RESEARCH

A Longitudinal Assessment of Academic Achievement in Indiana Charter Elementary Schools

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Abstract

This study describes the presenting academic competencies of elementary school children in the inaugural cohort of Indiana charter schools and reports a multi-level analysis of longitudinal growth in learning within the 2003-2004 academic year. Nine-hundred fifty six elementary students across ten charter schools sat for the Measures of Academic Progress (Northwest Evaluation Association) in both fall, 2003 and spring, 2004.

The results show that many students with significant academic challenges enroll in the charter school. Charter school students demonstrated growth in learning, particularly in reading, that was commensurate with growth in norming groups. A multi-level analysis showed that school level variables (low pupil-teacher ratio, average daily attendance) positively influenced growth in mathematics and language achievement, but not in reading and that student-level variables were not related to achievement. A heuristic based on the standard error ratio gave passing grades to most schools with respect to growth in learning, although there is variability among charter schools. Implications for policy and directions for future research are discussed.

A Longitudinal Assessment of Academic Achievement in Indiana Elementary Charter Schools

The charter school movement is the centerpiece of contemporary efforts to reform public education. It attempts to initiate positive change in public education through the mechanisms of innovation, choice and competition. Although these features of charter schools resonate with advocates of market-based educational reforms (Chubb & Moe, 1990), it is fair to say that the charter school concept enjoys broad support from a diverse group of stakeholders from across the political spectrum (Hassell, 1999; Manno, Finn, Bierlein & Vanourek, 1998; Murphy & Shiffman, 2002), although it has attracted significant opposition as well (Kolderie, 1990; Wells, 2002).

Critics of charter schools raise a number of issues. For example, there are concerns about charter school teacher credentials (Burian-Fitzgerald, Luekens, & Strizek, 2004) and the extent to which charter schools meet provisions of special education requirements (Fiore, Harwell, Blackorby & Finnegan, 2000; Fuller, Gawlik, Gonzales, Park & Gibbings, 2003). Some researchers wonder if charter schools will exacerbate patterns of racial and socioeconomic segregation (Cobb & Glass, 1999; Wells, Holme, Lopez & Cooper, 2000) or be held to state-mandated accountability standards (American Federation of Teachers, 2002).

These are important policy issues, to be sure, but it is the ability of charter schools to favorably influence student achievement that looms as the principle challenge facing the charter school movement. On this question the empirical evidence is both thin and mixed. On the thin side, reviewers of the charter school literature have commented on the "paucity of studies of student achievement" (Miron & Nelson, 2004, p. 162) and on the fact that current research on charter school performance is "scant" (U.S. Department of Education, 2004, p. 53). Moreover, the extant literature is equivocal on whether charter schools are having a demonstrable impact on student learning (Gill, Timpane, Ross & Brewer, 2001). For example, the summary and analysis by the Center for Educational Reform (2001) of 68 studies conducted on charter schools since 1995 revealed decidedly mixed outcomes. Miron and Nelson (2004) reported mixed to slightly negative impact of charter schools on achievement in their review of 17 evaluation projects. On the basis of their review of numerous evaluation reports, Bulkley and Fisler (2002) concluded more positively that, "No conclusive data indicates that charter schools on the whole are failing their students, and some charter schools are showing positive achievement results."

Indeed, conclusive data is hard to come by, largely because research in this area faces imposing methodological challenges. Three recent reports are illustrative. Lovelass (2002) compared achievement

scores of students in 376 charter schools across 10 states with students who attended regular schools. States were selected if they had at least 30 charters in operation in 1999, had tested students in grades four, eight, and 10, and had used the same achievement test in 1999, 2000 and 2001. Math and reading scores were aggregated into a composite achievement score in this analysis. Two results were prominent. First, charter public schools reported significantly lower achievement scores than did regular public schools. Second, new charters tended to have depressed scores for at least the first two years of operation.

