a general understanding of the situation of online charters.

Figure 4 shows the results of this analysis. There is no consistent trend either upward or downward in the results. Instead the overall effect size in math stays fairly consistent over time. The overall effect size in reading shows a gradual dip, but recovers part of that loss in 2012-13.

Figure 4: Impact of Online Charter Attendance on Academic Growth by Year, Reading and Math



The 0.00 line for this graph represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

** Denotes significant at the .01 level.

In the 2009 CREDO charter school study, charter schools had on average weaker growth than their traditional public school counterparts (Raymond, 2009). The 2013 update to that study showed stronger results for the charter sector compared to the TPS (Cremata, Dickey, Lawyer, Negassi, Raymond, and

Woodworth, 2013). An examination of growth trends for brick-and-mortar charter schools in the 2013 study showed a pattern of slow but gradual improvement over the past several years. Taking into consideration the newness of the online sector, it is possible such a pattern might appear here as well given sufficient time.

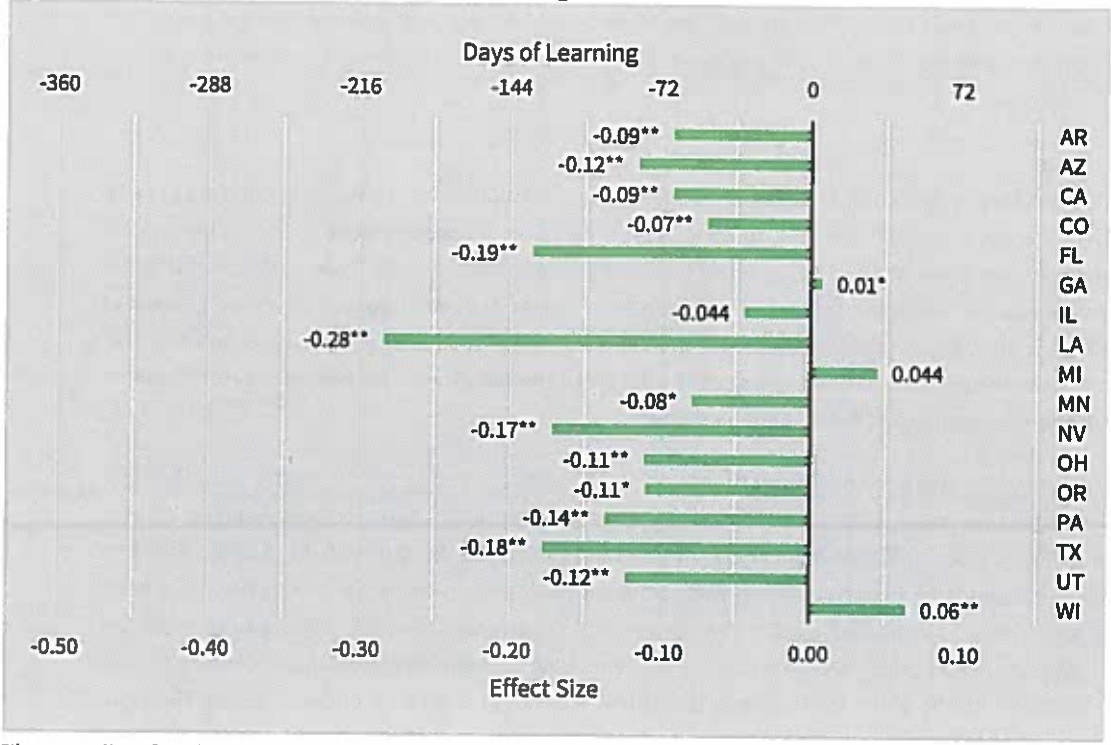
Results by State

To delve deeper, we also included analyses of online charter attendance by state. In the full-data general case analysis, we use statistical methods to control for differences between states. In the online charter by state analyses, we examine the impact of online charter attendance by each state as compared to the state's average student academic growth. In Figure 5 and Figure 6 the zero line is the average **growth** of a VCR student in the state. A positive effect size means the average online charter student had stronger growth than the average comparison. A negative effect size means growth for online charter students was weaker than the average VCR comparison student.

While the majority of states have negative effect sizes for students attending online charter schools, there are a few exceptional states with no difference or even positive effect sizes between online charter students and TPS students. Figure 5 shows the impact for online charter students in reading. Thirteen states have negative effect sizes in reading, two states positive, and in two states the differences were not significant[12]. As was indicated by the general results, the average reading effect size is negative; however in Wisconsin and Georgia, online charter students have growth which was significantly stronger than their VCRs. While the value for Michigan is positive and larger than that of Georgia, the Michigan value is not significant. This means we cannot be certain the result is not spurious or due to chance; thus it is described as "not different".

[12] DC was not included in these analyses due to insufficient number of schools.

Figure 5: Online Charter Effect Size by State, Reading



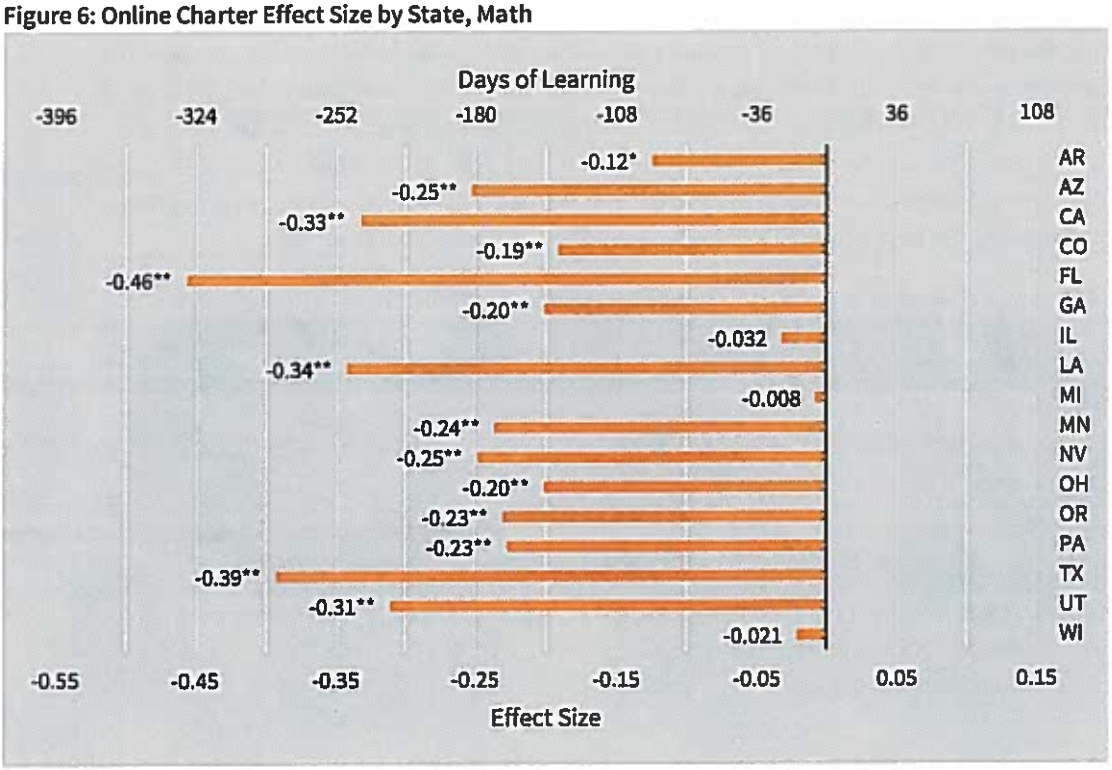
The 0.00 line for this graph represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

The effect sizes by state in math are shown in Figure 6. The effect sizes for math were both more negative and larger than those for reading. In 14 states, the impacts on math growth of attending an online charter school were significantly weaker than the comparison group. Three states had effect sizes which were not different from the comparison groups. No state had a positive effect size in math on average.

The math and reading results show there is a large amount of variation in the effectiveness of online charter schools in promoting academic growth in students attending those schools. The reasons behind this variation is a topic for future study. Practices in those states who are producing positive results may hold useful lessons for the remaining states.

Figure 6: Online Charter Effect Size by State, Math



The 0.00 line for this graph represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Sub-populations

Race-ethnicity

Exploring deeper into the performance question of schools requires us to examine the various sub-populations served by schools. In past studies of charter schools (Cremata, et al., 2013), CREDO has found evidence that students of different racial-ethnic backgrounds have different impacts on academic growth from attending charter schools. It has become standard practice to report academic growth by racial-ethnic groups. In the past, part of the motivation for the separate look at each student subgroup stems from the explicit mission of some charter school operators to serve communities whose students have historically fared poorly in school.

The student populations that online charter operators serve was shown in Table 2 to have greater proportions of White students and smaller shares of Hispanic and English Language Learner students.

While there is variation in the effect sizes of racial-ethnic groups, they are still all consistently negative.[13] Table 12 has the effect sizes in math and reading equal to the difference in performance between TPS students and online charter students for each of the racial-ethnic groups. Results were consistently less negative for reading than for math across all groups. Additionally, reading effect sizes are much more consistent between groups ranging from -0.08 (56 days) to -0.12 (86 days). White students in online charters have larger differences in growth relative to their TPS peers than all other groups except Native Americans in reading, but better than all sub-populations except Black students in math.

Table 12: Effect Size of Attending Online Charter School by Racial-Ethnic Group, Reading and Math

Racial-Ethnic Subpopulation	Reading	Days of Learning	Math	Days of Learning
White	-0.11**	-79	-0.25**	-180
Black	-0.08**	-58	-0.22**	-158
Hispanic	-0.11**	-79	-0.29**	-209
Asian/Pacific Islander	-0.09**	-65	-0.26**	-187
Native American	-0.12**	-86	-0.30**	-216
Multi-Racial	-0.09**	-65	-0.26**	-187

The effects in this table represent the difference between a student of a specific race in TPS and a student of the same race in an online charter school.

** Denotes significant at the .01 level.

Students in Poverty

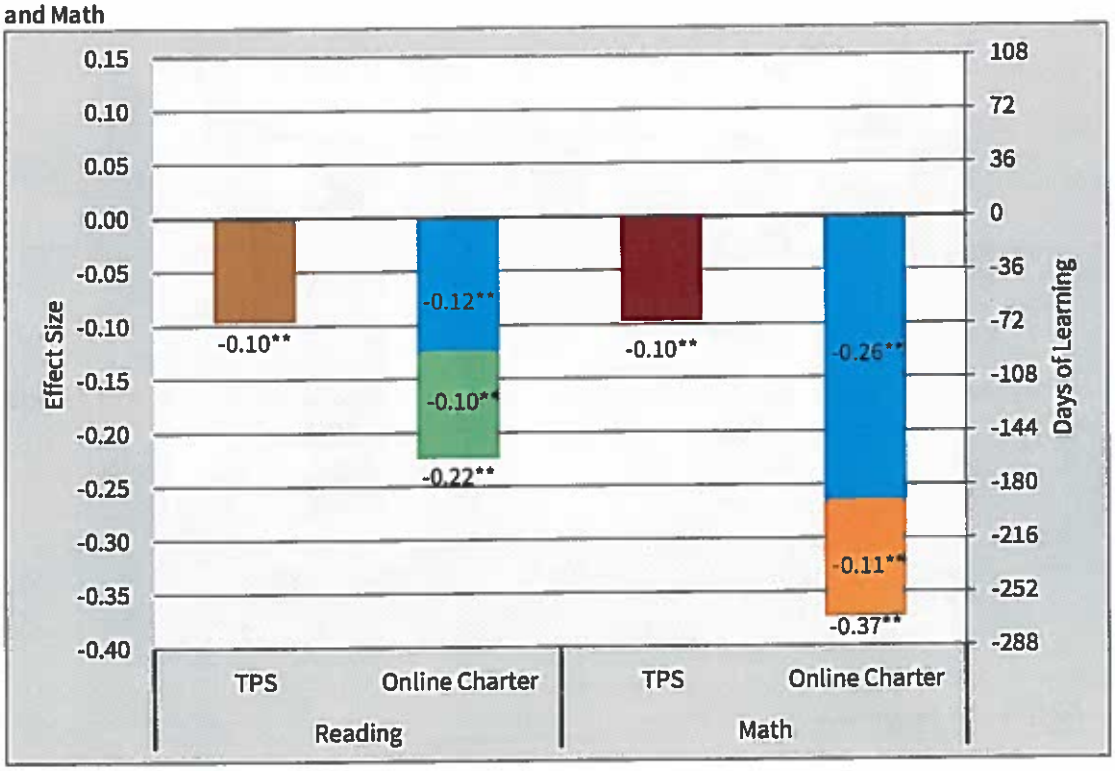
Race-ethnicity is not the only student characteristic which commonly has an impact on students' academic growth. Students in poverty, those who are English language learners, and special education students also often have academic growth which differs from the typical comparison student.

The average growth for students in poverty is generally lower than that for students who are not in poverty. In this analysis, the baseline comparison is TPS students who are not in poverty. We isolate the relationship between poverty and growth. This leaves a picture of the difference in the impact of online charter attendance on students in poverty compared to similar students who are not in poverty. The bars for online charter schools in Figure 7 consist of two different colors. The blue portion of the bar represents the average impact of attending an online charter school which effects all online charter students. The remainder of the bar represents the average difference between being an online charter student in poverty and an online charter student not in poverty. The total length of the bar is the average expected impact on growth of being an online charter student in poverty compared to being a TPS student who is not in poverty. Figure 7 confirms that being a student in poverty results in lower academic growth in both math and reading for all student groups regardless of the type of school attended with the online charter

[13] The survey of online charter providers also showed that they did not target any particular student demographically, but rather sought students with particular academic profiles. Thus a breakout of performance by the ordinary categories may not be as pertinent in an online environment as elsewhere.

student having the more negative overall effect. Figures 8 and 9 are read in the same manner with the blue portion of the bar representing the negative effect which all charter students face.

Figure 7: Overall Academic Growth for Students in Poverty Compared to Students Not in Poverty, Reading and Math



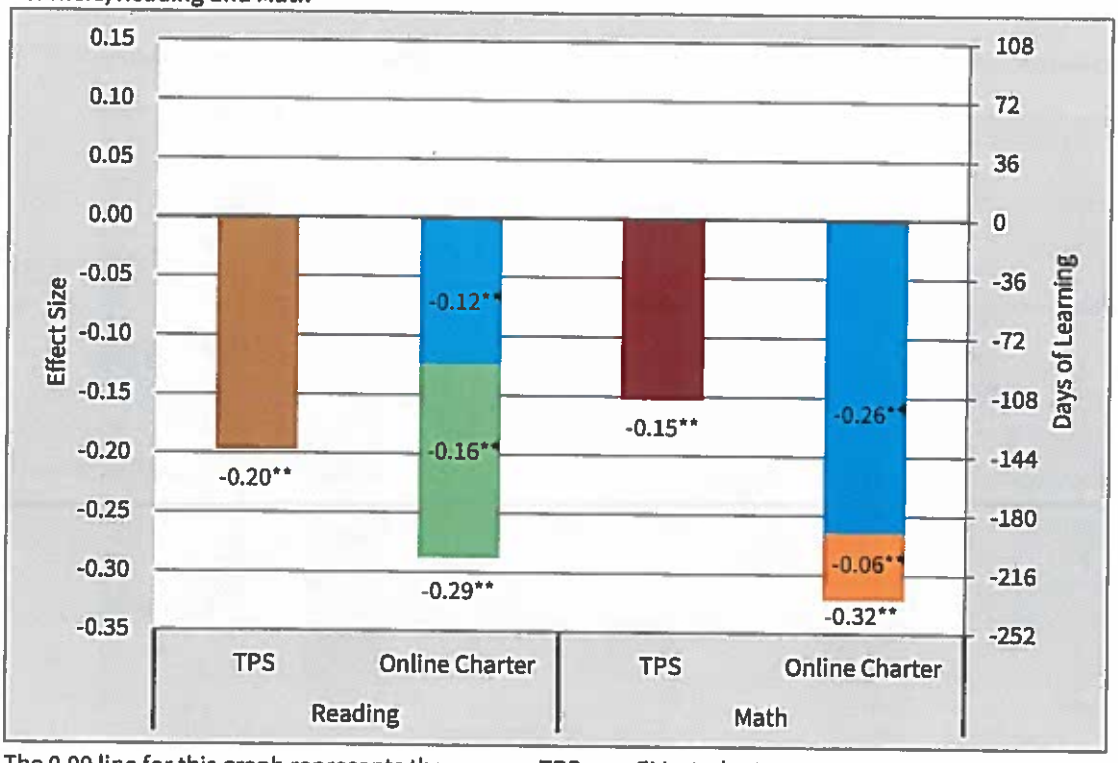
The 0.00 line for this graph represents the average non-poverty TPS student.

** Denotes significant at the .01 level.

English language learners

As with students in poverty, students who are English language learners tend to progress academically more slowly than students whose primary language is English. This is potentially even more of an issue in an online setting where students typically rely more heavily on reading as the primary method of curriculum delivery. Again, the data show that English-language learners in the data set have weaker growth as a group than non-English language learners. Figure 8 shows the growth for English language learners as compared TPS native English speakers.

Figure 8: Overall Academic Growth for English Language Learners Compared to Non-English Language Learners, Reading and Math



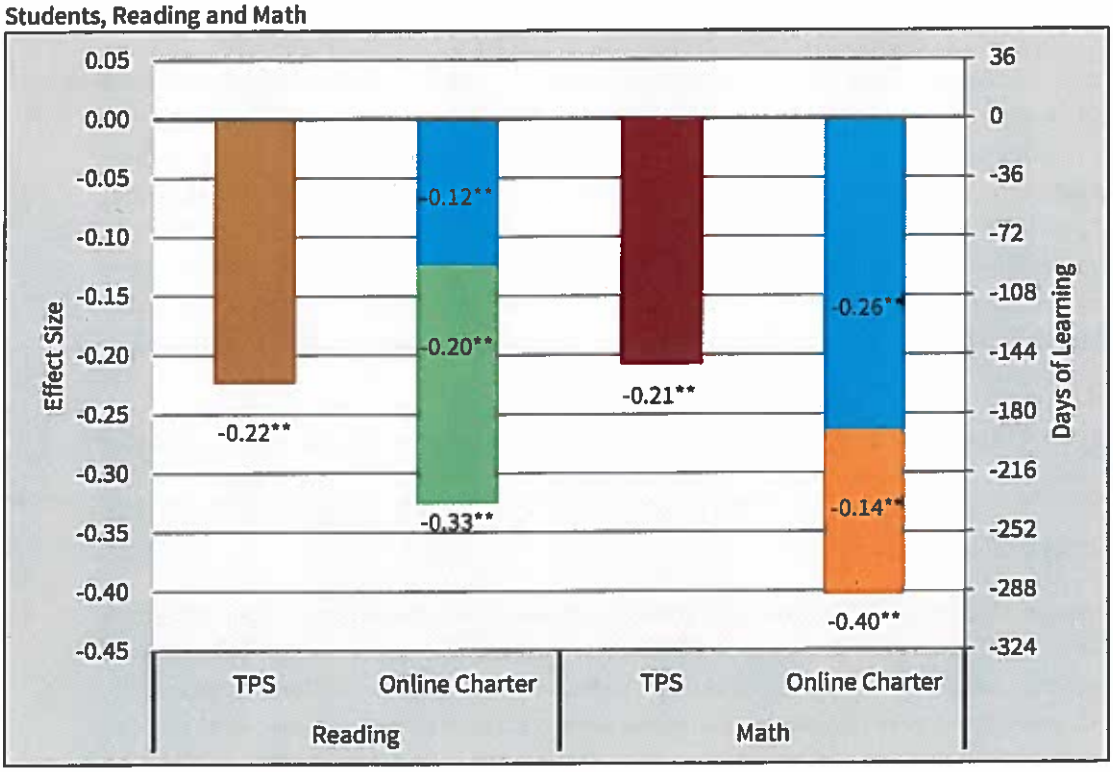
The 0.00 line for this graph represents the average TPS non-ELL student.

** Denotes significant at the .01 level.

Special education students

Another sub-population with significant impacts from online charter attendance is special education students. Again, special education students as a whole demonstrate weaker academic growth than their non-special education classmates as seen by the comparison of overall academic growth of special education students regardless of race/ethnicity or school type attended to non-special education student VCRs (see Figure 9).

Figure 9: Overall Academic Growth for Special Education Students Compared to Non-Special Education Students, Reading and Math



The 0.00 line for this graph represents the average TPS non-SPED student.
** Denotes significant at the .01 level.