Similarly, Nelson, Rosenberg and Van Meter (2004) analyzed charter school achievement on the 2003 National Assessment of Educational Progress on behalf of the American Federation of Teachers. The results showed that in a nationally representative sample, charter school pupils at both the fourth and eighth grade had lower achievement (about a half grade equivalent) in reading and math than did pupils in regular public schools. Finally, in a study of charter schools in five case study states (Texas, Colorado, Illinois, Massachusetts and North Carolina), using school-level, cross-sectional data from the 2001-2002 academic year, it was concluded that "charter schools were less likely than traditional public schools to meet a state's performance standard" (U.S. Department of Education, 2004, p. 54).

However, as the authors of these reports point out, the interpretation of the data does not lend itself to straightforward conclusions about the relationship between charter schools and academic achievement, largely because of selection effects. Other methodological difficulties are often noted, such as studies that examine school- or classroom-level means of successive cohorts of students and that student-level data is rarely available, which prevents longitudinal tracking of achievement outcomes over the course of matriculation. Other difficulties include inconsistent assessments used across charter and regular schools; assessments which are often restricted to certain grades and a lack of suitable statistical controls or comparison groups used in assessments (Charter School Achievement Consensus Panel, 2006; Bulkley & Fisler, 2002). Indeed, in Miron and Nelson's (2004) review only two studies out of 17 merited the highest rating of design quality by including an analysis of individual-level change with statistical controls and/or blocking. As a result it has become difficult to determine the value-added qualities of charter schools (Hill, Lake, Celio, Campbell, Herdman & Bulkley, 2001).

Indeed, although longitudinal assessment of achievement has demonstrated promising results in some charter school evaluations (Doran & Drury, 2002; Solomon, Paarke & Garcia, 2001, Gronberg & Jansen, 2001), these studies are rare and their relative absence from the literature has made it difficult to draw warranted conclusions about charter school effectiveness. In this paper we report on the value-added by Indiana charter elementary schools using student-level longitudinal data on standardized academic achievement within an academic year. Because Indiana's enabling legislation is relatively recent (2001), student performance in Indiana charter schools has not heretofore been included in evaluation studies or literature reviews.

Indiana Charter Schools

Indiana is the 37th state to pass a charter school law. The law grants authority for public universities and the mayor of Indianapolis (among other entities) to issue public school charters. The first cohort of charter schools commenced operation in August and September, 2002. In this first cohort, all of the elementary schools were authorized by the mayor of Indianapolis (N = 5) or by Ball State University (N = 5). Three additional charter elementary schools commenced operations in the following academic year (2003-2004). One of these 11 schools subsequently had its charter revoked by the authorizer, leaving a total of 10 schools participating in this study. Although the charter schools were under accountability and reporting requirements of their respective authorizers (and accountability requirements mandated by state law), there was broad consultation among charter school authorizers and stakeholders concerning the desirability of establishing a systematic data collection regime that would permit longitudinal assessment of academic achievement using a common metric.

It was agreed that the common assessment should meet certain requirements. First, the test should be aligned with Indiana proficiency standards. Second, the test should have a known and predictive relationship with the state-mandated test, called ISTEP+. Third, test data should be useful both for purposes of accountability and for instructional planning. Fourth, the test results should permit comparisons not only to national norms, but to local Indiana norms as well. In light of these specifications, the Indiana charter elementary schools adopted the Measures of Academic Progress published by the Northwest Evaluation Association as a common measure of academic achievement. Pupils sit for the Measures of Academic Progress at least twice a year in the fall and spring academic terms. This permits analysis of growth in learning within an academic year.

Two unique features of the Indiana charter school movement should be emphasized. First, all of the charter elementary schools, irrespective of authorizer, have committed to this common metric for gauging academic achievement. Second, there is a commitment to a systematic data collection regime that permits value-added longitudinal assessment of achievement outcomes, with appropriate statistical controls and comparison groups. Indiana charter schools afford, then, a unique opportunity for systematic assessment of charter school effectiveness.

The Present Study

In the present study we first present descriptive data regarding student academic performance in both the fall, 2003 and spring, 2004 assessments, compared with both Indiana and national norms. The 2003-2004 academic year is the first for which longitudinal comparisons are possible. We then examine whether growth in academic achievement over the course of the school year kept pace with growth observed in the norming samples. Finally we conducted a multi-level value-added analysis of achievement in each of the academic goal areas (reading, mathematics and language arts).

The multi-level analysis will allow us to estimate whether variation in school achievement over the course of the academic year can be traced to characteristics of students, such as their gender and eligibility for special education or Title 1 services or free/reduced lunch; or to characteristics of the school, such as average daily attendance, years of teacher experience and student-teacher ratio. Testing these effects is recommended by the White Paper of the National Charter School Research Project (Charter School Achievement Consensus Panel, 2006). Moreover, the present study surmounts many of the methodological hurdles noted earlier. We track individual student-level data longitudinally. We use standardized assessments common to all charter schools. We test students at every grade. We compare student achievement in the charter schools against state and national norm groups.

Method

Participants. A total of 1,169 students in grades two to N (typically 5th- or 6th-grade) from ten charter elementary schools sat for the Measures of Academic Progress (MAP) early in the fall term of 2003. One school in this cohort of 11 schools had its charter revoked by its authorizer, and consequently was not included in the analyses. Of this sample, 956 pupils were also administered MAP in the spring of 2004. Table 1 compares the fall achievement of students who sat for MAP assessment in both the fall and spring terms (labeled "longitudinal") and students who sat for MAP only once in the fall (labeled "attrition"). As one can see, the level of achievement in mathematics, reading and language was not markedly different between the two groups, although students who sat in both testing periods typically had somewhat higher levels of mean performance than did those who only took the test in the fall.

Table 1
Fall 2003 RIT Scores and Standard Deviations for Attrition and Longitudinal Students

	Mathematics		Reading		Language Arts	
	M	Std.Dev	M	Std.Dev	M	Std.Dev
Grade 2						
Attrition	167.8	12.1	164.0	17.2	171.3	15.3
Longitudinal	170.0	12.1	165.2	16.4	171.9	15.2
Grade 3						
Attrition	180.0	12.1	173.2	16.7	183.3	14.4
Longitudinal	184.1	14.3	179.4	18.2	186.8	16.1
Grade 4						
Attrition	190.0	13.3	184.7	17.9	193.3	15.5
Longitudinal	193.7	12.3	187.8	18.6	197.0	14.1
Grade 5						
Attrition	200.7	12.8	190.5	21.9	200.7	16.4
Longitudinal	201.9	12.7	194.6	17.9	203.2	13.1
Grade 6						
Attrition	204.8	14.5	195.7	15.9	204.6	12.5
Longitudinal	207.0	14.3	197.1	21.0	206.6	14.1

Table 2 reports the demographic profile of each school. It is evident that the charter elementary schools in Indiana serve a predominantly minority (mostly African-American) student population (81 percent). Over one third of pupils in these grades is eligible for free or reduced lunch; approximately half are male (51percent), and 8 percent qualified for special education services. Moreover, six of the 10 charter schools operating during this period were established in large urban centers (Schools B, C, D, E, H and I), while the remaining four charters were established in a smaller city (School J), a metropolitan suburb (School F) and a town (School A and School F).

Table 2
Demographic Profile of Indiana Charter Elementary Schools Grades 2 to N: AY 2003-2004

	Enrollment	Gender	Ethno-Racial	Free Reduced Lunch	Special Education
	Grades 2-N	% Male	% Minority	% Eligible	% Identified
School A	44	52.3	2.3	16.0	9.1
School B	164	59.2	100	55.0	1.8
School C	166	50	96.4	48.0	9
School D	112	50	73.2	60.0	12.5
School E	62	40.5	100	77.0	2.3
School F	72	51.4	18.1	16.0	5.6
School G	18	44.4	11.1	20.0	19.7
School H	189	53.4	100	58.0	4.8
School I	86	44.2	94.2	81.0	24.4
School J	43	30.2	55.8	44.0	18.6
Sample Total	N = 956	51.46%	81%	53%	8.7%

Note. Schools B, C, D, E, H and I are predominantly urban schools

Measures. The Measures of Academic Progress (MAP) is a computer-adapted test that includes tests of reading, language arts and mathematics. In a computer-adapted test each student takes a unique test that is dynamically developed during the course of the administration to find the student's instructional level. Hence the difficulty of the test is adjusted to the student's ability in the content area being tested. Although test administration is not timed, most students complete a given assessment in 30 to 45 minutes. Typically students sit for the MAP over the course of three days, with one test administered each day. The index of achievement derived from this assessment is called a "Rasch Unit score," or RIT score, where scores range from about 150 (second and third grade) to 300 (end of high school). It is an equal interval score so scores can be added to calculate classroom or school averages.