Online charter schools again demonstrate an ability to reduce the impacts of being a SPED student compared to non-SPED students. Math academic growth for students in online charters is significantly less negative compared to their non-SPED schoolmates, represented by the orange portion of the online charter bar, than that of the SPED VCRs and their classmates, the red bar. However, the full effect of being a special education student in an online charter school is still more negative overall than being a special education student in a TPS.

Interpretation of Subpopulation Effects

To help the reader to better understand the marginal differences in effect sizes included in the sub-population analyses, we have included the two figures below. Figures 10 and 11 show the expected value of the effect size[14] for student profiles with certain combinations of characteristics. The column on the left shows the expected value of the effect size for each student profile in a traditional public school setting. The column on the right shows the expected values for the same student profiles if the student

[14] Effect sizes in Figures 10 and 11 represent growth of each profile relative to White non-ELL non-poverty non-SPED students.

attended an online charter school. The higher a profile is positioned up the vertical axis, the stronger the expected growth for a student with that profile. The number after the profile is the expected effect size for that profile.

The student profiles include a profile for each racial-ethnic group students who are not ELL, not SPED, and not in poverty. There are additional profiles are for each racial-ethnic group with one of the three additional factors (ELL, SPED, in poverty) included. Student profiles which do not specifically state they include ELL or SPED or in poverty do not have those features. We did not produce profiles for every possible combination of race-ethnicity and the three factors as doing so would have made the figures unreadable. However, as the effect sizes for ELL, SPED, and being in poverty are additive, any profile which includes a combination of ELL, SPED, and/or poverty would appear lower on the vertical axis than the profiles shown with only one factor.

Figures 10 and 11 demonstrate how the findings from the subpopulation analyses impact expected student growth. All student profiles regardless of race-ethnicity or other factors have weaker growth in online charter schools than in TPS. This is due to the overwhelming negative impact on student growth from attending an online charter school.

ELL students and SPED students of a given race-ethnicity have weaker expected growth than students of the same race-ethnicity who are not ELL or SPED; however, as shown in Figures 8 and 9, online charter schools are more successful in minimizing these negative impacts relative to their sector average in math. This is most apparent in Figure 11 when comparing the performance differences between Asian non-ELL non-poverty non-SPED students with Asian ELL students between the two sectors. The distance between the dots representing the Asian non-ELL non-poverty non-SPED and Asian-ELL students on the TPS line is much larger than the same distance on the online charter line.

Figure 10: Expected Values of Effect Sizes by Student Profile, Reading

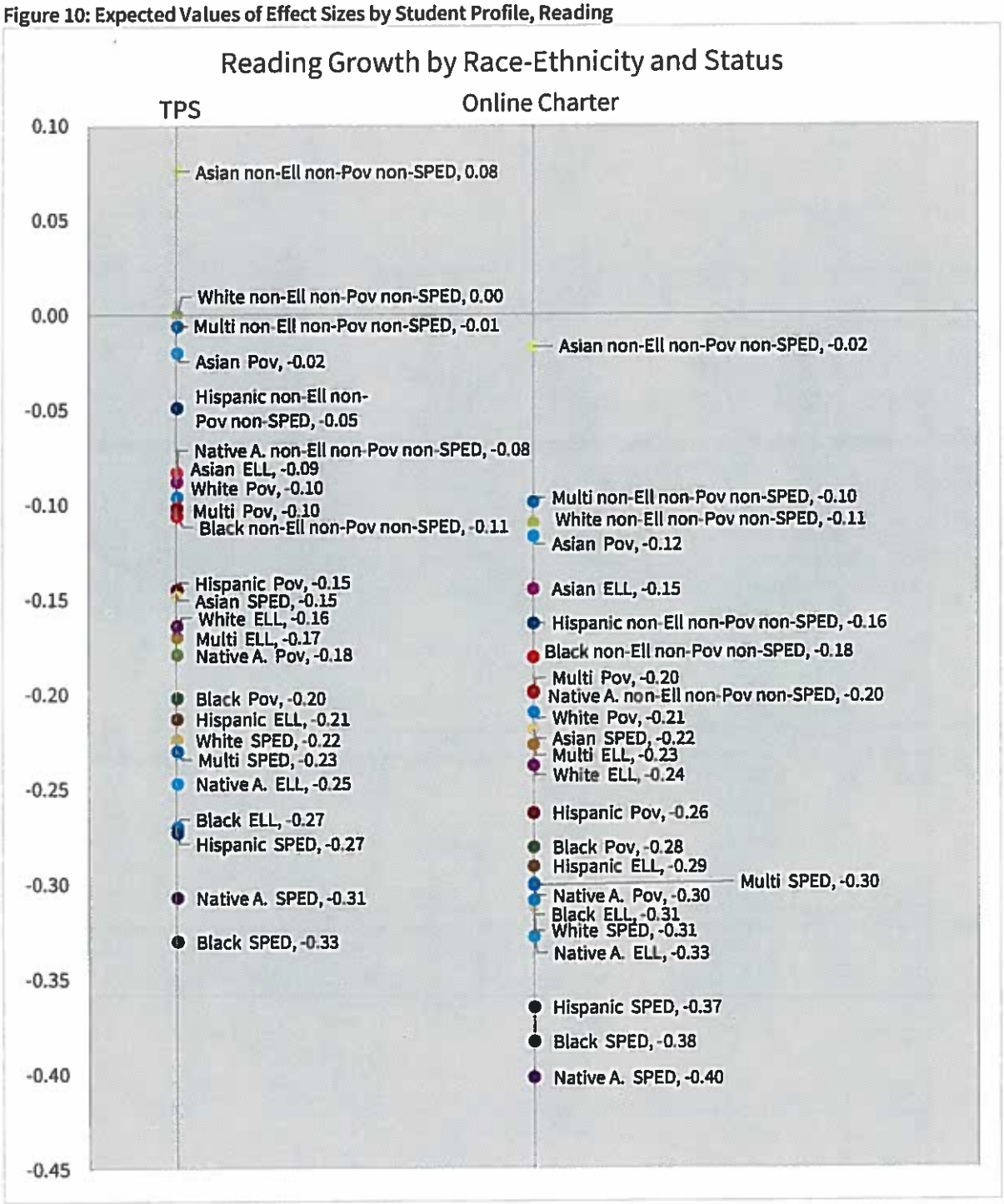
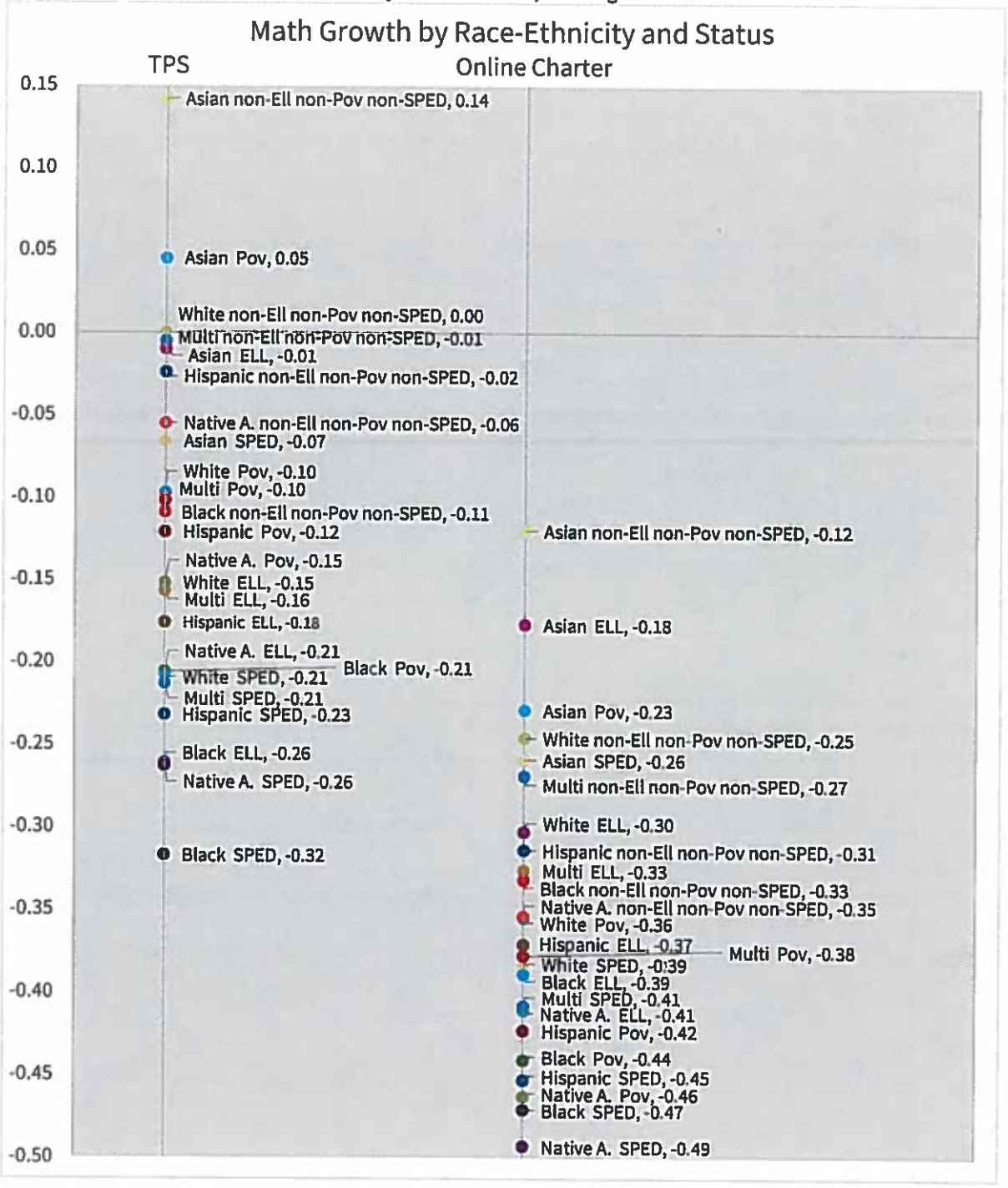


Figure 11: Expected Values of Effect Sizes by Student Profile, Reading



Online Charter Schools Compared to Brick-District Schools

In its 2009 charter school study, CREDO introduced the idea of the school quality curve. The quality curve uses a statistical model to compare each charter school to a virtual school consisting of the VCRs for students from each charter school. This is a strong comparison as it allows the reader to see how individual online charter schools compare to a school of their peers. These measures use a smaller growth period data window made of the last two growth periods as opposed to the four growth period data window of the student analyses.[15] To minimize the statistical inconsistencies which may arise from including schools with only a few students, we limit this analysis to only schools with at least 30 tested students per year.

The quality curve consists of three categories, those schools with average growth statistically significantly lower than that of their feeders, those with average growth which is not statistically different from their feeders, and those schools with average growth statistically significantly stronger than their feeders. These three categories are distinct. The placing of a school into each category has different meaning as to the performance of the school. As such, readers should resist the urge to combine categories from this analysis. Specifically, it is improper and can be misleading to state "x% of schools performed stronger or no different than their local market" just as it is improper to combine the weaker and no different schools. These numbers should always be reported as three separate categories.

Compared to their comparison schools, online charter schools generally have significantly weaker academic growth. Figure 12 shows the quality curve in reading. As there are 101 schools in the quality curve, the numbers represent both the number and percentage of schools in each category. Only two percent of the online charter schools outperform their comparison schools, 32 percent perform no differently, and 67 percent have weaker growth than their comparison schools. In math, a full 88 percent of online charter schools had significantly weaker growth than their comparison. These numbers are extremely weak compared to charter school performance found in previous CREDO studies.

While these numbers clearly show students attending online charter schools are not performing at the level of their comparisons, it is important to note the incredibly large size of the individual school feeder pools may have consequences on the strength of the aggregated VCR matches. With the elimination of the restraints of physical location, online schools pull students from a much broader portion of the state than do standard schools of choice. This increases the number of schools in the comparison group and weakens the comparability between each online charter school and its feeders compared to CREDO's other studies. Online charter schools tend to serve a much higher percentage of white students than TPS. Previous studies have consistently shown white students have smaller effect sizes from charter attendance than minority students. Also, online charter students have higher mobility rates than the

[15] The shorter period is necessary as the online charter sector in some states, as well as many individual online schools, are expanding at an exponential rate and comparisons from the earlier years may not reflect the current state of performance for the smaller samples which make up individual schools.

students who make up their VCRs. School instability has long been demonstrated to have a negative impact on student growth (South, Haynie, and Bose, 2007).

Due to the large number of feeder schools from which online charter schools attract their students, the TPS comparison groups for the quality curve consists of a much larger proportion of the schools in the state than the typical charter school. As a consequence, the bar for online schools in this comparison was high. In reading, even though only two online charter schools outperformed their comparison schools 18 of the online charter schools had achievement higher than their state's average achievement. Eleven of the 32 schools with growth not significantly different from their comparison schools had achievement above their state's average achievement, and six schools with weaker growth than their comparison school had achievement above the state mean. In math, none of the online charter schools had average achievement scores higher than their state average.

Figure 12: Online Charter School Quality Curve: Reading and Math

Even with these caveats firmly in mind, the percent of online charter schools whose students have weaker growth than their comparison is concerning. The qualifying argument of some online school providers is many of their students would have otherwise dropped out of school entirely. Thus any educational gains no matter how small are of benefit to the students and society. This argument may be justified when applied to high schools students, of which online charter schools have a higher percentage, but does not take into account the outcomes for elementary and middle schools students enrolling in online schools.

Network Affiliation

Being part of a larger network of schools may allow online charter schools to take advantage of economies-of-scale in purchasing supplies and equipment. But more importantly online charter schools in a network may be able to leverage human capital gains across multiple schools.

The overall results for online charter schools in a network do not show a significant difference in effect sizes for schools which are part of a larger network as compared to independent online charter schools. The results show no statistically significant difference for academic progress in either subject. This is not to say, however, that all networks of charter schools perform the same.

Charter schools in the same network often share resources such as curricula, operational practices, and personnel training programs. If the schools within a network consistently produce common outcomes which are significantly above or below those of independent online charters and other schools in other networks, it is reasonable to presume the schools in that network are doing something different from the other schools. The statistical models used already account for differences in the starting academic endowments of students. Further, due to the wide geographic range of online charter schools, the results are likely not due to locale. This points to network resources such as work processes, teacher recruiting/training/retention, or other shared resources as the source of the network's higher or lower performance. To investigate this, CREDO applies a statistical model which isolates the impact on student growth of affiliation with each network.

Table 13 shows that even the students who attended the highest performing online network schools had academic growth which was weaker or not significantly different when compared to VCRs attending school in TPS settings. A value of 0.00 in Table 14 would be equal to the performance of the average brick-and-mortar TPS.

Table 13: Effect Sizes by Network Compared to Average VCR, Reading and Math

	Reading	Days of Learning	Math	Days of Learning
Network 1	0.07	48	-0.17**	-124
Network 2	-0.02	-12	0.03	21
Network 3	-0.02	-15	-0.19**	-134
Network 4	-0.05**	-39	-0.16**	-114
Network 5	-0.07**	-48	-0.05**	-32
Network 6	-0.07**	-48	-0.21**	-152
Network 7	-0.09*	-66	-0.16**	-116
Network 8	-0.12**	-83	-0.27**	-191
Network 9	-0.12*	-84	-0.21**	-150
Network 10	-0.14**	-98	-0.28**	-202
Network 11	-0.15**	-105	-0.28*	-199
Network 12	-0.15**	-107	-0.20**	-147
Network 13	-0.15**	-109	-0.27**	-193
Network 14	-0.16**	-114	-0.25**	-177
Network 15	-0.17**	-121	-0.30**	-218
Network 16	-0.18**	-126	-0.18**	-130
Network 17	-0.18**	-130	-0.33**	-235
Network 18	-0.22**	-156	-0.36**	-260
Network 19	-0.26**	-188	-0.49**	-353
Network 20	-0.28**	-204	-0.50**	-360
Network 21	-0.35**	-250	-0.38**	-274

The 0.00 value for this table represents the average TPS, White, non-poverty, non-ELL, non-SPED student.
** Denotes significant at the .01 level.

Table 13 shows the impact of attending an online charter school as compared to TPS schools, but it is also interesting to see how networks perform within the online charter sector. Table 14 provides the results of this analysis using the same data as Table 13 re-centered on the average non-network online charter student. Table 14 shows a marked variation in the average performance of online charter schools by network as compared to the average independent online charter school. A value of 0.00 in Table 14 would be equal to the performance of the average independent online charter school.

Table 14: Effect Sizes by Network Compared to Independent Online Charter Schools, Reading and Math

	Reading	Days of Learning	Math	Days of Learning
Network 1	0.16**	115	0.06	43
Network 2	0.08**	58	0.26**	187
Network 3	0.08**	58	0.05	36
Network 4	0.04**	29	0.08**	58
Network 5	0.03	22	0.19**	137
Network 6	0.03	22	0.02	14
Network 7	0.00	0	0.07	50
Network 8	-0.02	-14	-0.03	-22
Network 9	-0.02	-14	0.02	14
Network 10	-0.04	-29	-0.05**	-36
Network 11	-0.05*	-36	-0.04	-29
Network 12	-0.05**	-36	0.03	22
Network 13	-0.06	-43	-0.04	-29
Network 14	-0.06**	-43	-0.01	-7
Network 15	-0.07**	-50	-0.07**	-50
Network 16	-0.08**	-58	0.05**	36
Network 17	-0.09**	-65	-0.10**	-72
Network 18	-0.12**	-86	-0.13**	-94
Network 19	-0.17**	-122	-0.26**	-187
Network 20	-0.19**	-137	-0.27**	-194
Network 21	-0.25**	-180	-0.15**	-108

The 0.00 value for this table represents the average Online Charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Online Charter Students Compared to Brick-Charter Students

It is possible the differences in performance between online charter students and brick-district students is due to the charter nature of the online charter schools rather than the online nature. To address this concern, we created an additional matched data set in which we matched online charter students to brick-charter students using the same algorithm we typically use to match charter students to TPS (i.e. matched online charter students to demographically identical students in brick-and-mortar schools from which the online charter students transferred). We then repeated all the analyses using this brick-charter as VCR set (see Appendix B for full results). The summary in Table 15 shows the results between the two samples were highly similar. There were no major differences between the two sets of analyses. These results confirm that the findings presented above are a result of the online aspect of the schools as opposed to the charter aspect.

Table 15: Summary of Significant Online Charter Impacts by VCR Group

	Reading		Math	
	TPS VCR	Brick-Charter VCR	TPS VCR	Brick-Charter VCR
Overall	Negative	Negative	Negative	Negative
White	Negative	Negative	Negative	Negative
Black	Negative	Negative	Negative	Negative
Hispanic	Negative	Negative	Negative	Negative
Asian	Negative	Negative	Negative	Negative
Native American	Negative	Similar	Negative	Negative

Mixed-Methods Analyses

The quantitative analysis of online charter impact results provides insight into how growth differs from a TPS student for those students who attend an online charter school. However, that information is the starting point to the larger question of why does attending an online school impact the students' growth. To delve deeper into the mechanisms behind the answer to the question of why, we can combine data on student achievement with information about the schools which students attend. We do this by estimating correlations between the presence (and in some cases dosage) of practices included in the survey and student achievement for students who attended online charter schools.[16]

While these models may provide some insight into the relationships between school practices and student achievement, they are not causal, that is to say we cannot prove the presence of a particular school policy creates the impact seen in the quantitative analysis. Such correlational examinations are interesting in that they point towards areas for additional research using causal models as well as provide information for future policy trials by online charter providers. It should also be noted the sample size of schools with both survey data and impact data was small (n=60) which limits the generalizability of these results.

Student Testing Data and School Survey Data

For the student-level comparisons, we were able to use statistical models which controlled for differences in race-ethnicity, gender, SPED, ELL, and poverty status of students to estimate effect sizes for several factors. Factors in the survey group naturally into clusters: curriculum, instructional practices, parent/student expectations, communications, student supports, etc. Results for the different clusters of questions are presented below. Again, while these results provide information about the relationship between online charter school characteristics/practices and student academic growth, they should not be considered causal.

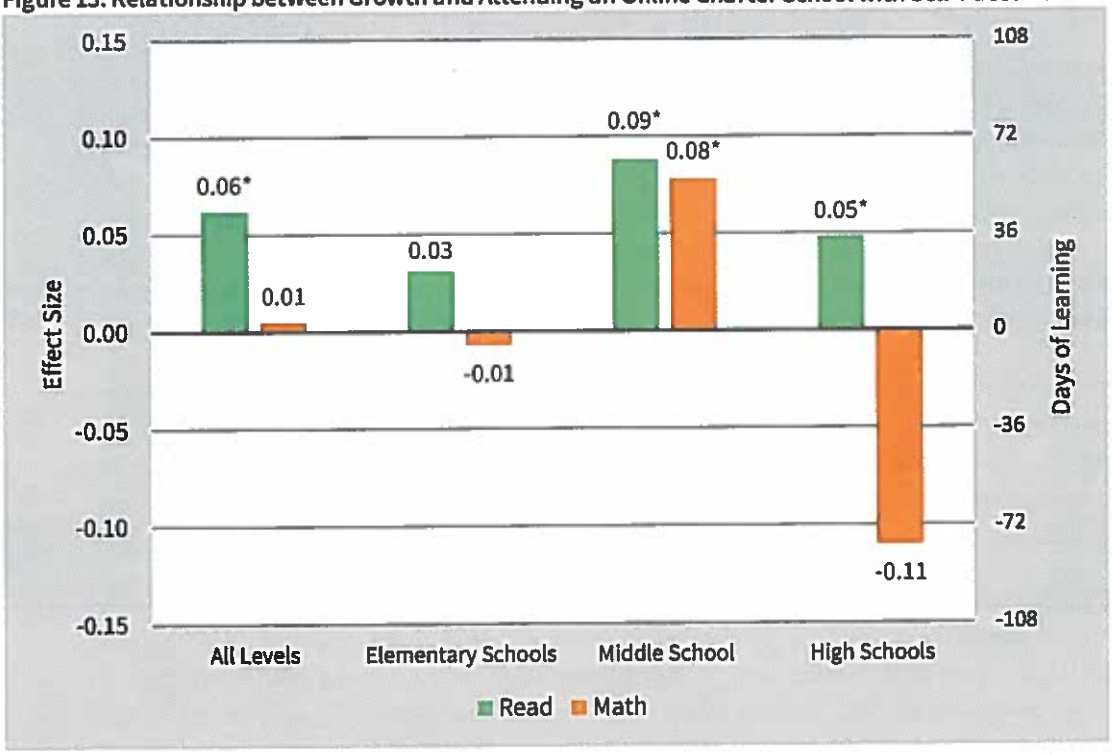
[16] As the survey was not administered to TPS school leaders, these correlations relate to online charter schools only. This means a positive or negative correlation represents growth which is stronger or weaker than the online charter average growth.

Self-Paced Delivery

A major characteristic of online education is the ability for curricula to be consumed in a self-paced manner. While some brick-and-mortar schools have broken away from the standard model by using a lesson structure in which students work through self-paced lessons, usually via technological delivery, most still use the typical single class lessons.

The survey administered by Mathematica asked online charter schools if they offered courses that are entirely self-paced. Seventy-sever percent of schools state they offer some entirely self-paced courses. CREDO's analysis of student academic growth finds students attending schools offering self-paced courses have academic growth in math which is not significantly different from schools not offering self-paced courses, but stronger growth in reading. However, it is reasonable to propose the ability to work independently in a self-paced course is a function of age. Younger students likely require more academic support than older students, thus the impact of participating in self-paced courses may differ by school level. Figure 13 shows the effect size of attending an online charter school which permits some level of self-paced courses by school level.

Figure 13: Relationship between Growth and Attending an Online Charter School with Self-Paced Classes



The 0.00 line for this graph represents the average online charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level.

Attending a school which allows self-paced courses has a significant positive relationship in reading for schools of all levels combined compared to online charter schools which do not allow self-paced courses. Breaking the effect out by school level shows the relationship is positive and significant for middle school and high school students, but not significantly different for elementary students. The relationship in math, however, was very different. The overall relationship for students in math was not significantly different from zero, and only for middle school students was access to self-paced math classes a positive benefit on academic growth. While the effect size in math for high school students was large, it was not significant. This means the effect could be due to chance even with its large size.

The survey results also contain information about the dosage of self-paced coursework. The question asks what percentage of a school's coursework is entirely self-paced. The responses ranged from five percent to 100 percent of coursework being self-paced with the most common answer being 100 percent. The statistical models show increasing the percentage of self-paced work has a negative relationship on academic growth in both reading and math. At first, this may not seem logical, especially in reading where having access to self-paced courses has a significant positive effect size. But, the apparent inconsistency can be explained by the concept that just because a proper dose of something is good, it doesn't mean a larger dose is better.

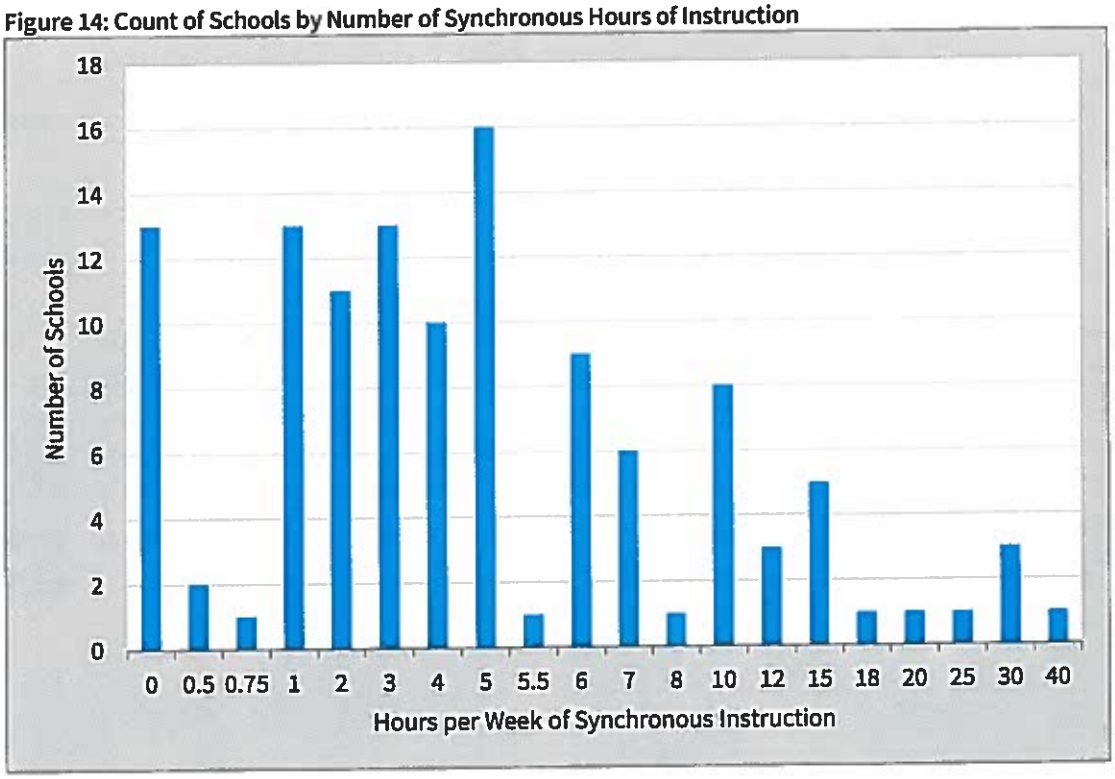
Synchronous vs. Asynchronous

Another element of curricula delivery is whether students complete work at the same time as a group or on their own schedule. Synchronous delivery is typically described as all students receiving instruction at the same time. Synchronous instruction is exemplified by the historical model in which the teacher teaches a lesson to the entire class all at once. Online schools can adopt various levels of synchrony in their curricula deliveries. Some schools may function exactly like the traditional brick-and-mortar school. They may require all students to log in at specific times to receive instruction with the only difference from a traditional brick-and-mortar school being that the students are in different physical locations.

Some online schools fully embrace the asynchronous model by allowing students to complete educational requirements whenever they wish. In fully asynchronous schools, students can meet their educational commitments at odd hours which better fit around the students' other activities, such as work or training. Even the number of days or number of hours a student must devote to educational experiences can be flexible in a fully asynchronous setting.

The Mathematica survey also addressed the hours of instruction which was synchronous by school level. The statistical models do not show any significant relationships in either reading or math at any school level based on the hours of instruction which was synchronous. As with self-paced instruction, schools varied greatly on the amount of time they spent in synchronous instruction. Figure 14 contains the number of online charter schools from the survey and the number of hours students in each school spend in synchronous instruction.

Figure 14: Count of Schools by Number of Synchronous Hours of Instruction



Class Size

The Mathematica survey includes information at each school level, elementary, middle, and high, on the average course size in the online school in both reading and math. The class size for ranged from one student per class to 180 students per class. Table 16 has the average class size and maximum class size by school-level. The impact of class size was significant and positive for middle school and high school students in both reading and math. While the effect size was very small, only .001, this is the impact per additional student.

Table 16: Reported Average and Maximum Class Size by School Level

	Average Class Size	Maximum Class Size
Elementary School	39	70
Middle School	60	150
High School	71	180

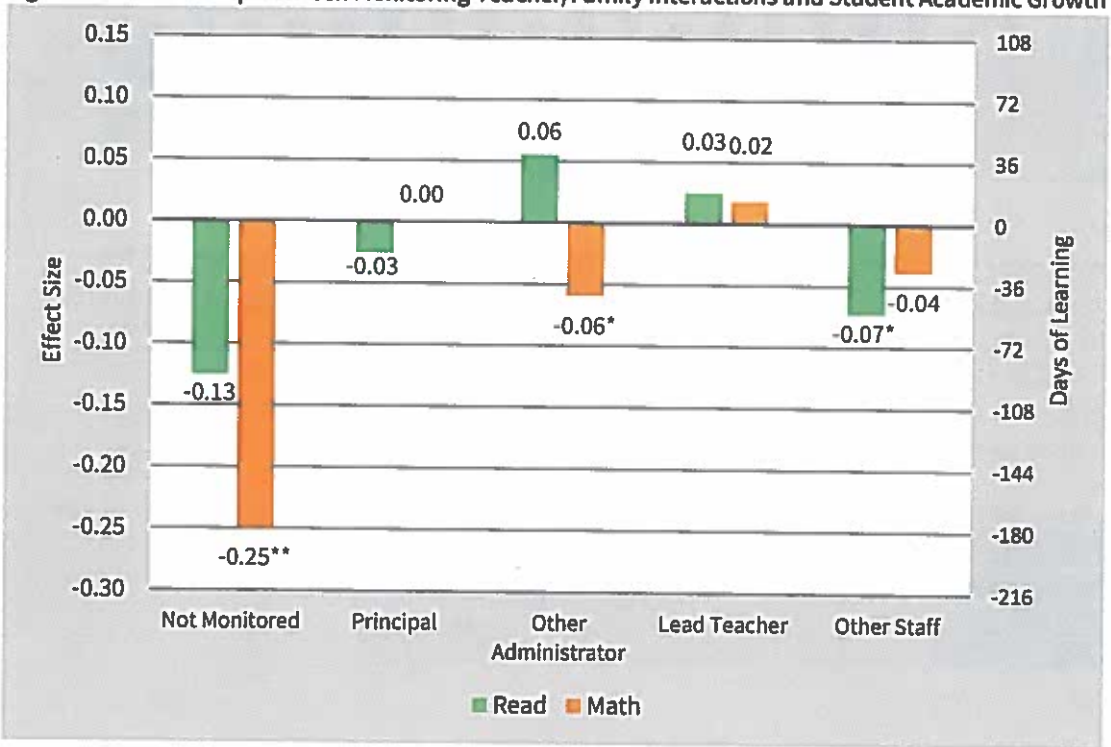
School and Family Interactions

One of the more interesting sets of questions included in the survey was an inquiry into the relationship between the school and the family receiving services. This line of questioning is of interest because schools employ a wide variety of policies. As the online student and their family may be located some

distance from the school's center of operations, it is possible no one in the family has ever had an in-person interaction with the teachers or a school administrator. Even if the family has visited the school operations center, it is still possible the teacher works out of a third location remote to the student and the operations center. These remote practices are different from the standard education model whereby teachers interact with students on a daily basis and provide parents with regular conference opportunities. Departures by some online schools from the traditional educational model also include a shifting of the responsibility for supervising educational progress and participation from the teacher to the parents.

The Mathematica survey includes a question about who monitors the interactions between the online teachers and students/parents. The options were: contact is not formally monitored, principal, other school administrator, lead mentor/teacher, other staff not listed. School leaders completing the survey were allowed to choose all answers which applied to their school. Results from the statistical models are very revealing about the need for someone to monitor these interactions. Figure 15 includes the relationships between student scores and attending a school which uses each policy.

Figure 15: Relationship between Monitoring Teacher/Family Interactions and Student Academic Growth



The 0.00 line for this graph represents the average online charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

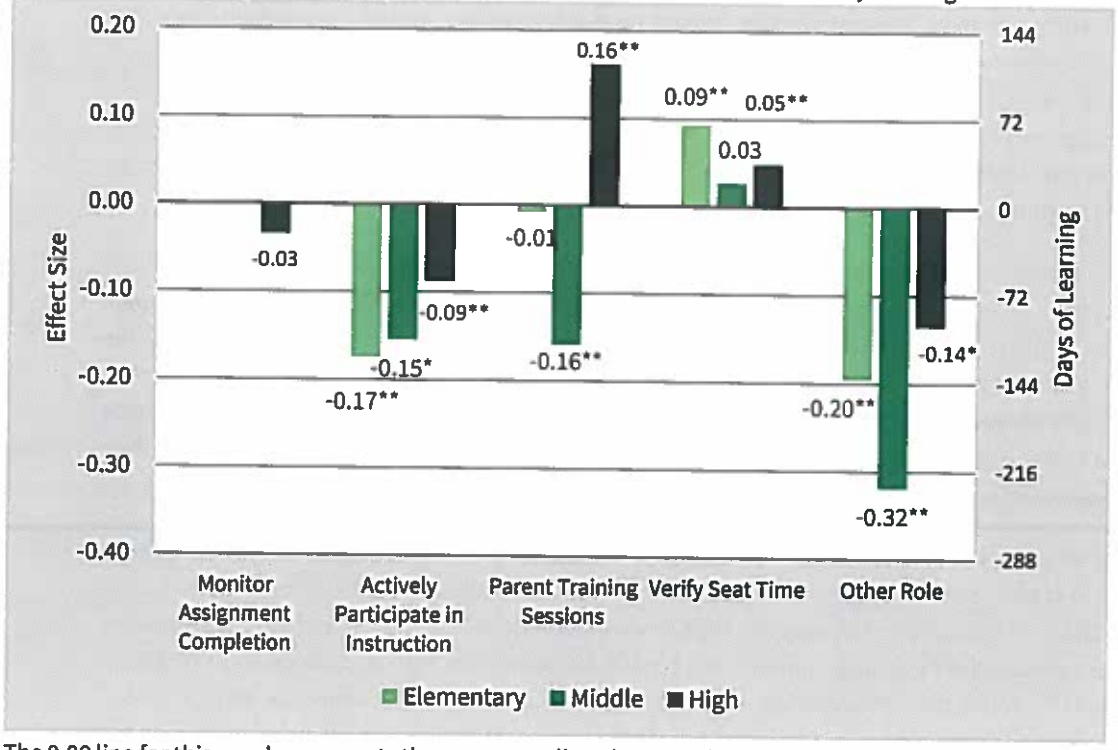
Not formally monitoring the interactions between teachers and families of online charter students is correlated with a large significant negative impact on math academic growth. The results were also negative in math when the supervision is delegated to a school administrator other than the principal. In reading the only significant result occurs for schools where the interaction is monitored by a non-administrator, non-teacher staff member. What is clear from these results is communication between the school and the family matters for online students, and the existence of that relationship needs to be monitored by someone other than just the assigned teacher to ensure the communication occurs.

Part of the reason communication between the schools and the families of online charter students is important may lie in the roles the online school expects parents to fill in their child's educational experience. Expectations for the role of the parent differ across online schools. In the survey, the principals are asked to select from a list of roles the school expects the parent to fill. It is worth noting the principal's affirmative response does not mean the parents are adequately fulfilling these roles, only that the school has an expectation the parents will provide these supports. This is a useful distinction when interpreting how student outcomes vary with these expectations.

The role of the parent is likely to change with the age of the student; accordingly, this survey item is asked in relation to specific school-levels: elementary, middle school, and high school. Building principals were asked to select all the roles which apply to their school. Some schools selected all possible responses while others reported only some or none. Some replies are ubiquitous across all the schools of a level which means a relationship between that reply and student academic growth cannot be estimated. For example, all elementary and middle school principals replied that they expect parents to monitor completion of assignments, this means we cannot estimate how strongly parental review of assignment completion matters for student performance.

The strength of the relationships between the online charter school reporting expected parental roles and academic growth in reading and math are given in Figures 16 and 17 respectively. The only parental roles which have a consistent positive relationship to student academic growth are the expectation of parents verifying seat time. In high school math, most of the parental roles were significant; however, this was primarily due to the fact that high schools which expected parents to actively participate in instruction and attend parent training sessions all also expected parents to monitor assignment completion. This means those two factors get a boost from the effect of monitoring assignment completion. Parents actively participating in instruction and filling other roles both have a consistently negative relationship with academic growth for all groups except high school math. While the statistical models in these analyses are not causal, the strong patterns we are seeing suggest the issue may be that schools are holding expectations for parents which the parents do not meet. It would be hard to explain otherwise why a school expecting parents to actively participate in instruction would have a negative relationship with growth if parents were adequately meeting the expectation.

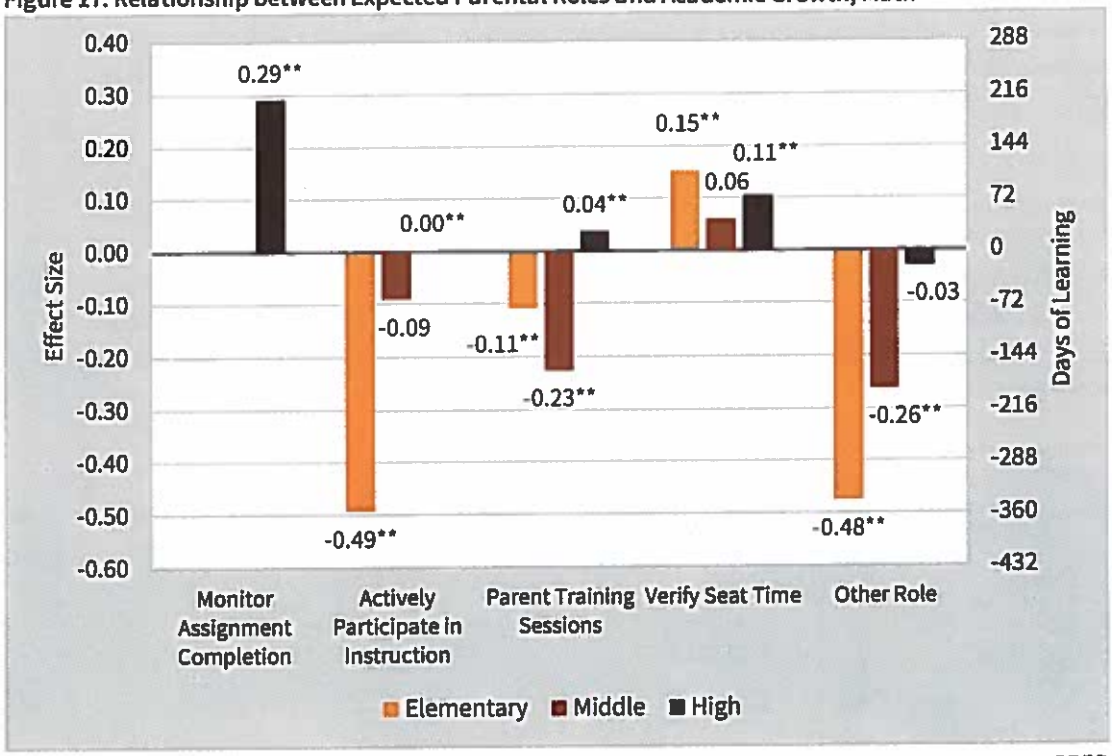
Figure 16: Relationship between Expected Parental Roles and Academic Growth, Reading



The 0.00 line for this graph represents the average online charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Figure 17: Relationship between Expected Parental Roles and Academic Growth, Math



The 0.00 line for this graph represents the average online charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Methods of Class Communication

Other items on the survey sought information on methods used by online schools to interact with students during instruction. There are questions which focused separately on asynchronous instruction and synchronous instruction.