Each MAP test draws from extensive test banks (over 15,000 items) that have been developed by trained teachers to cover a wide range of achievement goals, and includes items aligned with Indiana proficiencies. One way to examine alignment is to look at empirical relationships between MAP and Indiana's state-mandated test. A recent study (Cronin, 2003) compared RIT scores and ISTEP+ test information of over 24,000 students enrolled in third, sixth and eighth grade from 19 Indiana school corporations. Students sat for both assessments in the fall of 2002. The results showed that ISTEP+ and RIT scores were correlated in the range of 0.72 to 0.88, depending on grade and subject (with sixth and eighth-graders generally reporting higher correlations than third-graders). In addition, ISTEP+ cut scores can be predicted with 81 to 87 percent accuracy when both tests are administered in the same testing season.

Northwest Evaluation Association recently published the "RIT Scale Norms for Indiana" (similar norms are also available based on a national reference sample). It includes fall and spring test data of more than 100,000 Indiana students from 89 school districts. Hence the MAP achievement of charter elementary pupils can be compared readily to the achievement of peers across the state and with the national sample.

Moreover, in addition to grade-level indices of central tendency for each test (reading, language arts, mathematics), the RIT Scale Norms also report observed growth means (fall-to-spring, fall-to-fall, and spring-to-spring) in each achievement area. The data provides potential benchmarks to gauge continuous improvement from year to year. For example, a charter school might be said to meet minimum standards of accountability if average improvement of student RIT scores keeps pace with average growth norms of school children in the national and Indiana norm groups. In the present study we focus on the change in each of the content area scores from the fall 2003 to spring 2004 assessment.

Plan of Analysis. In order to determine the impact of selected student-level and school-level factors on change in academic performance, a Hierarchical Linear Model (HLM) approach is used. This analytical strategy permits the inclusion of independent variables from more than one level of the data (i.e., school level and student level). Student-level variables included special education participation (yes/no), free or reduced lunch status, receipt of Title I services and gender. School-level variables included average attendance rates, average number of years of teacher experience and the student-teacher ratio. Descriptive statistics for the school-level variables are reported in Table 2.

The HLM analysis models the change in scores from fall to spring using factors pertinent to both the student (e.g., free/reduced lunch status) and the schools (e.g., pupil-teacher ratio). In addition, this model provides an estimate of the impact of each school on score change versus the overall average growth across all schools. Finally, the HLM approach accounts for any correlation in performance that is due to attending a specific school, which is a necessary component of any analysis using such clustered data (Bryk & Raudenbush, 1992).

Value Added Assessment. A special application of HLM analysis to educational data is commonly referred to as the value-added assessment of school performance. Value-added assessment adjusts for students' incoming knowledge, in the form of a test score, and then assesses the impact of additional factors (e.g., poverty status, class size) on academic growth (Tekwe, Carter, Ma, Algina, Lucas, Roth, Ariet, Fisher & Resnick, 2004). When the school is included as a variable, as it is in this study, the value-added approach yields an estimate of school impact. This estimate can be thought of as the value added by the school after all other factors have been accounted for. This estimate of school impact can then be converted to an effect size that sheds light on the magnitude of a school's impact on student performance (Tekwe, et al, 2004).

Effect Sizes. Effect sizes provide a context for interpreting the results of significance tests. In addition to knowing whether an independent variable has a statistically significant impact on the response variable, it is also useful to know the magnitude of the impact. Tekwe, et al. (2004) described a method for determining the effect size that is attributed to a specific school in value-added assessment. This effect size is obtained by dividing the estimate of the school effect by its standard error. Tekwe, et al. (2004) also provide guidelines, discussed in more detail below, for interpreting effect sizes. While these guidelines are arbitrary, they do provide a framework for interpreting the impact that individual schools have on changes in student achievement scores, over and above the information yielded through statistical hypothesis testing of these effects.