For asynchronous instruction, the respondents are asked to identify all the methods used in their school to engage students in asynchronous learning. Possible survey responses were

- Email
- access to physical textbooks
- interactive online exercises
- using other websites with instructional focus or content
- recordings of lectures
- discussion forums or threaded discussion groups
- social media
- other tools not listed above

Of all the options, only two have significant relationships with academic growth. In reading, having access to recordings of lectures has a positive 0.10 standard deviation (72 days) effect size in relation to reading growth in schools which do not have access. In math, having access to physical (paper) textbooks has 0.09 (65 days) positive relationship with math growth compared to schools which do not.

Practices for synchronous instruction are also included in the survey. Because of the "real time" nature of synchronous instruction, these practices are more centered on live communications methods. Table 17 lists the various communication methods and their relationship with academic growth in reading and math.[17] In both reading and math, using audio conferencing in synchronous instruction has a positive relationship with academic growth. Providing instruction through online chat forums has a strong negative relationship with math growth. Likewise, instant messaging does not appear to be an effective means of communicating "real time" reading instruction to students.

Table 17: Tools Used to Support Synchronous Instruction, Reading and Math

	Reading	Math
Video Conferencing	-0.01	0.07
Screen Sharing	0.19	0.18
Audio Conferencing	0.13*	0.29**
Online Chat Forum	-0.19	-0.54**
Instant Messaging	-0.13**	0.00
Phone Calls	-0.03	-0.17
Text Messaging	0.10	0.05
Other	0.00	0.21**

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Another question asks principals if their school provides technological support to students. Options include schools providing an internet connection, a computer, computer accessories, or assistive technology for students with disabilities. Of these options, none has a significant relationship with academic growth in either reading or math with the exception of assistive technology in math has a strong (-0.10) significant relationship with academic growth. This relationship emphasizes why we do not make causal claims in this portion of the study. It is difficult to imagine a situation where providing disabled students with assistive technology would cause the student to experience weaker academic growth. What is more likely is that students with disabilities so severe they require special adaptive equipment may not be fully compensated for in the statistical models which control for the average effect of students being in special education.

[17] It is noteworthy that very little impact was identified for these tools in general. Many methods show moderate to strong relationships which are not significant. This may be due to the small number of replies in that category. Having a small number of replies means the statistical models cannot differentiate between truly strong relationships and those which falsely appear strong by chance.

School-Level Data and School Survey Data

CREDO used the student-level data from the impact analysis above to produce school-level fixed effects measures of academic progress which were then merged with the school principal survey. Combining school-level data with the survey data provides a slightly different lens through which to view the outcomes. The student-level comparisons provide a wider view of the relationship between the various survey topics and academic growth, but the results can be heavily influenced by the largest schools which will have many more individual student records. By looking at how the survey factors relate to school-level effect sizes, the weight of the relationships is distributed more evenly between the larger and smaller schools.

Because many of the survey questions ask if a school uses a particular practice or does not use that practice, it is possible to use a t-test to estimate the average relationship of that practice to the school's effect size on student growth. This provides additional information beyond that derived from just using a correlation as it provides the reader with additional information on the relative size of the impacts of different educational practices.

Many of the survey questions were grouped around related concepts such as parental roles, factors relating to principal experience and compensation, and factors related to school operational policies. The correlations between these questions and the school-level effect sizes have been grouped by general category below. It is worth noting that the survey data was collected from across the nation and values were weighted for non-response. The data included in the correlations below represents a subset of the survey data as the below data was limited to only those responses which also had school-level coefficient estimates. The use of a restricted survey data set in this section means the aggregated numbers presented here will likely be different from those presented in the descriptive volume of the report. For purposes of any national discussion, the reader should refer to the values from the descriptive volume.

The complete set of correlations between school-level effect sizes and survey responses is provided in Appendix C of this report. The reader should keep in mind that by chance, 5 percent of the correlations will be significant in each subject. To this end, the table in Appendix C includes all of the correlations and their p-values to allow for better interpretation of the significance of the relationship between each condition and the school-level effects.

School-Wide Policies

Students enrolled in online charter schools, especially asynchronous schools, may experience a variety of expectations on their individual participation. The presence or absence of clear-cut policies for student participation could be expected to have a strong relationship with academic growth. The Mathematica survey includes three items relating to student participation. Principals were asked if their school has a school-wide policy spelling out expectations for students in the completion of assignments, class participation, and attendance in synchronous portions of instruction. Only one school in the correlational data did not have school-wide requirements for completion of assignments. Having clearly defined rules for class participation has a positive relationship with academic growth in reading, but the effect was not

significant in math. However, there was a negative correlation in math between school effect sizes and schools reporting they monitored student participation by the pace at which students completed course assignments.

Table 18: School-Wide Policies, Reading and Math

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Class Participation	.37*	0.14*	.25	0.13
Attendance in Synchronous Instruction	.24	0.06	.02	0.01
Monitors Pace of Student Completion of Assignments	-.27	-0.13	-.38*	-0.29*

* Denotes significant at the .05 level.

Due to the use of asynchronous instruction in online charter schools, the awarding of course credits based on seat time may not be an appropriate metric. Another means of awarding course credits to students is through the assessment of course content mastery. Schools were asked if students could earn course credits through demonstration of mastery in none, some, or all courses. Table 19 shows a negative correlation exists between holding the policy of allowing mastery based credits in some subjects and school-level effect size in both reading and math.

Table 19 also includes results for correlations between school-level effects and the frequency with which schools assessed students. There was no significant correlation between the frequency of assessment of students and student academic growth in math. There was a moderate correlation in reading between more frequent assessments and academic growth for elementary and middle school students. Frequency of assessment was not correlated with school-level effects for high school students.

Table 19: Course Credits and Assessment Frequency, Reading and Math

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Seat Time Credits Only	.12	0.03	-.03	-0.01
Mastery Based Credits in Some Courses	-.35*	-0.09*	-.33*	-0.12*
Mastery Based Credits in All Courses	.04	0.01	.04	0.02
School Participates in Title I	-.36*	-0.08	.03	0.01
Frequency of Assessment Elementary Grades	.49*	n/a	.16	n/a
Frequency of Assessment Middle School Grades	.42*	n/a	.11	n/a
Frequency of Assessment High School Grades	.05	n/a	-.10	n/a

* Denotes significant at the .05 level.

Another set of school-wide policies included in the survey revolved around school funding. The principals where asked if the school received funding based on course completions as opposed to course enrollments, if schools received target funds for providing special education services, and if the school participated in the federal Title I program. Of these factors, only participation in Title I had a significant relationship and only in reading.

One major set of policy decisions which are usually set at the school-wide level is curriculum and instructional practices. The survey included a variety of questions related to the development of curriculum and methods for delivering the curriculum. In reading, receiving curriculum from the management company was associated with positive school effect sizes. Correspondingly, reporting in-house developed curriculum and teachers of record being responsible for developing curriculum was negatively correlated with school effect sizes in reading. None of these policies had significant correlations in math.

Method of delivery for the school's curriculum is another important factor which can impact student academic growth. Among the various delivery methods included in the survey, only one the frequent use of teacher-guided synchronous instruction in 7th grade reading was significantly correlated with school-level effect sizes. The correlation was not significant in math. A more specific breakout of synchronous instruction looked at the number of hours spent in synchronous instruction for each school-level. Most of these correlations were not significant except more hours of synchronous instruction in math was significant and positive for 4th grade students.

Table 20: School-Wide Policies Relating to Curriculum and Instruction, Reading and Math

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Some Curriculum Provided by Management Company	.53*	0.17*	.22	0.10
Majority of Curriculum Developed In-House by Individual Course Instructors	-.27*	-0.12*	-.04	-0.02
Teacher of Record Responsible for Developing Curriculum	-.55*	-0.13*	-.24	-0.08
Increased Frequency of Teacher-Guided Synchronous Discussion 4th Grade	.33	n/a	.25	n/a
Increased Frequency of Teacher-Guided Synchronous Discussion 7th Grade	.41*	n/a	.10	n/a
Increased Frequency of Teacher-Guided Synchronous Discussion High School	.16	n/a	.07	n/a
Time in Synchronous Instruction 4th Grade	.10	n/a	.37*	n/a
Time in Synchronous Instruction 7th Grade	-.02	n/a	.10	n/a
Time in Synchronous Instruction High School	-.25	n/a	.01	n/a

* Denotes significant at the .05 level.

Student Support Activities

One issue in which online charter schools may differ substantially from the typical brick-and-mortar school is in student support activities of the school. The survey included several questions about various student support activities taken on by the school. These included activities common to all schools such as one-on-one interventions, providing guidance counselors, assessing student needs. Online charter schools also have some unique support activities such as tech support for students or provision of internet services.

The first step to providing services to students is assessing what services each child needs. The survey included a question about actions taken by online charter schools to assess student needs when a new student enrolls in the school. Table 21 shows the relationship between many possible types of entry assessments and school effect sizes. Of the steps listed, only assessments of parental or other home supports and the students' learning disabilities have a significant relationship with the school effect size.

Table 21: Entry Assessment for New Enrollees

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Academic Skills	.05	0.02	.01	0.01
English Language Skills	.27	0.07	.30	0.11
Potential Barriers for Online Learning	.20	0.05	.12	0.04
Parental or Other Home Supports	.27	0.06	.33*	0.10*
Student Learning Disabilities	.11	0.02	.34*	0.10*
Other Disabilities	.11	0.02	.12	0.03
Pull Records from Previous School	-	-	-	-
Phone Call to Household	.17	0.07	-.02	-0.01
Home Visit	-.23	-0.06	-.04	-0.01

* Denotes significant at the .05 level.

One-on-one interventions are practices taken by a school when a teacher, administrator, or parent has concerns that a student requires additional services to achieve academic success. When teachers and students are not physically present in the same location, intervention may look different from the standard classroom. Some online schools have tutors whose sole job is to provide interventions. Other schools expect the teacher to work directly with the students outside of the regular class time. Of course, even online schools are still required to provide special education supports required by the student's individual education plan (IEP). A series of questions about who provides the one-on-one support show some significant relationships between the provider and student academic growth.

Table 22 shows the relationship between various providers and school-level fixed-effects estimates of academic growth for elementary students. Providing proper special education support for elementary students in online charter schools is correlated with positive academic growth. Further, the use of non-teacher tutors does not seem to provide the same level of academic growth as receiving one-on-one support from the class teacher in reading. The relationship in math is not significant.

The results for middle school and high school students were similar to those for elementary students with regards to the use of tutors and coaches. Unfortunately, the number of schools in the upper grade levels who do not have teacher-provided and special education faculty-provided one-on-one support was too small to compute a value for these relationships at the middle school or high school levels.

Additionally, the amount of time a student spend in one-on-one instruction was not significantly correlated with student achievement for students at any level.

Table 22: Providers of One-on-One Support to Students, Reading and Math

	Reading		Math	
Provider	Correlation	Effect Size	Correlation	Effect Size
ELEMENTARY				
Teacher	.25	0.08	.03	0.01
Tutor/Coach	-.45*	-0.09*	.11	0.03
Special Education Faculty	.53*	0.10*	.41*	0.10*
MIDDLE SCHOOL				
Tutor/Coach	-.45*	-0.09*	.20	0.05
HIGH SCHOOL				
Tutor/Coach	-.52*	-0.11*	.003	0.001

* Denotes significant at the .05 level.

The survey also contained a variety of questions about other support services provided to students. Most of these programs did not have a significant relationship with the school effect size. Table 23 includes the other support programs which did have a significant relationship with school-level estimates of student growth. The presence in a school of a program for talented and gifted students being associated with stronger growth seems logical. The negative relationships between academic growth and programs to support students who are parents may seem counterintuitive as we would expect those programs to help those students rather than hinder them. However, the fact that students in some schools are dealing with being a parent at a young age while students in other schools may not face that challenge, thus the school does not provide such a program, may explain the negative correlation. Likewise, it is hard to imagine that in-person tech support harms a student's academic growth. Rather, students from families which have such a low level of computer literacy that they require outside support to set up their computer likely have other challenges which are the actual cause of the negative correlations.

Finally, an increase in the number of guidance counselors serving an online school was correlated with significant positive growth in reading and a non-significant correlation in math.

Table 23: School-Provided Supports

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Talented and Gifted Program	.41*	0.09*	.27	0.08
Programs for Students Who Have Children	-.09	-0.02	-.31*	-0.10*
In-Person Set Up of Computer	-.39*	-0.09*	-.23	-0.08
Guidance Counselors	.39*	n/a	-.01	n/a

* Denotes significant at the .05 level.

School and Family Interactions

In the student-level analysis, several elements of school and family interactions had significant relationships with student achievement. This still holds true in the school-level analysis although the relationships are not all the same. The differences are related to the weighting of the student values which result from looking at the relationships using average school effect sizes instead of individual student values.

For the student-level data, schools in which parents were expected to be actively involved in their child's instruction have a negative relationship with growth. In the school-level analysis, we again see a negative relationship between schools' expectation that parents will actively participate in the student's instruction and academic growth (see Table 24). For the remainder of parental roles, the results were either not significantly related or could not be measured due to the small sample size and a lack of variation in responses.

Table 24: Relationship between Expected Parental Roles and Academic Growth, Reading and Math

	Reading		Math	
Provider	Correlation	Effect Size	Correlation	Effect Size
ELEMENTARY				
Actively Participate in Instruction	-.42*	-0.08*	.29	0.07
Parent Training Session	.06	0.02	.03	0.01
Verify Seat Time	.02	0.00	.21	0.05
MIDDLE SCHOOL				
Actively Participate in Instruction	-.27	-0.06	.24	0.07
Parent Training Session	-.03	-0.01	-.22	-0.08
Verify Seat Time	-.10	-0.02	.14	0.04
HIGH SCHOOL				
Actively Participate in Instruction	-.21	-0.05	.24	0.08
Parent Training Session	.01	0.00	-.10	-0.03
Verify Seat Time	-.05	-0.01	.08	0.02

* Denotes significant at the .05 level.

Professional Development and Compensation

One of the processes by which schools support teacher improvement is through professional development opportunities. The survey inquired about the frequency and delivery format of professional development within online charter schools. The only format of professional development which had a significant correlation with student academic growth in either math or reading was online-delivered

profession development. There was a negative correlation (-.38) between the increasing frequency of online-delivered teacher professional development and student growth in math. The relationship in reading was not significant. The correlations between the frequency of in-person teacher professional development and student growth was not significant in math nor reading. Schools which report having teachers observed by master teachers or teaching coaches had significantly lower effect sizes in math than those who did not.

One practice which did have a significant positive relationship with school effect sizes was providing teachers with diagnostic test results at the individual student level for purposes of planning instruction. This correlation was .34 in reading, but not significant in math.

Table 25: Teacher Professional Development Activities, Reading and Math

	Reading Correlation	Math Correlation
Frequency of Online Professional Development	-.03	-.38*
Frequency Observed by and Received Feedback from Master Teacher	-.10	-.37*
Frequency Provided with Diagnostic Test Results for Individual Students	.34*	.04

* Denotes significant at the .05 level.

Schools also have a variety of professional development for school leaders. Among those included on the survey, only site visits to other schools had a significant correlation with school-level effect size. In schools where school leaders reported visiting another school for the purpose of improving their own work as a school leader in the past 12 months, the correlation with school effect size was .35 in reading.

Table 26: School Leader Professional Development Activities, Reading and Math

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
University Coursework	-.04	-0.01	-.01	-0.00
Visits to Other Schools	.35*	0.08*	.20	0.06
Coaching by Leader of Another School	.16	0.04	-.01	-0.00
Participating in School Leader Network	.20	0.05	.28	0.11
Workshop Presenter	.17	0.04	.07	0.02
Workshop Participant	-.31	-0.10	-.11	-0.05

* Denotes significant at the .05 level.

Teacher incentives are another policy area which varies from school to school. Charter schools have more flexibility in the methods used to compensate teachers than the traditional public schools. The questionnaire included a series of questions about factors that impact teacher salaries for the online charter school. The questions asked if a teacher would be paid more as a result of the factors listed in Table 27 below. Most of the options do not have a significant relationship with growth. The two exceptions were pay based on student growth and on the teacher holding an advanced degree. These two factors were significantly related to student growth in reading. Interestingly, while course completion as an influencing factor on teacher compensation was not significantly correlated with school-level effects, including student course completion was negatively correlated (-.45) with school-level effect size in math.

While not direct compensation per se, tenure can also be an important means of rewarding teachers. We found a significant positive correlation between teachers' ability to earn tenure and school effect sizes in reading but not in math.

Table 27: Influencing Factors for Teacher Compensation, Reading and Math

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Teacher Evaluation	.29	0.06	.08	0.02
Student Growth	.41*	0.09*	.30	0.09
Student Proficiency	.08	0.02	.21	0.08
Course Completion Rates	.17	0.06	.26	0.12
Holds Advanced Degree	.39*	0.08*	.05	0.01
Years Experience	.12	0.03	.19	0.06
Multiple Certifications	.11	0.03	.25	0.10
Hard-to-Staff Position	.09	0.02	.13	0.04
Number of Students	-.20	-0.06	.03	0.01
Mentor to Other Teachers	-.10	-0.02	.08	0.03
Teachers Can Earn Tenure	.31*	0.11*	.13	0.06

* Denotes significant at the .05 level.

A similar question relating to compensation for school leaders was also included in the survey (see Table 28). The only compensation factor which had a significant relationship with student achievement level was student proficiency level. The correlation between basing school leader salary on student achievement level was .45. This significant relationship was not present in reading.

Table 28: Influencing Factors for School Leader Compensation, Reading and Math

	Reading		Math	
	Correlation	Effect Size	Correlation	Effect Size
Number of Enrolled Students	-.07	-0.02	-.06	-0.02
Student Achievement Growth	.24	0.05	.22	0.07
Student Proficiency Level	.28	0.06	.45*	0.14*
Course Completion Rates	.05	0.01	.25	0.09
Reenrollment Rates	.18	0.04	.03	0.01
Retention of Teachers	-.31	-0.10	-.11	-0.05
School Profit	.23	0.05	-.17	-0.05

* Denotes significant at the .05 level.

Throughout the various related concepts, we did not find factors which impacted both reading and math. Likewise, we did not find consistent groups of factors within a concept which had significant relationships with school effect sizes. The absence of clear sets of factors which have a relationship with school effect sizes was in itself an interesting finding. The school-level survey did not reveal clear group of mechanisms by which to influence school-level effect sizes.

School leaders have a wide variety of responsibilities in any school. While the school leader of an online charter school has many responsibilities in common with the leader of a brick-and-mortar school, the online school may demand a different balance of responsibilities and that rebalancing may result in different outcomes. While we do not have comparative data, school leaders were asked to report what percentage of their time they spent on a variety of activities. We computed the correlation between the percent of time spent on several activities and the school-level effect size on student academic growth. School leaders spending higher percentages of their time with students, including discipline and academic guidance, was correlated with higher school-level effects in reading. None of the other school leader activities was significantly correlated with school-level effect size.

Table 29: Percent of School Leader Time by Task, Reading and Math

	Reading Correlation	Math Correlation
Internal Administrative Tasks	-.21	-.30
Observing Teachers	.09	.07
Working with Teacher Coaches or Other Instructional Leaders	.04	.13
Developing or Leading PD	-.21	-.01
Reviewing Student Achievement Data	.38*	.30
Student Interactions	-.12	.05
Parent Interactions	-.06	.28

* Denotes significant at the .05 level.

Non-Significant Findings

As part of the school-level analysis, we evaluated the relationships between the survey responses and each individual school's estimated effect size in both math and reading. The majority of the relationships were not significant. Table 30 contains a partial list of survey response items found to have non-significant correlations with student academic growth. The full set of correlations is provided in Appendix C of this report.

Table 30: Survey Items of Interest with Non-Significant Correlations with Math and Reading Effect Sizes

Survey Item
School monitors synchronous seat time
Percentage of coursework which is self-paced
Average class size
School size

Student Testing Data and Policy Changes

In our US Constitution, education is one policy domain that is relegated to state authority and control. The individual's right to a free public education is guaranteed in each state's state constitution. As such, every state has the duty to set the policies which govern the operation of schools within their state. This means education practices permissible in one state, may be banned in another. In fact, several states allow neither online schools nor charter schools at all.