Results

Patterns of Student Achievement. Table 3 reports a descriptive summary of student achievement in each of the academic goal areas (mathematics, language arts and reading) compared against national and Indiana norms. The tabulated data is the difference score between a charter school's mean grade-level RIT score in a goal area and the corresponding grade-level mean in the norming groups. A negative score indicates achievement below the norm groups. For example, with respect to fall, 2003 data, students entering second grade in School A had an average mathematics score that was 2.65 RIT points above the mean of second-graders in the national norming group, and 2.37 RIT points above the mean of Indiana second-graders. Indeed, students in School A outperformed the norm groups in most areas, with the exception of pupils in fifth grade, who lagged 3 to 9 RIT points behind their peers in the norming samples.

Table 3
Mean RIT Score Differences Between Charter School Achievement and National and Indiana Norm Groups, Fall 03 and Spring 04

	Mathematics				Language Arts				Reading			
	Fall 03		Spring 04		Fall 03		Spring 04		Fall 03		Spring 04	
	National	Indiana	National	Indiana	National	Indiana	National	Indiana	National	Indiana	National	Indiana
School A												
Grade 2	2.65	2.37	7.99	6.39	-.88	-1.38	5.63	2.23	-1.01	-1.11	4.28	2.68
Grade 3	1.68	-0.2	4.30	2.10	8.28	5.58	4.30	2.10	6.93	4.93	8.43	6.53
Grade 4	2.75	1.75	3.25	1.75	4.87	3.47	3.25	1.75	.23	-.67	6.08	4.58
Grade 5	-3.04	-4.18	-6.40	-8.40	-5.44	-6.94	-6.40	-8.40	-4.49	-5.59	.41	-.89
School B												
Grade 2	-11.72	-12.0	-5.10	-6.70	-11.65	-12.15	-4.25	-7.65	-16.70	-16.80	-5.04	-6.64
Grade 3	-12.41	-14.29	-7.94	-10.14	-9.04	-11.74	-6.87	-10.57	-12.59	-14.59	-9.67	-11.57
Grade 4	-5.54	-6.54	-.04	-1.54	-.65	-2.05	.58	-2.72	-5.89	-6.79	-1.41	-2.91
Grade 5	-10.22	-11.36	-8.82	-10.82	-4.98	-6.48	-7.98	-10.78	-14.20	-15.30	-7.78	-9.08
School C												
Grade 2	-12.29	-12.57	-19.57	-21.17	-10.89	-11.39	-16.34	-19.74	-16.47	-16.57	-16.60	-18.20
Grade 3	-.27	-2.15	-6.10	-8.30	-.43	-3.13	-.83	-4.53	-5.49	-7.49	-6.39	-8.29
Grade 4	-10.1	-11.1	-14.12	-15.62	-7.16	-8.56	-10.33	-13.63	-13.89	-14.79	-13.43	-14.93
Grade 5	-6.2	-7.34	-8.05	-10.05	-1.49	-2.99	-4.01	-6.81	-13.27	-14.37	-10.93	-12.23
School D												
Grade 2	-8.65	-8.93	2.30	.70	-10.68	-11.18	2.00	-1.40	-14.83	-14.93	-.10	-1.70
Grade 3	-4.88	-6.76	.25	-1.95	-6.52	-9.22	1.03	-2.67	-7.07	-9.07	-.59	-2.49
Grade 4	-6.21	-7.21	.54	-.96	-4.57	-5.97	.79	-2.51	-14.76	-15.66	1.56	.06
Grade 5	-7.37	-8.51	-3.60	-5.60	-9.83	-11.33	-6.37	-9.17	-17.60	-18.70	-3.10	-4.40
School E												
Grade 2	11.75	11.47	8.57	6.97	11.38	10.88	4.81	1.41	4.30	4.20	9.17	7.57
Grade 3	12.44	10.56	7.59	5.39	10.40	7.70	3.79	.09	5.94	3.94	3.23	1.33
Grade 4	-.76	-1.76	1.31	-.19	1.46	.06	.86	-2.44	-.32	-1.22	2.06	.56

Table 3
Mean RIT Score Differences Between Charter School Achievement and National and Indiana Norm Groups, Fall 04 and Spring 05

	Mathematics				Language Arts				Reading			
	Fall 03		Spring 04		Fall 03		Spring 04		Fall 03		Spring 04	
	National	Indiana	National	Indiana	National	Indiana	National	Indiana	National	Indiana	National	Indiana
School F												
Grade 2	-7.13	-7.43	4.67	3.07	-14.13	-14.63	7.27	3.87	-9.77	-9.87	7.73	6.13
Grade 3	-0.70	-2.58	.050	-2.15	-2.60	-5.30	4.69	.99	-8.08	-10.08	5.86	3.96
Grade 4	-.63	-1.63	-8.37	-9.87	1.95	.55	1.27	-2.03	2.85	1.95	-6.45	-7.95
Grade 5	4.39	3.25	7.03	5.03	7.70	6.20	7.21	4.41	7.09	5.99	5.99	4.69
Grade 6	2.37	0.39	.81	-1.59	2.94	1.78	.91	-1.79	-3.14	-4.04	-4.27	-5.47
School G												
Grade 2												
Grade 3	-8.95	-10.83	-9.70	-11.90	-17.60	-20.30	-9.70	-11.90	-8.20	-10.20	-11.45	-13.35
Grade 4	-1.60	-2.6	2.20	.70	.70	-.70	-.30	-3.60	4.60	3.70	6.30	4.80
Grade 5	-1.70	-2.84	-5.80	-7.80	2.30	.80	2.10	-.70	12.80	11.70	5.90	4.60
Grade 6	-4.20	-6.18	-1.15	-3.55	3.05	1.89	5.45	2.75	4.75	3.85	5.30	4.10
School H												
Grade 2	-10.6	-10.88	-7.07	-8.67	-9.97	-10.47	-7.07	-8.67	-14.49	-14.59	-5.47	-7.07
Grade 3	-14.57	-16.45	-6.59	-8.79	-7.10	-9.80	-6.59	-8.79	-16.65	-18.65	-2.04	-3.94
Grade 4	-10.76	-11.75	-7.86	-9.36	-6.85	-8.25	-7.86	-9.36	-16.00	-16.90	-3.59	-5.09
Grade 5	-6.01	-7.15	-.78	-2.78	-4.79	-6.29	-.78	-2.78	-6.20	-7.30	.59	-.71
Grade 6	-9.67	-11.65	-9.16	-11.56	-7.20	-8.36	1.73	-.97	-15.32	-16.22	-4.32	-5.52
School I												
Grade 2	-17.47	-17.75	-12.20	-13.80	-15.80	-16.30	-12.20	-13.80	-22.10	-22.20	-14.80	-16.40
Grade 3	-12.90	-14.78	-12.06	-14.26	-12.60	-15.30	-17.16	-20.86	-17.86	-19.86	-15.28	-17.18
Grade 4	-18.97	-19.97	-19.50	-21.00	-19.57	-20.97	-18.79	-22.09	-29.38	-30.28	-20.25	-21.75
Grade 5	-17.90	-19.04	-18.71	-20.71	-16.86	-18.36	-17.63	-20.43	-28.33	-29.43	-15.61	-16.91
Grade 6	-16.09	-18.07	-17.57	-19.97	-14.64	-15.80	-12.08	-14.78	-24.61	-25.51	-12.98	-14.18
School J												
Grade 2	-6.03	-6.31	6.94	5.34	-3.86	-4.36	10.00	6.60	-10.41	-10.51	5.54	3.94
Grade 3	-11.08	-12.96	4.15	1.95	-3.60	-6.30	8.38	4.68	-8.55	-10.55	3.11	1.21
Grade 4	-2.0	-3.0	11.20	9.70	3.00	1.60	11.60	8.30	-6.00	-6.90	8.40	6.90
Grade 5	-6.68	-7.82	-.07	-2.07	1.59	.09	2.61	-.19	-5.64	-6.74	1.92	.62
Grade 6	-18.70	-20.68	.35	-2.05	-10.70	-11.86	-4.05	-6.75	-26.25	-27.15	-13.45	-14.65