In the second volume of this report, the Center on Reinventing Public Education (CRPE) conducted an analysis of state education policies as they relate to online charter schools (Pazhouh, Lake, and Miller 2015). They found that in those states which do allow online schools, policies governing online charter schools vary. Further, individual states can and do change their policies independently. This leads to a pattern of occasional policy shifts as some states change their policies but others do not; the overall pattern of policy shifts across all the states can be exploited for research purposes. We can use statistical models which allow us to examine the differences in student academic growth which correspond to the existence and changes in an individual state's online school polices.

In their analysis, CRPE identified education policies which may have a relationship with the academic growth of online charter school students. CREDO then computed correlations between school-level effects and the presence of three of these policies. The three policies included were: authorizer oversight fees, the existence of for-profit online charter schools with state-wide enrollment policies in a state, and if a state had specialized oversight provisions specifically for online charter schools.

Authorizer oversight fees are fees charged to the charter schools by the organizations who authorize and have oversight authority over the charter schools. These fees are usually computed as a percentage of the per-pupil funding received by the charter school. As Pazhouh, Lake, and Miller state in their policy

review, "Fees from large online schools can come to represent a large proportion of agency operating revenues and may create a disincentive to regulate and close consistently low-performing online charter schools." The second factor, for-profit and state-wide enrollment documents the presence of policies within the state which allow for BOTH the operation of for-profit charter schools and the ability of online charter schools to enroll students from any location within the state. Finally, some state laws include unique oversight and accountability provisions specific to online charter schools. Most of these provisions are partial measures, addressing authorizing entities and processes, special application requirements (i.e., technology plans), or accountability provisions regarding the frequency and manner of reporting.

Table 31 below shows a significant negative relationship between authorizers collecting oversight fees and student academic growth in math. Having online charter specific oversight policies and stronger charter laws in general have a significant and positive relationship with math academic growth. In reading, only the strength of the state's charter law had a significant relationship with academic growth. These correlations fit the narrative provided by CRPE in the second volume of this report.

Table 31: Correlations between Education Policies and School-Level Effects

	Math	Reading
Authorizer Oversight Fees	-0.21*	-0.12
For-Profit and State-Wide Enrollment	0.19	-0.11
Specialized Oversight Policies	0.20*	-0.19
Strength of Charter Law	0.33*	0.25*
Strength of Charter Law Ranking	0.32*	0.06

* Denotes significant at the .05 level.

During the data window of this study, there were four policy changes which were likely to impact online charter schools. As these changes occurred over time within a state, we used student-level data to estimate a yearly school effect and then compared those school effects before and after the specific policy change. Table 32 shows the average change in academic growth associated with the implementation of each policy. Table 32 also contains a list of topics included in the regulation change. Details on the policy changes are available in the Pazhouh, Lake, and Miller volume of this report. Due to the existence of multiple simultaneous policy changes, it is not possible to disentangle which aspect of each law holds the causal mechanism in relation to student achievement.

Table 32: State-Level Policy Change Description

State	CO	MN	OH	OH
	HB-11-1277	SF-1528	HB-3660	HB-2301
Effect Size	-0.07	-0.27**	0.16**	0.17*
Policy Topics Contained in Law				
Accountability	X	X		
Oversight/Governance	X		X	X
Authorizing	X	X		
Communication		X	X	X
Quality Review		X		
Funding			X	
Enrollment Processes/Caps			X	X
Teacher Licensure				X
Assessment				X
Equipment/Internet Access				X

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

The policy change in Colorado was not correlated with a significant change in academic growth. The policy change in Minnesota was associated with a large significant negative effect size. Both of the policy changes in OH were associated with stronger academic growth. The difficulty in making an analysis such as this is accounting for multiple policy changes in each law. For example, the list of changes associated with Ohio SB 2301 cover several policies. The positive relationship could be due to more student access brought about by the elimination of the enrollment cap and the requirement for districts to release up to three percent of students to attend online charter schools, or the positive impacts could also be the result of the requirements for teachers to have state-certification. The current data did not allow us to tease out these possibilities. Over more time, comparing multiple changes in multiple states could allow more refinement of which policies are having what impact. Unfortunately, we are limited by the number of changes which took place within the data window of our study.

Summary and Implications

The purpose of this report was to present to online education stakeholders data-based information on the academic impact of attending online charter schools. The report combined student-level data, school-leader survey responses, and state policy data. Using academic data, we compared the growth of students attending online charter schools to that of students in TPS and students in brick-and-mortar charter schools. We also combined student-level data with information from a survey conducted by Mathematica Policy Research. This mixed methods analysis permitted us to examine the relationship

between a variety of online charter school policies and student academic growth. We also included information from the Center on Reinventing Public Education's review of state policies. As online charter schools are a seldom-studied area, this report represents one of the most in-depth examinations of the topic.

Online charter students had weaker growth than their VCRs. While results vary for each student, the data showed the majority of online charter student records had weaker academic growth in both math and reading compared to their VCRs. The pattern of weaker growth remained consistent across racial-ethnic subpopulations and students in poverty. Online charter schools were found to reduce the negative impacts on growth in math for students who were English language learners and special education students relative to their non-ELL and non-SPED peers compared to the size of the negative impacts for the ELL and SPED VCRs to the non-ELL and non-SPED VCRs.

Pre-online mobility is the same for online charter students and their VCRs. The study of student mobility showed students who eventually enroll in online charter schools have pre-online mobility rates similar to those of their VCR comparisons. However, after enrolling in online charter schools, these students tend to become more mobile changing schools at a rate 2 to 3 times higher than their peers. Twenty-two percent of online charter students eventually return to TPS sector with the average time in an online charter school being two years.

Positive growth across a sector is possible. Some online charter schools which were part of multi-school networks had average impacts on academic growth which were stronger than the typical online charter. Online charter schools in Wisconsin and Georgia had academic growth in reading which on average was stronger than their VCRs. These findings show it is possible for online charter schools to produce stronger growth, but it is not the common outcome.

Few school-level practices had a strong relationship with academic growth. A review of the relationship between school practices as reported in the Mathematica survey and student academic growth found mostly insignificant correlations between school practices and growth. Of practices in the survey which had strong positive correlations, attending schools which offered some self-paced classes was the most wide-spread and was found to be consistent across all school levels. The findings on the expected parental roles was also revealing in that placing more instructional responsibilities on parents was strongly correlated with weaker growth across most settings.

Teasing out the impact of state-level policies is difficult. The role of state-level policies matters in online charter education. The state-level policy changes included in the study did have significant relationships with the academic growth of online charter students. With the data included in this analysis, it was not possible to tease out which aspects of the particular policy changes led to the changes in academic growth. This is a critical area for future study.

Being an online school matters more than being a charter school. Finally, the major impacts of attending an online charter school appear to be primarily driven by the online aspect of the schools.

Analyses comparing online charter school students to brick-and-mortar charter students produced results which were nearly identical to the results derived from comparisons of online charter students and TPS students. If the charter aspect of online charter schools or an interaction between the charter and online aspects were the driving factors of online charter school growth, we would have expected to find different results between the brick-and-mortar charter analysis and the TPS analysis. We did not.

Implications

Finding the best means to educate every student will require society to think beyond the bounds of traditional schools. Online schools are a relatively new and rapidly expanding method of providing an alternative to traditional schools. The findings presented in this report establish a starting point for discussing the future implications of attending online charter schools.

1. Current online charter schools may be a good fit for some students, but the evidence suggests that online charters don't serve very well the relatively atypical set of students that currently attend these schools, much less the general population. Academic benefits from online charter schools are currently the exception rather than the rule. Online charter schools provide a maximum of flexibility for students with schedules which do not fit the TPS setting. This can be a benefit or a liability as flexibility requires discipline and maturity to maintain high standards. Not all families may be equipped to provide the direction needed for online schooling. Online charter schools should ensure their programs are a good fit for their potential students' particular needs.

2. Current oversight policies in place may not be sufficient for online charter schools. There is evidence that some online charter schools have been able to produce consistent academic benefits for students, but most online charter schools have not. The charter bargain has been "Flexibility for Accountability" and all charter schools must be held to that concept. Authorizers must step up to their responsibilities and demand online charter providers improve outcomes for students. Authorizers should hold a firm line with those schools which cannot meet their end of the charter bargain.

3. States should examine the current progress of existing online programs before allowing expansion. Online schools have the potential to serve large numbers of students with practically no physical restraints on their expansion. As such, mechanisms which have typically played a role in regulating the growth of brick-and-mortar schools such as facility construction and limited potential student pools do not exert pressure on online schools. Without these natural constraints, online schools have the potential to expand more rapidly than traditional schools. This makes it critical for authorizers to ensure online charter schools demonstrate positive outcomes for students before being allowed to grow and that online charter schools grow at a pace which continues to lead to improved outcomes for their students.

Appendix A: DESCRIPTIVE PROFILE OF ONLINE CHARTER STUDENTS

Table 33 shows the number of students from each state by year included in the study sample. This count represents tested students with at least two years of data who were enrolled fulltime in the identified, wholly online charter schools. As can be seen in Table 33, there was a wide variation in online charter enrollment across the states. Additionally, some states have stable enrollment patterns while others have rapidly increasing enrollment numbers. In some states, the online charter enrollment rate increased ten-fold over the course of three years. The rate at which online charter enrollment is increasing in some states provided emphasis on the need and timeliness of this study.

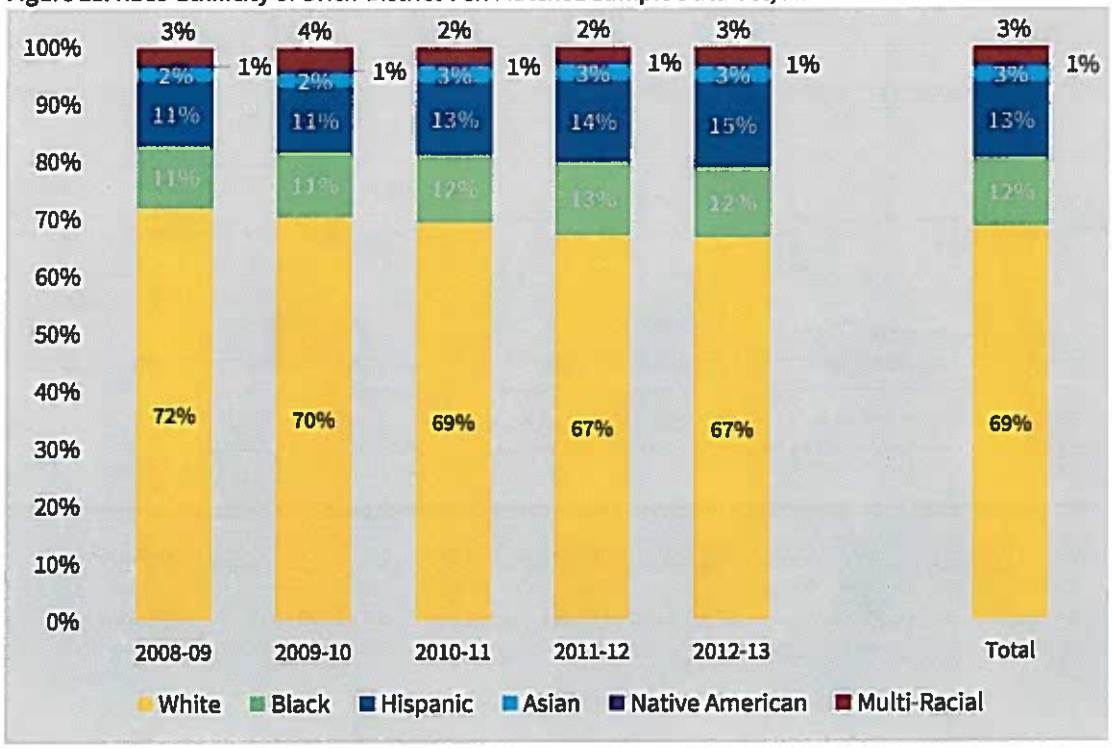
Table 33: Number of Matched Online Charter Students by State and Year, Math

State	2009-10	2010-11	2011-12	2012-13	Total
AR	232	236	235	228	1,166
AZ	3,201	3,240	4,166	4,303	17,118
CA	6,260	7,769	9,519	9,845	38,400
CO	1,456	2,935	3,961	4,043	14,920
DC	14	33	29	27	117
FL	6	6	25	68	107
GA	2,299	2,975	4,676	4,012	15,436
IL	337	389	439	493	1,658
IN	50	191	1,067	1,941	3,269
LA	0	0	467	927	1,394
MI	119	253	466	605	1,552
MN	395	455	477	292	1,905
NV	1,840	2,912	2,743	3,334	11,655
OH	5,309	6,245	6,012	6,582	27,772
OR	1,515	1,600	1,857	1,997	7,887
PA	6,784	7,704	9,011	9,935	39,540
TX	364	802	3,492	5,603	10,269
UT	488	903	1,108	967	3,596
WI	336	439	682	‡	1,466
Total	31,005	39,087	50,432	55,202	199,227

‡2012-13 data was not available for Wisconsin.

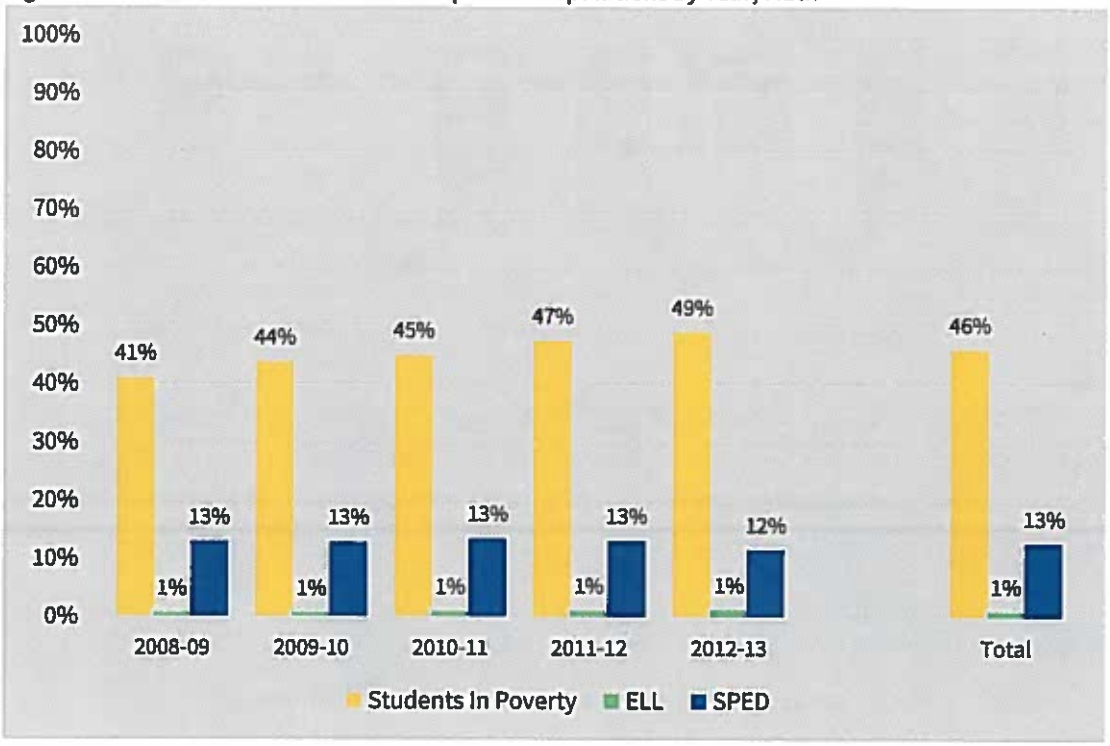
The demographics of the matched sample are similar to the rates shown in Table 2. Figure 18 shows the race-ethnicity of the students in the brick-district VCR matched sample. The matched sample was made up predominantly by White students. One-in-four students in the matched sample were Black or Hispanic with Asian, Native American, Multi-Racial students making up the remainder of the sample. While the online charter demographics differ from those of both brick-and-mortar district and charter schools, they are similar to the demographics of online schools operated by districts.

Figure 18: Race-Ethnicity of Brick-District VCR Matched Sample Data Set, Math



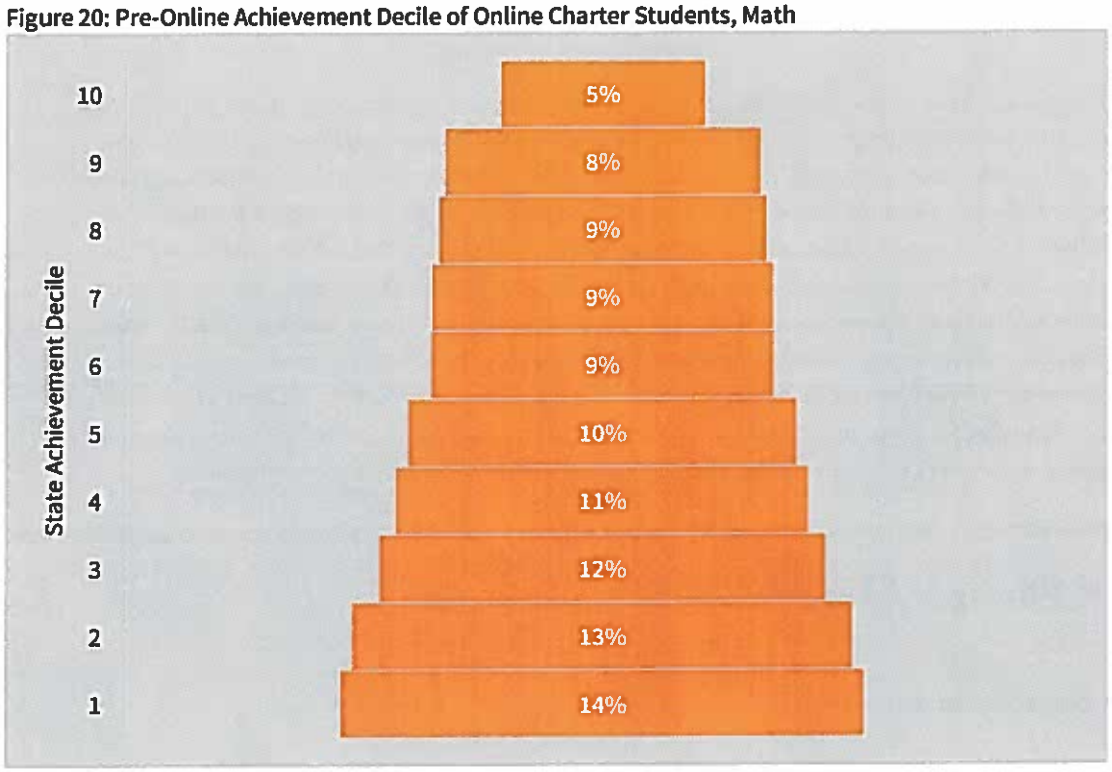
As shown in Table 2 in the main body of the report, the percentage of students in poverty attending online charter schools is lower than that of the feeder schools, but higher than the entire brick-district sector in the studied states. Based on Figure 19, the percentage of students in poverty enrolled in online charter schools has increased over the time of the study. The percentages of ELL students and special education students are steady across the years. As noted previously, the percentage of ELL students enrolled in online schools is much lower than in brick-and-mortar schools. This was true regardless of whether the online school was a district-run or a charter run school.

Figure 19: Brick-District VCR Matched Sample Sub-Populations by Year, Math



The students in online charter schools were more likely to come from the lower deciles of academic achievement than the TPS students. In Figure 20, the width of the block in the beehive graph represents the percentage of students from each decile of achievement on their state's proficiency exam in the year before the student enrolled in an online charter school. An equal distribution of students across all deciles would produce a cylinder shape in which every band is the same width. The difference in the width of the top and bottom bands indicates higher enrollment of lower achieving students in online charter schools. Fourteen percent of online charter students were in the first (lowest) decile; whereas, only five percent of online charter students were in the highest decile.

Figure 20: Pre-Online Achievement Decile of Online Charter Students, Math



While there are some differences in the populations attending TPS, the TPS which lost students to online charter schools, and online charter schools, the sample used in our analysis uses pairs of students who are matched on observable characteristics which are known to have an impact on educational growth and achievement. The matched groups are identical or near-identical on all the match criteria shown in Figure 1. Due to the high match rate (96%), we can be confident that the sample of matched students is highly representative of the full population of online charter students in the study states. By using test scores from before enrolling in online schools for our online students in addition to the other demographic factors, our matching process has included a proxy for the sum impact of the all the factors, observable and unobservable, which impact the students' educational outcomes. The prior test score represents the sum educational progress of the student before entering an online charter school; thus students who are identical in observable characteristics and have the same prior test score likely have unobservable student characteristics with the same total impact on achievement for the student and their twin at the time the students were matched. This holds true even if those unobservable characteristics are not necessarily identical between the student and their twin. The identical prior test score then functions as a proxy for the unobservable characteristics of the student. This supports the matched data set as a strong and proper counterfactual for the online charter students.