In contrast there is a pervasive pattern of deficits for both fall and spring assessments in many of the other charter elementary schools. In School I, for example, students were 12-21 RIT points behind national norms in mathematics and language arts, and 17 to 31 RIT points behind in reading in the fall, 2003 assessment. Double-digit deficits were also common in School B, C, E and H. These data indicate that many school children are enrolling in these charter elementary schools with significant academic challenges to surmount. Three of the charters (School B, C and H) opened for the first time in fall, 2003, while the remaining charters were in their second year of operation. Consequently, this pattern of achievement is largely diagnostic of the presenting academic skill level of students enrolling in new charter schools, rather than evidence of charter school effectiveness, per se.

Still one does hope to find that students who are exposed to a charter school "treatment" for a full academic year would show growth in learning that is at least commensurate with observed growth in national and Indiana norming samples. The mean charter school growth is illustrated in Figure 1 (mathematics), Figure 2 (reading) and Figure 3 (language arts), respectively, and is compared with mean growth in both the Indiana and national norming groups.

As one can see in Figure 1, academic growth in mathematics from fall-to-spring was broadly comparable across the three groups. The charter elementary schools outpaced the norming samples at grades three and four, were competitive at grade five, but lagged behind at grades two and six. More pronounced differences were evident in fall-to-spring growth in reading. As Figure 2 illustrates, growth in reading achievement in the charter schools demonstrably outpaced growth in reading achievement at all grade levels in both the Indiana and national norming groups. Finally, charter school students in grade three and grade six showed more growth in language arts than the norming groups, comparable growth with the norming groups at fourth grade, but slower growth at fifth grade than the norming groups.

Figure 1:
Mean Fall-to-Spring Growth in Mathematics Achievement in Indiana Charter Elementary Schools Compared with National and State Norming Groups.