Appendix B: TECHNICAL APPENDIX

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[18]. 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, free or reduced price lunch status, special education status, English language learner status, and whether they were held back the previous year. The literature on measuring educational interventions[19] 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 state, year, and period (1st year in charter, 2nd year in charter, etc.). The study's baseline model is presented below.

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

where the dependent variable is

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

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, S is a state fixed effect; C is an indicator variable for whether student i attended an online charter in period t; and ε 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 online 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 online charter variable into "online charter_black," "online charter_hispanic," etc. To further break down the impact of online charters by race and poverty, the variables above were split again. For example, black students in charter schools are

[18] 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.

[19] 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.

split further into students that qualify for free and reduced price lunches ("charter_black_poverty") and those that do not ("charter_black_nonpoverty").

As part of the study, we conducted additional analyses using alternative model specifications. The purpose of using additional specifications is to ensure the robustness of the results, i.e. ensure the findings were not an artifact of the analytic model chosen. The alternative specifications for this study included completing the analyses using a data set made with VCRs from brick-and-mortar charter school students, conducting two different ordinary least squares (OLS) models on achievement rather than growth using a multi-year panel of student data for all students with test scores in the states included in the study, and a set of OLS comparisons intended to explore how choice related bias might impact the report findings. The model for the OLS comparison (see model 3 below) was similar to model 1 with the exception that the dependent variable was growth. The results of these analyses are included later in this appendix.

$$A_{i,t} = \theta A_{i,t-1} + \beta X_{i,t} + \rho Y_t + \sigma S + \gamma C_{i,t} + \varepsilon_{i,t} \qquad (3)$$

We also examined the relationship between student records and responses to the survey administered to school leaders. We assigned the schools' responses from the survey to the records of students who attended those online schools. We then dropped all students who attended schools which did not have a survey response. This analysis used a model which was a slight variation on model 1 above.

$$\Delta A_{i,t} = \theta A_{i,t-1} + \beta X_{i,t} + \rho Y_t + \sigma S + \eta Q_s + \varepsilon_{i,t} \qquad (4)$$

Where Q_s represents the array of responses on the survey for a given online charter school. The other variables were identical to those in model 1 above. The errors were still clustered around charter schools.

Empirical Bayesian Shrinkage

Tables 13 and 14 in the main body of the report include marginal and full estimates of growth by network for students who attended an online charter school which was part of a charter network. One of the reviewers suggested we might need to conduct empirical Bayesian shrinkage to adjust the estimates due to the differences in the number of students included in each group. We computed the estimated coefficients applying empirical Bayesian shrinkage and found the adjusted estimates were similar to the unadjusted estimates. None of the estimates changed the level of significance or changed by a noticeable amount. Table 34 includes the results for both original estimates and the adjusted estimates of network marginal growth relative to non-network online charter schools. The values in Table 34 are comparable to those in Table 13.

Table 34: Empirical Bayesian Shrinkage of Effect Sizes by Network Compared to Independent Online Charter Schools, Reading and Math

	Reading	Reading with EB Shrinkage	Math	Math with EB Shrinkage
Network 1	0.16**	0.13**	0.06	0.06
Network 2	0.08**	0.08**	0.26**	0.26**
Network 3	0.08**	0.07**	0.05	0.04
Network 4	0.04**	0.04**	0.08**	0.07**
Network 5	0.03	0.03	0.19**	0.18**
Network 6	0.03	0.03	0.02	0.02
Network 7	0.00	0.00	0.07	0.06
Network 8	-0.02	-0.02	-0.03	-0.03
Network 9	-0.02	-0.02	0.02	0.02
Network 10	-0.04	-0.04	-0.05**	-0.05**
Network 11	-0.05*	-0.05*	-0.04	-0.03
Network 12	-0.05**	-0.05**	0.03	0.03
Network 13	-0.06	-0.05	-0.04	-0.03
Network 14	-0.06**	-0.06**	-0.01	-0.01
Network 15	-0.07**	-0.07**	-0.07**	-0.07**
Network 16	-0.08**	-0.08**	0.05**	0.05**
Network 17	-0.09**	-0.08**	-0.10**	-0.09**
Network 18	-0.12**	-0.12**	-0.13**	-0.12**
Network 19	-0.17**	-0.16**	-0.26**	-0.25**
Network 20	-0.19**	-0.18**	-0.27**	-0.26**
Network 21	-0.25**	-0.24**	-0.15**	-0.15**

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Alternative Specifications

Brick-and-Mortar Charter School VCR

This section contains information from the statistical models which compared the matched VCRs made up of brick-and-mortar charter schools to online charter students. Table 35 includes the demographic descriptive output for the brick-and-mortar charter school VCR data set.

Table 35: Student Population Demographics by Charter Sector

	All Charters	Charter Feeder Schools	Online Charter Schools
Number of Schools	5,534	906	166
Percent Students in Poverty	51%	49%	48%
Percent English Language Learner Students	9%	7%	1%
Percent Special Education Students	9%	9%	11%
Percent White	33%	42%	69%
Percent Black	30%	21%	13%
Percent Hispanic	29%	27%	11%
Percent Asian/Pacific Islander	4%	4%	2%
Percent Native American	1%	1%	1%
Percent Multi-Racial	3%	3%	4%
Average Total Enrollment per School	344	525	986
Total Enrollment	1,901,109	476,044	163,722

Table 36 includes the effect sizes for attending online charter schools for various subpopulations. The results while slightly different were similar enough to those found in the comparisons between TPS VCRs and online charter students to not merit repeating in the main body of the report. The marginal results are provided here for those with an interest in the results from this second control group.

Table 36: Effect Size by Subpopulations for Online Charter vs. Brick-Charter, Reading and Math

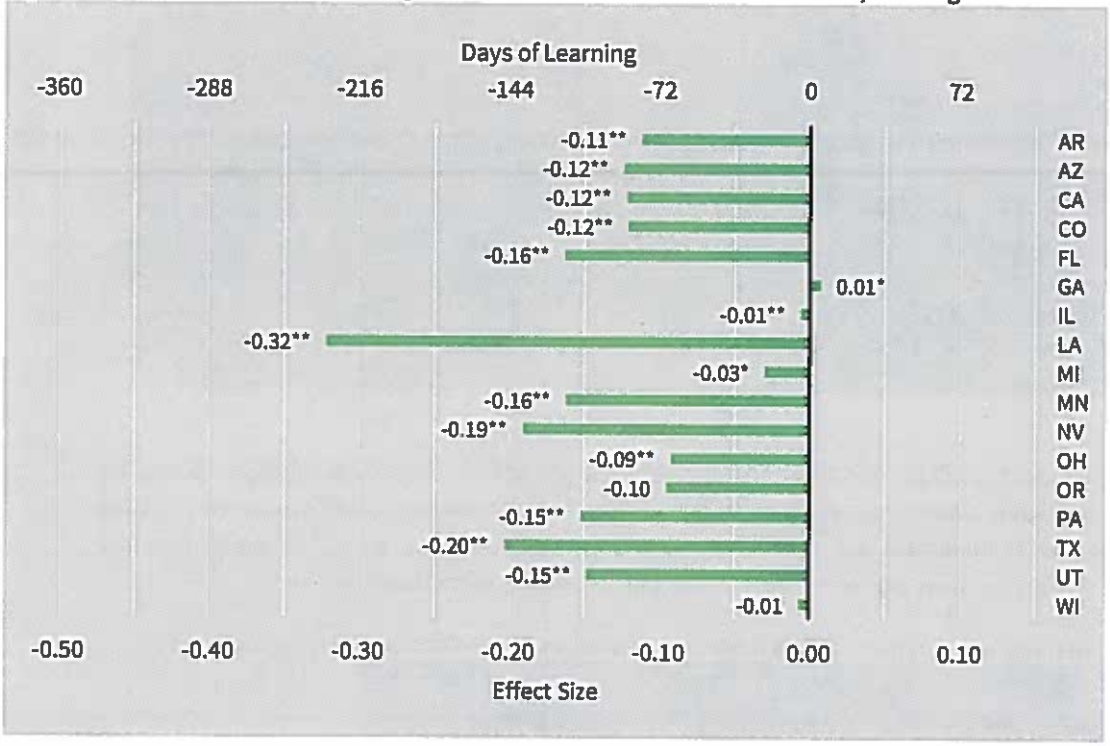
	Reading	Standard Error	Math	Standard Error
Overall	-0.12**	0.01	-0.25**	0.01
White	-0.12**	0.01	-0.23**	0.01
Black	-0.08**	0.03	-0.23**	0.02
Hispanic	-0.13**	0.01	-0.28**	0.02
Asian	-0.08**	0.01	-0.23**	0.02
Native American	-0.07	0.05	-0.32**	0.04

The effects in this table represent the difference between a student of a specific race in TPS and a student of the same race in an online charter.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Figures 21 and 22 contain the effect sizes by state from attending an online charter school for reading and math respectively. Comparing Figures 5 and 21 for reading and Figure 6 with Figure 22 for math shows there is some variation in state effect sizes between the two VCR groups, but in general the effect sizes by state for the TPS VCR comparison in the main body and the effect sizes by state for the brick-and-mortar VCR analysis are of the same direction and a similar magnitude. The similarity in results indicates the online nature of the online charter schools is a much stronger driver of their effectiveness than the charter nature. If the charter aspect had a stronger influence, the effect sizes between online charters and brick-and-mortar charter VCRs would differ more from the effect sizes between online charters and TPS VCRs.

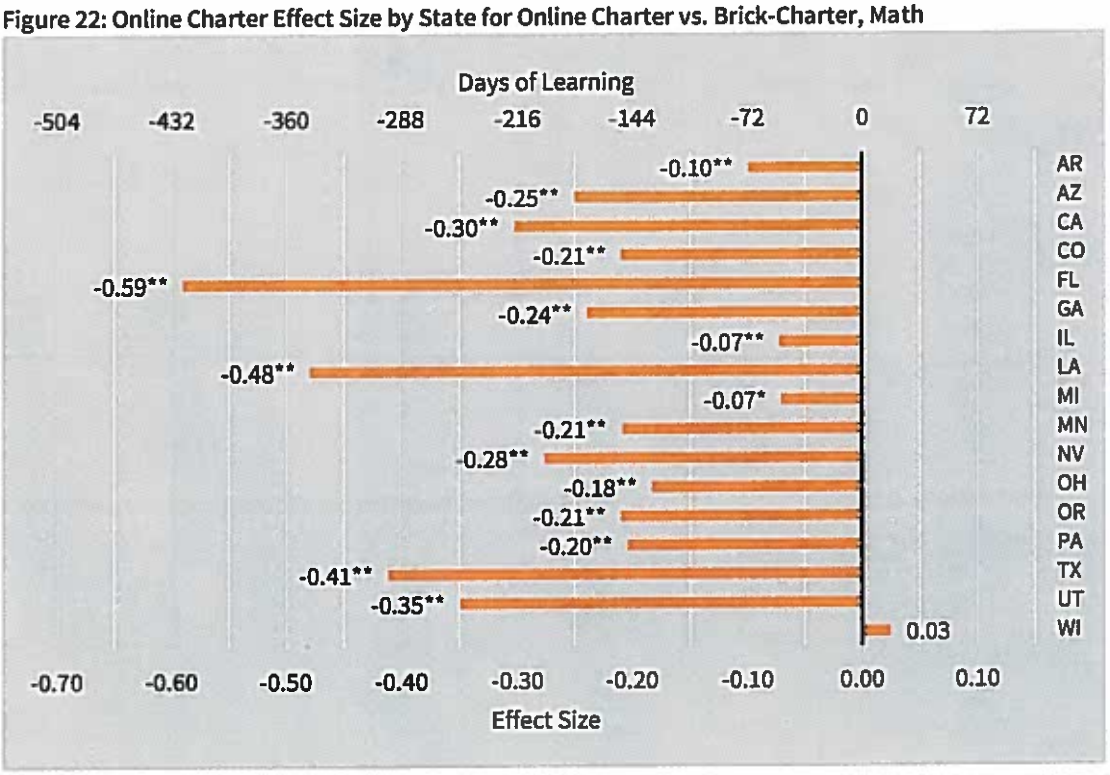
Figure 21: Online Charter Effect Size by State for Online Charter vs. Brick-Charter, Reading



The 0.00 line for this graph represents the average Brick-and-Mortar Charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Figure 22: Online Charter Effect Size by State for Online Charter vs. Brick-Charter, Math



The 0.00 line for this graph represents the average Brick-and-Mortar Charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Generalized OLS Model on Multi-Year Panel Data

For the panel data OLS analysis, we used achievement as the dependent variable. This was done to ensure the findings were not directly related using a growth measure.[20] Partial outputs from the OLS regressions are shown in Table 37. The values for state-level and grade-level controls are not included for the sake of space. In reading, attending an online charter school had a significant negative effect size of -0.135, equivalent to 97 days less learning. In math, the effect size for online charter attendance was -0.347, equivalent to 250 days less learning. Growth for students attending an online charter school were significantly weaker than that of brick-and-mortar charter students. These findings support those presented in the main body of this report.

[20] The growth measure used was $z\_subj_{t1} - z\_subj_{t0}$, where z_subj was the student's achievement in a given year.

Table 37: Panel Data Unrestricted OLS Regression Output, Reading and Math

	Reading	Standard Error	Math	Standard Error
z_orig_subj	0.610**	0.000	0.620**	0.000
z_orig_other_subj	0.105**	0.000	0.089**	0.000
charter_brick	0.009**	0.000	-0.011**	0.000
onlinecharter	-0.135**	0.002	-0.347**	0.002
female	0.067**	0.000	-0.024**	0.000
lunch	-0.132**	0.000	-0.128**	0.000
ELL	-0.330**	0.000	-0.149**	0.000
SPED	-0.517**	0.001	-0.488**	0.001
retained	0.053**	0.000	-0.104**	0.000
re_black	-0.150**	0.000	-0.177**	0.000
re_hisp	-0.057**	0.000	-0.052**	0.000
re_asianpi	0.069**	0.000	0.152**	0.000
re_nativam	-0.100**	0.001	-0.097**	0.001
re_multi	-0.015**	0.001	-0.026**	0.001
year_2009	0.012**	0.000	0.016**	0.000
year_2010	0.008**	0.000	0.009**	0.000
year_2011	0.017**	0.000	0.022**	0.000
_cons	0.129**	0.001	0.152**	0.001
Obs	55281185		54030479	
R-Sqr	0.608		0.589	

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Restricted OLS Model on Multi-Year Panel Data

We also analyzed an additional OLS model with a restricted data set. The restrictions to the data set removed all students who did not have a pre-online school observation (they were in an online charter during their first year in the data set) and limited the analysis to the first year in an online charter school. These restrictions allowed us to isolate the specific impact of going to an online charter school, ensuring that estimated effects were not biased by treatment occurring in prior years. This method has been shown to successfully replicate "gold-standard" experimental impact estimates.[21] Table 38 includes the regression results for this analysis. The results of the restricted analysis showed a stronger negative trend than did the unrestricted OLS analysis. Students who attended an online charter analysis had significantly weaker growth in both reading with an effect size of -0.239, equivalent to 172 days less learning and in math with an effect size of -0.445, equivalent to 320 days less learning.

[21] Gill, B., Furgeson, J., Chiang, H., Teh, B., Haimson, J., and Verbitsky-Savitz, N. "Replicating Experimental Impact Estimates in the Context of Control-Group Noncompliance." Statistics and Public Policy, forthcoming.

To examine if the declining achievement for online students was in fact just a continuation of previously declining achievement, we computed the pre-online charter growth trend for the students who would eventually change to an online school. In the year before they entered an online charter school, the future online students had negative academic growth. The change in reading achievement for this group in the year before they entered an online charter school was -0.06 in reading, equivalent to 43 less days of learning, and -0.08 in math, equivalent to 58 days of learning. The conclusion of these analyses was that while it was true students who eventually transferred to online charter schools had negative growth in TSP before transferring, the steep decline in their growth after transferring to an online charter school indicated that the circumstances which lead to pre-online charter trajectory were not likely to be the source of the students' lowered academic achievement found while attending an online charter school.

Table 38: Panel Data Restricted OLS Regression Output, Reading and Math[22]

	Reading	Standard Error	Math	Standard Error
z_orig_subj	0.599**	0.000	0.610**	0.000
z_orig_other_subj	0.188**	0.000	0.172**	0.000
charter_brick	0.028**	0.000	0.000	0.000
onlinecharter	-0.239**	0.003	-0.445**	0.003
female	0.081**	0.000	-0.035**	0.000
lunch	-0.114**	0.000	-0.096**	0.000
ell	-0.273**	0.000	-0.080**	0.000
sped	-0.265**	0.000	-0.235**	0.000
retained	0.123**	0.002	0.137**	0.002
re_black	-0.116**	0.000	-0.135**	0.000
re_hisp	-0.059**	0.000	-0.046**	0.000
re_asianpi	0.048**	0.000	0.132**	0.000
re_nativam	-0.101**	0.001	-0.095**	0.001
re_multi	-0.012**	0.001	-0.022**	0.001
year_2009	0.001**	0.000	0.012**	0.000
year_2010	-0.006**	0.000	0.001*	0.000
year_2011	0.009**	0.000	0.014**	0.000
_cons	0.082**	0.001	0.080**	0.001
Obs	39526810		38278136	
R-Sqr	0.649		0.605	

The 0.00 value for this table represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

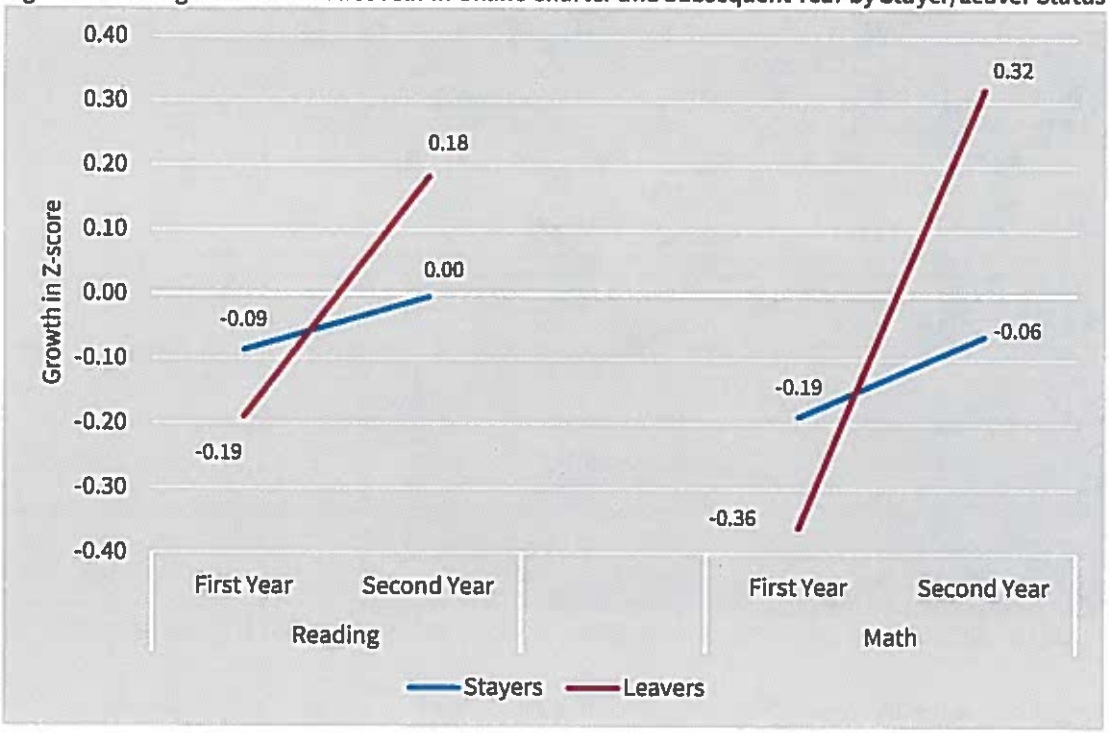
[22] Due to data access limitations, Table 30 did not include data for TX or IL; whereas, Table 29 did. We verified the unrestricted panel data coefficients were the same in models with and without TX and IL included.

Online Charter School Choice Analysis

We next explored deeper the impact of enrollment selection using two "chooser-matched" models which included only those students who attended online charter schools. Both of these models included achievement as the dependent variable and included controls for the student demographic characteristics as well as state specific dummy variables to control for mean differences between states.

In the first model, we kept the records for only the students' first year in an online charter school and the year after the first year in an online charter school regardless if the second year was in an online charter or not. Figure 23 shows that online charter school students had negative growth.[23] Students who would eventually end up staying in an online charter for only one year, leavers, had weaker first-year growth in online charters than those students who would stay at least two years in an online charter school, stayers. Both leavers and stayers had stronger growth in their second year than in their first year in an online charter school; however, the growth in the second year was significantly smaller for those students who spent their second year in an online school, stayers, compared to those students who returned to a TPS in their second year, leavers.

Figure 23: Average Growth for First Year in Online Charter and Subsequent Year by Stayer/Leaver Status



The 0.00 line for this figure represents the average Online Charter Ever-Attending student.

[23] Growth=$A_{i,t} - A_{i,t-1}$

We conducted regressions for both reading and math using the same data set as used for the above graph. We included a variable which indicated if the student remained in an online charter school in the second year or returned to a TPS school. The students who stayed in an online charter school for the second year were represented by the coefficient stayer. Those who returned to TPS were represented by the coefficient leaver. The stayer coefficient is the marginal difference between the students who remained in online charter schools for the second year and the students who returned to a TPS school, leavers. The average change in achievement for the leavers is represented by the coefficient leaver. In reading, the students who left online charter schools after one year had second year growth of 0.33 standard deviations (the equivalent to 238 days of additional learning). The average growth of students who remained in online charter schools lagged behind that of those who left by -0.16 standard deviations (the equivalent of 115 days less learning).

Table 39: Continuing Online Charter Enrollees Compared to One Year Enrollees – Marginal Results, Reading

	Coefficient	se
z_orig_read	0.64**	0.003
z_orig_math	0.18**	0.003
stayer marginal to leaver	-0.16**	0.006
leaver	0.33**	0.006
female	0.09**	0.004
lunch	-0.08**	0.004
ell	-0.15**	0.018
sped	-0.18**	0.008
retained	0.19**	0.012
re_black	-0.06**	0.006
re_hisp	-0.05**	0.006
re_asianpi	0.05**	0.010
re_nativam	-0.07**	0.020
re_multi	0.00	0.011
year_2009	-0.09**	0.006
year_2010	-0.13**	0.006
year_2011	-0.13**	0.008
_cons	0.01	0.011
Obs	107106	
R-Sqr	0.654	

The 0.00 value for this table represents the average Online Charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

In math, the differences between stayers and leavers was even larger. The students who left online charter schools to return to a TPS school had second year growth of 0.55 standard deviations (equivalent to 396 days of learning). Those who remained in online charter schools had growth which was on average -0.39 standard deviations (equivalent to 281 days of learning) less than the students who left online charter schools. The direction and magnitude of the coefficients from this analysis were consistent with those of the other analyses conducted.

Table 40: Continuing Online Charter Enrollees Compared to One Year Enrollees – Marginal Results, Math

	Coefficient	se
z_orig_math	0.60**	0.003
z_orig_read	0.20**	0.003
stayer marginal to leaver	-0.39**	0.006
leaver	0.55**	0.007
Female	-0.06**	0.004
lunch	-0.09**	0.004
ell	0.018	0.017
sped	-0.12**	0.007
retained	0.13**	0.011
re_black	-0.09**	0.006
re_hisp	-0.05**	0.006
re_asianpi	0.12**	0.012
re_nativam	-0.08**	0.019
re_multi	-0.013	0.012
year_2009	-0.08**	0.006
year_2010	-0.15**	0.006
year_2011	-0.11**	0.008
_cons	-0.15**	0.011
Obs	103136	
R-Sqr	0.631	

The 0.00 value for this table represents the average Online Charter, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

The last analysis we conducted was the future online charter choosers analysis. For this analysis, we kept only students who would eventually attend an online charter school but who attended a TPS during their first year in the data set. We then kept their first year in the data set and their first year in an online charter school. We created a variable to indicate their enrollment in an online charter school. The model included student achievement as the dependent variable and student demographic characteristics as

independent variables.[24] The regression results in Table 41 show attending an online charter school had a significant negative impact on reading achievement, -0.17 standard deviations (122 days). Likewise the impact on math achievement of attending an online charter school (see Table 42) was -0.34 standard deviations (245 days) compared to the students' first year in the data set.

Table 41: Future Online Charter Choosers, Reading

	Coefficient	se
z_orig_read	0.65**	0.003
z_orig_math	0.17**	0.003
read_missing	-0.22**	0.052
onlinecharter	-0.17**	0.009
female	0.09**	0.004
lunch	-0.07**	0.004
ell	-0.14**	0.016
sped	-0.20**	0.008
retained	0.07**	0.008
re_black	-0.06**	0.006
re_hisp	-0.03**	0.005
re_asianpi	0.06**	0.009
re_nativam	-0.03	0.017
re_multi	0.03*	0.011
year_2009	0.02**	0.008
year_2010	0.03**	0.009
year_2011	0.08**	0.010
_cons	-0.02	0.010
Obs	120376	
R-Sqr	0.622	

The 0.00 value for this table represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

[24] State dummy variables and grade-level dummy variables were included in the model, but are not shown in the results table to conserve space.

Table 42: Future Online Charter Choosers, Math

	Coefficient	se
z_orig_math	0.61**	0.003
z_orig_read	0.17**	0.003
math_missing	-2.12**	0.176
onlinecharter	-0.34**	0.009
female	-0.04**	0.004
lunch	-0.07**	0.004
ell	-0.03	0.016
sped	-0.17**	0.008
retained	0.02**	0.007
re_black	-0.09**	0.006
re_hisp	-0.04**	0.005
re_asianpi	0.13**	0.011
re_nativam	-0.06**	0.017
re_multi	0.01	0.011
year_2009	0.01	0.008
year_2010	-0.00	0.009
year_2011	0.07**	0.010
_cons	-0.06**	0.010
Obs	118157	
R-Sqr	0.612	

The 0.00 value for this table represents the average TPS VCR, White, non-poverty, non-ELL, non-SPED student.

* Denotes significant at the .05 level. ** Denotes significant at the .01 level.

Appendix C: CORRELATES OF SCHOOL-LEVEL EFFECTS WITH SURVEY REPSONSES

Appendix C contains correlations between school-level effect sizes and the responses to the survey of online charter school practices conducted by Mathematica. Correlations could not be computed for survey items with inadequate variation of responses. For example, if all the responses to a binary question (yes/no) were the same, a correlation cannot be computed. Items for which a correlation could not be computed are marked with a dash "-".

Table 43 includes the correlations and p-values for each item with sufficient variation. Those values which are significant at the .05 level are marked with a "*". Due to the high number of correlations computed, it is likely at least some (5%) will be significant by chance. Based on the statistical principles used in this study, we expect 12 of the significant results in each subject to be the result of chance. To aid the reader in interpreting the results, we have included the p-value for each correlation. A lay explanation of the p-value is that the p-value represents the likelihood a correlation is the result of chance. The lower the p-value; the lower the likelihood that the result is due to chance. The traditional threshold for determining significance is a p-value of .05 or less. Correlations with large p-values should be considered to be due to chance regardless of the strength of the correlation.

The column Response Type in Table 43 provides information on the type of response possible on the survey. The description 'binary' means the value of "1" was entered in the field if the practice in the survey question existed at the school and "0" if it did not. This means a positive correlation indicates that the presence of the practice described was related to stronger growth than the average online charter school while a negative correlation indicates the presence of the practice was related to weaker growth. The description 'ascending' means the value was dosage-based and coded with a higher number if the condition occurred more frequently. Thus a positive correlation means more of the practice is related to stronger growth. Finally, the description 'descending' means the value was dosage-based and coded with a lower number if the practice occurred more frequently. For a descending item, a positive correlation would indicate having less of the practice present in the school is associated with stronger growth. Readers are advised to pay attention to the Response Type as it will have an impact on the interpretation of the results.

For dosage based variables, the correlations were produced using standard Pearson correlations. Correlations between binary variables and school-level effects were computed using a point bi-serial model which produces correlations between a binary and continuous variable equivalent to Pearson correlation.

Table 43: Correlations of School-Level Effects with Survey Responses, Math and Reading

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Does your school's program enable students to earn course credits by demonstrating mastery, regardless of "seat time"?							
No, students in all courses must meet seat time requirements	0.12	0.3811		-0.03	0.8143		Binary
Yes, students in any course can earn course credit by demonstrating mastery	0.04	0.7478		0.04	0.7504		Binary
Students in selected courses, subjects, or grades can earn course credit through demonstration of mastery	-0.35	0.0056	*	-0.33	0.0098	*	Binary
Does your school's program include courses that are entirely self-paced?	0.00	0.9830		-0.12	0.4232		Binary
What percent of your courses are entirely self-paced?	-0.05	0.7699		-0.10	0.5871		Ascending
In total, how much time is spent in synchronous instruction, each week, for an average student in the fourth grade?	0.10	0.5759		0.37	0.0308	*	Ascending
How many students are involved in a typical fourth-grade math section?	0.37	0.1122		0.07	0.7554		Ascending
How many students are involved in a typical fourth-grade English / Language Arts section?	0.37	0.1122		0.07	0.7554		Ascending

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
In an average week, does a typical student in fourth grade spend any time in one-on-one interaction with a teacher or tutor (via chat, phone, tutoring, etc.)?	-0.19	0.3034		-0.30	0.1061		Binary
How much time, on average, does a typical student in fourth grade spend in one-on-one interaction with a teacher or tutor (via chat, phone, tutoring, etc.) per week?	-0.07	0.7214		-0.17	0.4157		Ascending
Who provides one-on-one instructional support to students in fourth grade?							
Teacher of record for the course	0.25	0.2392		0.03	0.8863		Binary
Tutor/Coach	-0.45	0.0255	*	-0.11	0.6152		Binary
[Removed]							Binary
Other instructional staff, not listed above - Specify:	-	-		-	-		Binary
Other teacher	-	-		-	-		Binary
Special education faculty	0.53	0.0076	*	0.41	0.0478	*	Binary
Parent	-	-		-	-		Binary
How frequently are the following instructional method(s) used in fourth grade?							
Lecture	-0.12	0.5693		0.16	0.4331		Descending
Teacher-guided synchronous discussion	-0.33	0.1128		-0.25	0.2294		Descending
Collaborative learning involving two or more students working together	0.07	0.7302		-0.27	0.1895		Descending
Individualized, student-driven independent study	-0.29	0.1611		-0.33	0.1060		Descending
What role, if any, is a parent or guardian expected to play to support the educational program of a student in the fourth grade?							
Make sure the student keeps up with assignments	-	-		-	-		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Actively participate in the student's instruction	-0.42	0.0376	*	0.29	0.1593		Binary
Participate in parent training sessions	0.06	0.7698		0.03	0.9054		Binary
Verify seat time	-0.02	0.9197		0.21	0.3047		Binary
Other role, not listed above - Specify:	-	-		-	-		Binary
In total, how much time is spent in synchronous instruction, each week, for an average student in the seventh grade?	-0.02	0.8937		0.10	0.5566		Ascending
How many students are involved in a typical seventh-grade math section?	0.26	0.2591		0.03	0.8993		Ascending
How many students are involved in a typical seventh-grade English / Language Arts section?	0.27	0.2393		0.03	0.8936		Ascending
In an average week, does a typical student in seventh grade spend any time in one-on-one interaction with a teacher or tutor (via chat, phone, tutoring, etc.)?	-0.23	0.1697		-0.28	0.0834		Binary
In an average week, how much time does a typical student in seventh grade spend in one-on-one interaction with a teacher or tutor (via chat, phone, tutoring, etc.) per week?	-	-		-	-		Ascending
Who provides one-on-one instructional support to students in seventh grade?							
Teacher of record for the course	-	-		-	-		Binary
Tutor/Coach	-0.45	0.0177	*	0.20	0.2870		Binary
[Removed]							Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Other instructional staff, not listed above - Specify:	-	-		-	-		Binary
Other teacher	-	-		-	-		Binary
Special education faculty	-	-		-	-		Binary
Parent	-	-		-	-		Binary
How frequently are the following instructional method(s) used in seventh grade?							
Lecture	-0.19	0.3162		-0.10	0.5929		Descending
Teacher-guided synchronous discussion	-0.41	0.0209	*	-0.10	0.5600		Descending
Collaborative learning involving two or more students working together	0.21	0.2550		0.01	0.9564		Descending
Individualized, student-driven independent study	-0.19	0.3093		-0.19	0.2996		Descending
What role, if any, is a parent or guardian expected to play to support the educational program of a student in the seventh grade?							
Make sure the student keeps up with assignments	-	-		-	-		Binary
Actively participate in the student's instruction	-0.27	0.1392		0.24	0.1779		Binary
Participate in a parent training sessions	-0.03	0.8642		-0.22	0.2145		Binary
Verify seat time	-0.10	0.5810		0.14	0.4393		Binary
Other role, not listed above - Specify:	-	-		-	-		Binary
In total, how much time is spent in synchronous instruction, each week, for an average student in high school?	-0.25	0.1350		0.01	0.9715		Ascending
How many students are involved in a typical high school math section?	0.14	0.5604		0.01	0.9552		Ascending
How many students are involved in a typical high school English section?	0.14	0.5592		0.02	0.9470		Ascending

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
In an average week, does a typical high school student spend any time in one-on-one interaction with a *teacher or tutor* (via chat, phone, tutoring, etc.)?	-	-		-	-		Binary
In an average week, how much time does a typical student in high school spend in one-on-one interaction with a *teacher or tutor* (via chat, phone, tutoring, etc.)?	-	-		-	-		Ascending
Who provides one-on-one instructional support to students in high school?							
Teacher of record for the course	-	-		-	-		Binary
Tutor/Coach	-0.52	0.0030	*	0.00	0.9830		Binary
removed							Binary
Other instructional staff, not listed above - Specify:	-	-		-	-		Binary
Other teacher	-	-		-	-		Binary
Special education faculty	-	-		-	-		Binary
Parent	-	-		-	-		Binary
How frequently are the following instructional method(s) used in high school?							
Lecture	-0.25	0.1729		-0.08	0.6406		Descending
Teacher-guided synchronous discussion	-0.16	0.3884		-0.07	0.7145		Descending
Collaborative learning involving two or more students working together	0.25	0.1783		-0.03	0.8594		Descending
Individualized, student-driven independent study	-0.34	0.0593		0.01	0.9396		Descending
What role, if any, is a parent or guardian expected to play to support the educational program of a student in high school?							
Make sure the student keeps up with assignments	-	-		-	-		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Actively participate in the student's instruction	-0.21	0.2477		0.24	0.1681		Binary
Participate in parent training sessions	0.01	0.9637		-0.11	0.5422		Binary
Verify seat time	-0.05	0.7852		0.08	0.6621		Binary
Other role, not listed above - Specify:	-	-		-	-		Binary
Where does the school's curriculum content come from? Please select the response below that best applies to the majority of your school's curriculum.							
Purchased from outside provider(s)	-0.15	0.2514		-0.13	0.3277		Binary
Provided by a school management organization that oversees our school	0.16	0.2347		-0.05	0.6897		Binary
Developed in-house and used by all instructors of the relevant courses	-0.09	0.5100		-0.01	0.9579		Binary
Developed in-house by individual course instructors	-0.12	0.0362	*	-0.04	0.7762		Binary
Who monitors teachers' contact with students and parents?							
Contact is not formally monitored	-	-		-	-		Binary
Principal	-0.16	0.2482		-0.07	0.5890		Binary
Other school administrator	-0.01	0.9178		-	-		Binary
Lead mentor/ teacher	0.01	0.9482		-0.03	0.8233		Binary
Other staff, not listed above	-0.08	0.5708		-0.01	0.9672		Binary
Do you have school-wide policies spelling out expectations for students in terms of ...							
Completion of assignments?	-	-		-	-		Binary
Class participation?	0.37	0.0303	*	0.25	0.1384		Binary
Attendance in synchronous instruction?	0.24	0.1577		-0.02	0.9211		Binary
Does your school monitor attendance or student participation in any of the following ways?							
Pace of student's completion of course assignments	-	-		-	-		Binary
Activity in the online system	-0.27	0.0858		-0.38	0.0097	*	Binary

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Seat time involved in synchronous work with a teacher	0.20	0.2004		0.22	0.1423		Binary
Other measure of completion of course work - Specify:	-	-		-	-		Binary
Below is a list of programs and supports schools can offer to students. For each, please indicate whether your school offers this program or support.							
One-on-one tutoring for struggling learners	-	-		-	-		Binary
Supplemental group instruction for struggling learners	-0.12	0.4924		-0.29	0.0903		Binary
Dropout prevention or dropout recovery program	0.10	0.5664		0.01	0.9369		Binary
Study-skills classes	0.08	0.6694		-0.13	0.4671		Binary
Clubs or activities (e.g., literary magazine, cultural activity groups, pep club)	0.14	0.4254		0.12	0.5030		Binary
Mental/behavioral health services	0.07	0.6747		0.03	0.8526		Binary
Music instruction	0.19	0.2931		-	-		Binary
Fine arts instruction	0.16	0.3574		-0.03	0.8439		Binary
Specialized instruction for English-language learners	0.18	0.3123		0.11	0.5316		Binary
Speech and language therapy or services	-	-		-	-		Binary
Talented/gifted program	0.41	0.0156	*	0.27	0.1150		Binary
Other services for students with IEPs	-	-		-	-		Binary
Please indicate whether your school offers any of the following programs or supports to high school students.							
Advanced Placement Courses	0.10	0.5568		-0.17	0.2763		Binary
International Baccalaureate program	-	-		-	-		Binary
Supports for students who have children of their own	-0.09	0.5986		-0.31	0.0462	*	Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
How many students at this school participate in the dropout prevention or dropout recovery program?	0.03	0.8885		-0.19	0.3620		Ascending
How many students at this school participate in Advanced Placement Courses?	0.29	0.1375		-0.08	0.6758		Ascending
How many students at this school participate in the International Baccalaureate program?	-	-		-	-		Ascending
On average, approximately how often do teachers conduct assessments of students in a typical ...							
4th grade math section	-0.49	0.0197	*	-0.16	0.4728		Descending
4th grade English / Language Arts section	-0.49	0.0197	*	-0.16	0.4728		Descending
On average, approximately how often do teachers conduct assessments of students in a typical ...							
7th grade math section	-0.37	0.0547	*	-0.11	0.5809		Descending
7th grade English / Language Arts section	-0.42	0.0294	*	-0.14	0.4644		Descending
On average, approximately how often do teachers conduct assessments of students in a typical ...							
High school math section	0.03	0.8825		0.10	0.5685		Descending
High school English section	-0.05	0.7862		0.04	0.7400		Descending
Does the school systematically conduct an entry assessment for students who have just enrolled using any of the following measures or methods?							
Academic skills	0.05	0.7860		0.01	0.9332		Binary
English-language skills	0.27	0.1419		0.30	0.0823		Binary
Potential barriers for online learning	0.20	0.2769		0.12	0.5132		Binary
Level of parent or other home supports for online learning	0.27	0.1290		0.33	0.0539	*	Binary
Learning Disabilities	0.11	0.5338		0.34	0.0495	*	Binary
Any disabilities other than learning disabilities	0.11	0.5564		0.12	0.4990		Binary
Pull student's records from previous school(s)	-	-		-	-		Binary

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Phone call to household	0.17	0.3412		-0.02	0.9053		Binary
Home visit	-0.23	0.2044		-0.04	0.8268		Binary
Does this school promote student performance on state assessments in any of the following ways?							
Test preparation embedded in regular courses	0.09	0.6025		-0.09	0.5979		Binary
Separate test preparation course required in relevant grades/ subjects	0.25	0.1557		0.17	0.3340		Binary
Intensive, targeted support for students who may have difficulty achieving proficiency standards on state assessments	0.33	0.0583		0.17	0.3268		Binary
How frequently does your school actively send parents information on their child's progress via email, phone, or postal mail?	0.11	0.4843		-0.05	0.7277		Ascending
Does this progress report for parents include a measure of student engagement or participation?	-	-		-	-		Binary
How does your school respond when students are identified as disengaged?							
Email parent	-	-		-	-		Binary
Personal call to parent(s)	-	-		-	-		Binary
Automated call to parent(s)	0.16	0.3054		-0.07	0.6454		Binary
Visit home	-0.03	0.8655		-0.18	0.2433		Binary
Enlist social services	0.10	0.5260		0.09	0.5592		Binary
Offer student incentive to participate	0.03	0.8628		0.00	0.9868		Binary
Other response, not listed above – specify:	0.33	0.0341	*	0.20	0.1887		Binary
Letter mailed to home	0.21	0.1824		0.21	0.1734		Binary
Are any of the following tools used to support asynchronous instruction?							
Email	-	-		-	-		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Physical (paper) textbooks	0.17	0.3425		0.14	0.4357		Binary
Online textbooks	0.04	0.8443		-0.10	0.5846		Binary
Interactive online exercises	-	-		-	-		Binary
Other websites with instructional focus or content	-0.03	0.8888		0.19	0.2815		Binary
Recordings of lectures	0.06	0.7528		-0.14	0.4373		Binary
Discussion forums or threaded discussion groups	-0.23	0.1970		-0.01	0.9478		Binary
Social media (blogs, wiki)	-0.08	0.6497		-0.01	0.9743		Binary
Other tool not listed above (specify)	-0.24	0.1790		0.02	0.9180		Binary
Are any of the following tools used to support synchronous instruction?							
Video conferencing (Skype, FaceTime, etc.)	-0.14	0.4460		-0.03	0.8802		Binary
Screen sharing/web conferencing	0.01	0.9636		-0.24	0.1785		Binary
Audio conferencing	0.84	0.0551		0.10	0.5689		Binary
Online chat forum	0.02	0.9243		-0.13	0.4793		Binary
Instant messaging (IM) or other one-on-one chats	-0.30	0.0983		-0.14	0.4381		Binary
Phone calls	-0.03	0.8525		-0.03	0.8523		Binary
Text messaging	-0.28	0.1687		-0.07	0.7366		Binary
Other tool not listed above (specify)	0.47	0.0346	*	0.33	0.1431		Binary
What types of technology, if any, does this school provide, without charge, to students?							
Internet connection (e.g. internet service or subsidy for internet service, modem, router, and/or hotspot)	-0.13	0.4555		-0.08	0.6500		Descending
Computer (e.g. laptop or desktop computer, or tablet computer such as iPad)	0.03	0.8607		-0.08	0.6493		Descending
Computer Accessories (e.g. webcam, microphone, head set, cd/dvd drive, printer, or scanner)	0.08	0.6556		-0.02	0.8928		Descending

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Assistive Technology for students with disabilities	0.01	0.9780		-0.32	0.0627		Descending
Does the school provide tech support to teachers in any of the following ways?							
No tech support is provided to teachers at this school	-	-		-	-		Binary
Live, personal support (via phone or chat)	-0.11	0.4172		-0.19	0.1542		Binary
Manuals, written guides, or FAQ documents	-0.02	0.8683		-0.17	0.2035		Binary
Other support, not listed above (specify)	-	-		-	-		Binary
When is live, personal tech support available to teachers?							
Weekdays during business hours	-	-		-	-		Binary
Weekday evenings	0.34	0.0557		0.20	0.2507		Binary
Weekends	-0.12	0.4952		0.25	0.1443		Binary
How is tech support provided to students?							
No tech support is provided to students at this school	-	-		-	-		Binary
Manuals, technical guides, FAQ documents	-0.10	0.4596		-0.23	0.0898		Binary
Live phone or chat support	-0.06	0.6775		-0.10	0.4799		Binary
Troubleshooting via remote control of computer	-0.10	0.4830		-0.20	0.1433		Binary
Online ticketing system	-0.19	0.1620		0.23	0.0830		Binary
In-person set up of computer	-0.39	0.0033	*	-0.23	0.0795		Binary
Other support, not listed above (specify)	-	-		-	-		Binary
When is live, personal tech support available to students?							
Weekdays during business hours	-	-		-	-		Binary
Weekday evenings	0.30	0.0580		0.21	0.1827		Binary
Weekends	0.10	0.5213		0.11	0.4786		Binary
In total, how many teachers are currently employed at this school? (full-time)	0.26	0.1020		-0.06	0.7234		Ascending

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
In total, how many teachers are currently employed at this school? (part-time)	-0.05	0.7765		0.05	0.7410		Ascending
What is the total number of full-time equivalent (FTE) teachers employed by the school?	0.23	0.1654		-0.07	0.6750		Ascending
How many of the following other instructional and support staff (including those contracted for services) work in this school (in FTE units)?							
Teacher aides/instructional assistants	0.06	0.7362		0.13	0.4602		Ascending
Tutors	-0.06	0.7673		-0.22	0.2590		Ascending
Guidance counselors	0.39	0.0266	*	-0.01	0.9696		Ascending
Other instructional support staff	0.20	0.3043		-0.07	0.7021		Ascending
From the list below, please rank the three most important factors when deciding which candidates to offer jobs.							
Commitment to this school's mission / willingness to work hard	-0.01	0.9152		-0.16	0.2334		Binary
Certification status (holds a valid teaching certificate)	-0.15	0.2465		-0.15	0.2493		Binary
College grade point average (GPA)	-	-		-	-		Binary
College major in content area to be taught	0.08	0.5689		0.04	0.7600		Binary
Score on a test (e.g. Praxis)	-	-		-	-		Binary
Experience teaching courses online	-0.17	0.1823		-0.19	0.1377		Binary
General experience as a teacher	0.04	0.7652		-0.04	0.7379		Binary
Master's degree	-	-		-	-		Binary
Performance in teaching sample class	0.16	0.2099		0.06	0.6566		Binary
Quality of candidate's pre-service teacher training program	-	-		-	-		Binary

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Other factor(s), not listed - specify:	-	-		-	-		Binary
Are your school's teachers covered by a collective bargaining agreement?	0.09	0.6093		0.22	0.2049		Binary
Do teachers come to a central location to do most of their online teaching, or do they do most of their teaching from their homes?	-0.18	0.2527		-0.09	0.5722		Binary
Is the teacher of record for a particular class responsible for ...							
Lesson planning?	-0.27	0.1216		-0.05	0.7929		Binary
Developing curriculum?	-0.55	0.0009	*	-0.24	0.1634		Binary
Lecturing?	0.08	0.4679		-0.26	0.1352		Binary
Grading student work?	-	-		-	-		Binary
One-on-one tutoring?	0.21	0.2353		0.03	0.8589		Binary
Identifying struggling learners?	-	-		-	-		Binary
Communicating with parents?	-	-		-	-		Binary
Managing online learning environments (e.g. online forums or discussion boards)?	0.00	0.9845		-0.15	0.1409		Binary
Troubleshooting technical issues?	-0.10	0.5890		-0.05	0.7620		Binary
Other - Specify:	0.05	0.7998		0.14	0.4218		Binary
Which of the following statements best describes the expectation for most 4th grade teachers of core academic subjects (reading, math, science, or social studies)?							
Most 4th-grade core academic teachers specialize in a subject	-	-		-	-		Binary
Most 4th-grade core academic teachers are generalists, responsible for multiple subjects	0.03	0.8129		-0.10	0.4421		Binary
Approximately how many students, in total, is a full-time 4th grade teacher typically expected to teach?	0.05	0.7952		0.22	0.2648		Ascending

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Approximately how many students, in total, is a full-time 7th grade teacher typically expected to teach?	-0.05	0.7558		-0.04	0.7964		Ascending
Approximately how many students, in total, is a full-time high school teacher typically expected to teach?	-0.02	0.8930		0.08	0.6477		Ascending
Approximately how many students, in total, is a part-time 4th grade teacher typically expected to teach?	-	-		-	-		Ascending
Approximately how many students, in total, is a part-time 7th grade teacher typically expected to teach?	-	-		-	-		Ascending
Approximately how many students, in total, is a part-time high school teacher typically expected to teach?	-	-		-	-		Ascending
Does a typical fourth-grade math class include instructional staff in addition to the teacher (e.g. aides, tutors)?	0.39	0.0779		0.28	0.2145		Binary
Does a typical fourth-grade English / Language Arts class include instructional staff in addition to the teacher (e.g. aides, tutors)?	0.36	0.1029		0.23	0.3035		Binary

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Does a typical seventh-grade math class include instructional staff in addition to the teacher (e.g. aides, tutors)?	0.31	0.1102		0.17	0.3674		Binary
Does a typical seventh-grade English / Language Arts class include instructional staff in addition to the teacher (e.g. aides, tutors)?	0.23	0.2564		0.05	0.7846		Binary
Does a typical high-school math class include instructional staff in addition to the teacher (e.g. aides, tutors)?	0.15	0.4445		0.18	0.3192		Binary
Does a typical high school English class include instructional staff in addition to the teacher (e.g. aides, tutors)?	0.14	0.4663		0.03	0.8709		Binary
Does this school provide teachers with paid time for professional development?	-	-		-	-		Binary
During the 2013-2014 school year, how frequently did a typical teacher participate with other teachers from this school in synchronous, online professional development?	-0.03	0.8807		-0.38	0.0263	*	Ascending

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
During the 2013-2014 school year, how frequently did a typical teacher participate with other teachers from this school in in-person professional development at a central location?	0.02	0.9206		0.11	0.5423		Ascending
During the 2013-2014 school year, how frequently did a typical teacher participate with other teachers in regular faculty meetings (online or in person) for this school?	-0.18	0.3214		-0.03	0.8671		Ascending
How many times during the 2013-2014 school year did teachers experience the following at your school?							
Observed by and received feedback from a peer	-0.02	0.9206		-0.01	0.9375		Ascending
Observed by and received feedback from a master teacher or someone else who coaches teachers	-0.10	0.5730		-0.37	0.0279	*	Ascending
Observed by and received feedback from a principal, administrator, or someone else who monitors performance	0.19	0.2804		0.13	0.4711		Ascending
Provided with diagnostic test results for individual students to help them determine which topics/skills to focus on	0.34	0.0531	*	0.04	0.8230		Ascending
Asked to submit lesson plans to master teacher, department chair, principal, or other administrator for review	-0.04	0.8407		0.28	0.1069		Ascending

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Attended workshops, conferences, or other kinds of group-based training	0.05	0.0784		0.10	0.5682		Ascending
Please rank, in order, the three most important factors considered when evaluating teachers at this school.							
Observations of teacher's instruction	-0.01	0.9328		0.12	0.3776		Binary
Teacher's accessibility to students (e.g. logs of student-teacher communication, response time to student inquiries, time to grade and return assignments)	-0.14	0.2755		0.01	0.9224		Binary
Feedback from other teachers or instructional coaches	0.25	0.0559		0.06	0.6356		Binary
Feedback from students or parents	0.08	0.5290		0.17	0.1866		Binary
Student course completion rate	0.13	0.3215		-0.45	0.0003	*	Binary
Student achievement growth	0.21	0.1101		-0.09	0.4710		Binary
Portfolio of examples of student work (e.g., student essays, lab reports)	-	-		-	-		Binary
Meeting expectations for student engagement	0.00	0.9755		-0.17	0.1869		Binary
Other factor(s), not listed - specify:	-	-		-	-		Binary
Are teachers in your school paid more based on any of the following:							
Teacher evaluation results	0.29	0.1061		0.08	0.6693		Binary
Student achievement growth	0.41	0.0202	*	0.30	0.0901		Binary
Student proficiency levels	0.08	0.6577		0.21	0.2333		Binary
Course completion rates of students	0.17	0.3588		0.26	0.1327		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Advanced degrees, such as master's degrees or doctoral degrees	0.39	0.0266	*	0.05	0.7928		Binary
Teaching experience	0.12	0.5041		0.19	0.2763		Binary
Additional certifications	0.11	0.5412		0.25	0.1487		Binary
Filling a hard-to-staff position	0.09	0.6099		0.13	0.4603		Binary
Number of students taught	-0.20	0.2615		0.03	0.8731		Binary
Serving as a mentor or coach to other teachers	-0.10	0.6005		0.08	0.6361		Binary
Can teachers at this school earn tenure?	0.31	0.0501	*	0.13	0.4097		Binary
What opportunities do instructional staff in your school have to take on additional responsibilities to advance their careers?							
Supervise junior teachers (as a department chair or lead teacher)	0.25	0.1668		0.00	0.9964		Binary
Become an instructional coach or master teacher	0.28	0.1185		0.03	0.8650		Binary
Teach more and/or larger classes	-0.19	0.3057		-0.07	0.7014		Binary
Lead professional development for groups of staff	0.25	0.1652		-0.01	0.9591		Binary
Approximately how long do teachers stay with the school on average (months)?	-	-		-	-		Ascending
Approximately how long do teachers stay with the school on average (years)?	-0.13	0.4500		0.27	0.1087		Ascending
Throughout the school year, what percentage of your work week, on average, do you spend on the following tasks in this school?							
Internal administrative tasks, including human resource/ personnel issues, regulations, reports, school budget	-0.21	0.2480		-0.30	0.0772		Ascending
Observing teachers	0.09	0.6113		0.07	0.6988		Ascending

	Coefficient	p-value	Sig	Coefficient	p-value	Sig	Response Type
Working with instructional coaches, grade leaders, departmental leaders, or other instructional leaders in your school	0.04	0.8397		0.13	0.4558		Ascending
Developing or leading professional development activities for staff	-0.21	0.2522		-0.01	0.9429		Ascending
Student interactions, including discipline and academic guidance	0.38	0.0298	*	0.30	0.0799		Ascending
Student interactions, including discipline and academic guidance	-0.12	0.5016		0.05	0.7578		Ascending
Parent interactions	-0.06	0.7322		0.28	0.1083		Ascending
Other task not listed above, specify	-	-		-	-		Ascending
Other task not listed above, specify	-	-		-	-		Ascending
Other task not listed above, specify	-	-		-	-		Ascending
Other task not listed above, specify	-	-		-	-		Ascending
Are student test score growth or student test-score levels included as a criterion in the evaluation of your performance?							
Student test-score growth is included in my performance evaluation	0.21	0.2504		0.05	0.7813		Binary
Student test-score levels are included in my performance evaluation	0.10	0.5961		0.21	0.2281		Binary
Is your compensation as leader of this school, including salary and bonuses, affected by any of the following…							
Number of enrolled students	-0.07	0.7068		-0.06	0.7168		Binary
Students' achievement growth on standardized assessments (or the school's value added)	0.24	0.1752		0.22	0.2017		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Students' test-score levels on state assessments	0.28	0.1194		0.45	0.0073	*	Binary
Student course completion rates	0.05	0.7751		0.25	0.1403		Binary
Reenrollment of current students across school years	0.18	0.3269		0.03	0.8699		Binary
Retention of teaching staff	-0.31	0.0748		-0.11	0.5334		Binary
School's operating profit or loss	0.23	0.1962		-0.17	0.3168		Binary
Other (specify)	-	-		-	-		Binary
In the past 12 months, have you participated in the following kinds of professional development activities as the leader of this school?							
University course(s) related to your role as leader of this school	-0.04	0.8437		-0.01	0.9463		Binary
Visits to other schools designed to improve your own work as leader of this school	0.35	0.0504	*	0.20	0.2577		Binary
Mentoring, peer observation, or coaching by or for a leader of another school	0.16	0.3757		-0.01	0.9470		Binary
Participating in a school leader network (e.g., a group of school leaders organized by an outside agency or through the internet)	0.20	0.2765		0.28	0.1054		Binary
Workshops, conferences, or training in which you were a presenter	0.17	0.3559		0.07	0.6936		Binary
Other workshops or conferences in which you were not a presenter	-0.31	0.0748		-0.11	0.5334		Binary
Have you (the leader of this school) participated in a principal training program?	0.12	0.5046		0.21	0.2385		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Prior to the 2013-2014 school year, how many years did you serve as the leader of this school	0.08	0.6011		0.08	0.6060		Ascending
Do you have prior experience as principal at another school?	0.19	0.2275		-0.06	0.7222		Binary
Was your previous experience at a conventional brick-and-mortar school, a virtual/online school or a combination of both?							
Conventional brick-and-mortar	0.00	0.9824		0.07	0.5910		Binary
Virtual/on-line school	-0.22	0.0905		-0.20	0.1187		Binary
Both	-0.18	0.3209		-0.01	0.9522		Binary
How long were you a principal at the previous school(s)?	-0.15	0.5453		0.07	0.7665		Ascending
Before you became a school leader, how many years of elementary or secondary teaching experience did you have, if any?	-0.31	0.0808		-0.12	0.4954		Ascending
How many years of teaching experience have you (the leader of this school) had in a virtual/online school?	-0.18	0.3198		-0.11	0.5180		Ascending
Is this school its own LEA (Local Education Agency)?	-0.08	0.6279		0.02	0.8913		Binary
A school's funding can be impacted by a number of factors. Is the school's funding impacted by the total number of courses completed?	-0.13	0.4149		0.02	0.9204		Binary
Does your school participate in the federal Title I program?	-0.36	0.0394	*	0.03	0.8667		Binary

	Coeffi cient	p-value	Sig	Coeffi cient	p-value	Sig	Response Type
Does your school receive designated funding for special education services?	-0.03	0.8817		-0.21	0.2464		Binary
Does your school's authorizer monitor any of the following student outcomes in your school							
State test results	-	-		-	-		Binary
Attendance rates	-0.23	0.1910		-0.05	0.7573		Binary
Re-enrollment rates	0.27	0.1272		0.15	0.4044		Binary
Course completion rates	-0.03	0.8825		0.25	0.1515		Binary
Is your school affiliated with a school management organization that provides curriculum or instructional support services?	0.30	0.0569		0.04	0.7785		Binary
Does the management organization's central office provide your school with any of the following?							
Curriculum and Instructional Materials	0.53	0.0098	*	0.22	0.2909		Binary
Access to instructional coaches?	-0.10	0.6521		-0.08	0.7098		Binary
Professional development for teachers, such as workshops and in-service training programs?	-	-		-	-		Binary
A system of diagnostic or formative student assessments and results?	0.15	0.4919		-0.17	0.4215		Binary
Technical assistance, support, or resources in areas in which student test scores are weak?	0.15	0.4888		-0.02	0.9218		Binary
In your opinion, do state or local laws or policies impose constraints on your school's growth?	-0.03	0.8695		-0.27	0.1156		Binary

References

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.

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.

Cremata, E., Davis, D., Dickey, K., Lawyer, K., Negassi, Y., Raymond, M., and Woodworth, J. (2013). National Charter School Study. Center for Research on Education Outcomes (CREDO) Report. Retrieved 10 July, 2015 from: http://credo.stanford.edu/documents/NCSS%202013%20Final%20Draft.pdf

Fortson, K., Gleason, P., Kopa, E., and Verbitsky-Savitz, N. (2015). "Horseshoes, hand grenades, and treatment effects? Reassessing whether nonexperimental estimators are biased." *Economics of Education Review* 44: 100-113.

Gill, B., Furgeson, J., Chiang, H., Teh, B., Haimson, J., and Verbitsky-Savitz, N. "Replicating Experimental Impact Estimates in the Context of Control-Group Noncompliance." Statistics and Public Policy, forthcoming.

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Disruption versus Tiebout improvement: The costs and benefits of switching schools. Journal of Public Economics, 88(9), 1721-1746. Retrieved 10 July, 2015 from: http://www.sciencedirect.com/science/article/pii/S004727270300063X

Hanushek, E.A., Peterson, P.E., and Woessmann, L. (2012). Is the US Catching Up? International and State Trends in Student Achievement. Education Next, Vol. 12, No. 4. Fall 2012. Retrieved 10 July, 2015 from: http://educationnext.org/is-the-us-catching-up/

Pazhouh, R., Lake, R., and Miller, L. (2015). "The Policy Framework for Online Charter Schools." Center on Reinventing Public Education, University of Washington Bothell, 2015.

Raymond, M. (2009). Multiple choice: Charter school performance in 16 states. Center for Research on Education Outcomes (CREDO) Report. Retrieved 10 July, 2015 from: http://credo.stanford.edu/reports/MULTIPLE_CHOICE_CREDO.pdf

South, S. J., Haynie, D. L., & Bose, S. (2007). Student mobility and school dropout. *Social Science Research*, *36*(1), 68-94. Retrieved 10 July, 2015 from: http://www.sciencedirect.com/science/article/pii/S0049089X05000700