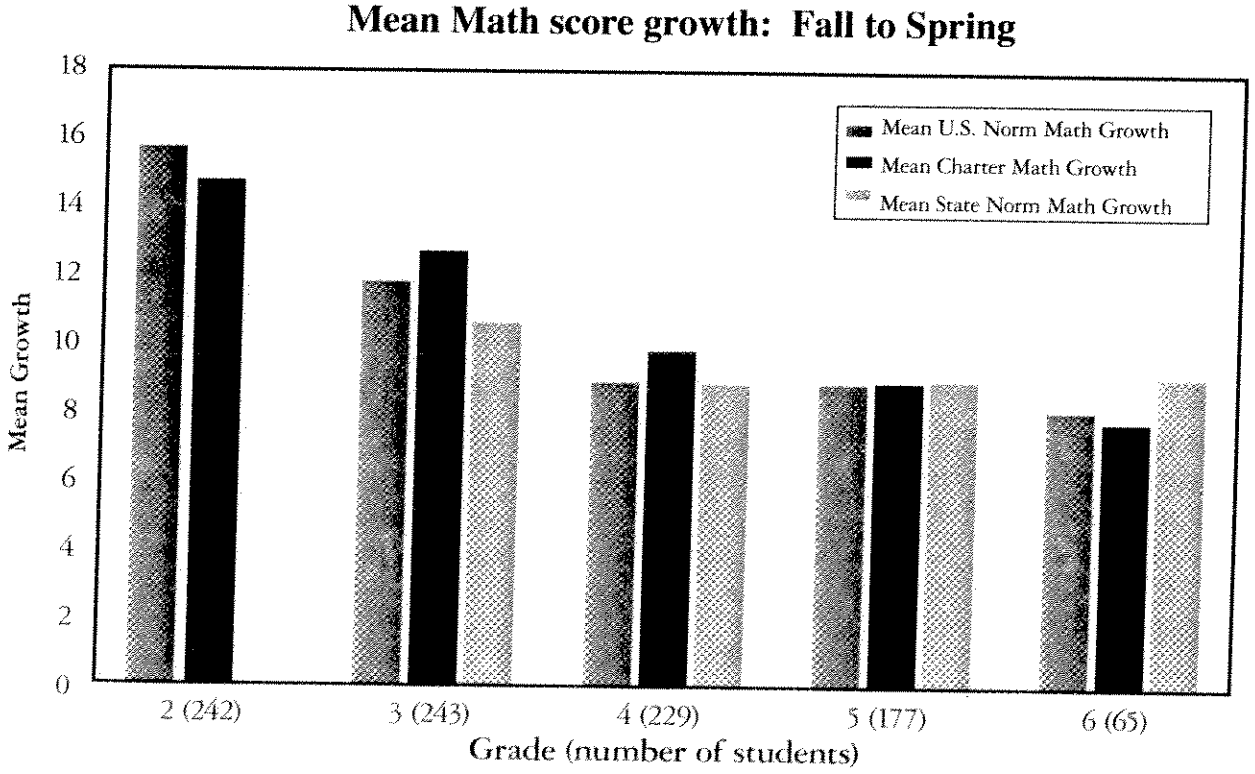


Figure 2:
Mean Fall-to-Spring Growth in Reading Achievement in Indiana Charter Elementary Schools Compared with National and State Norming Groups

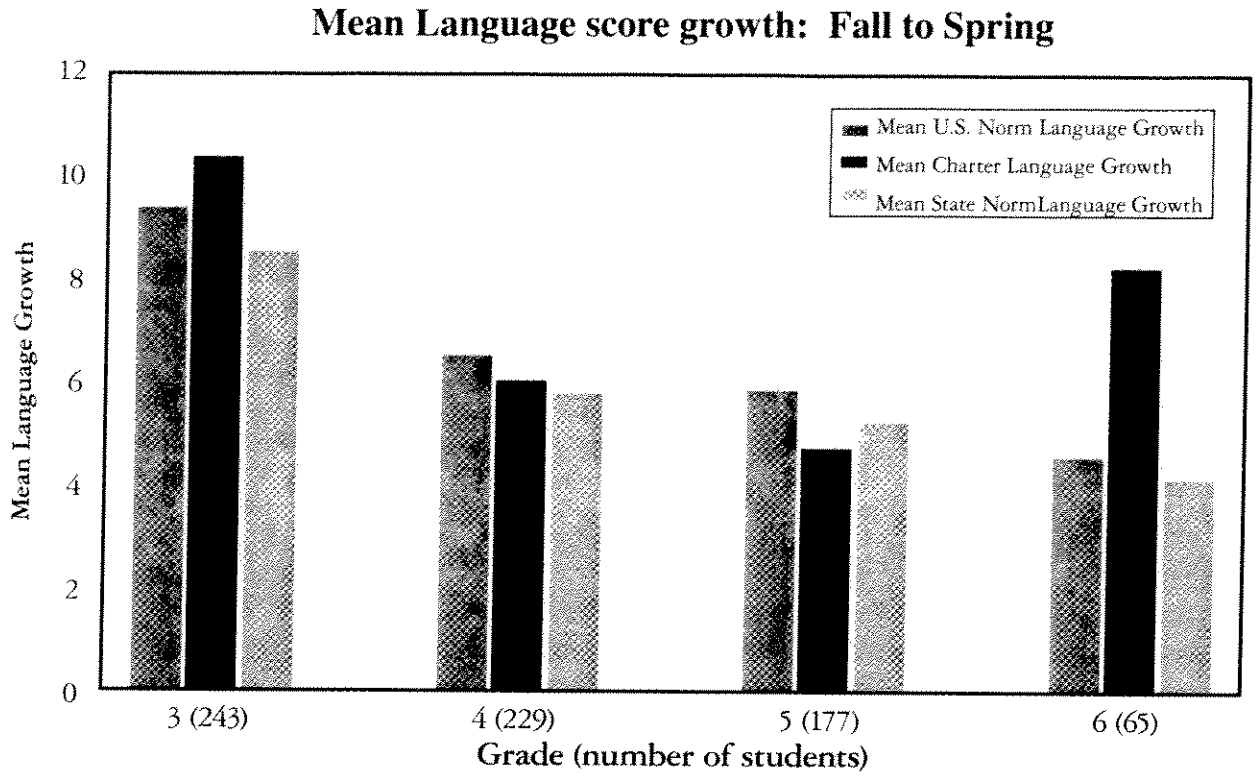
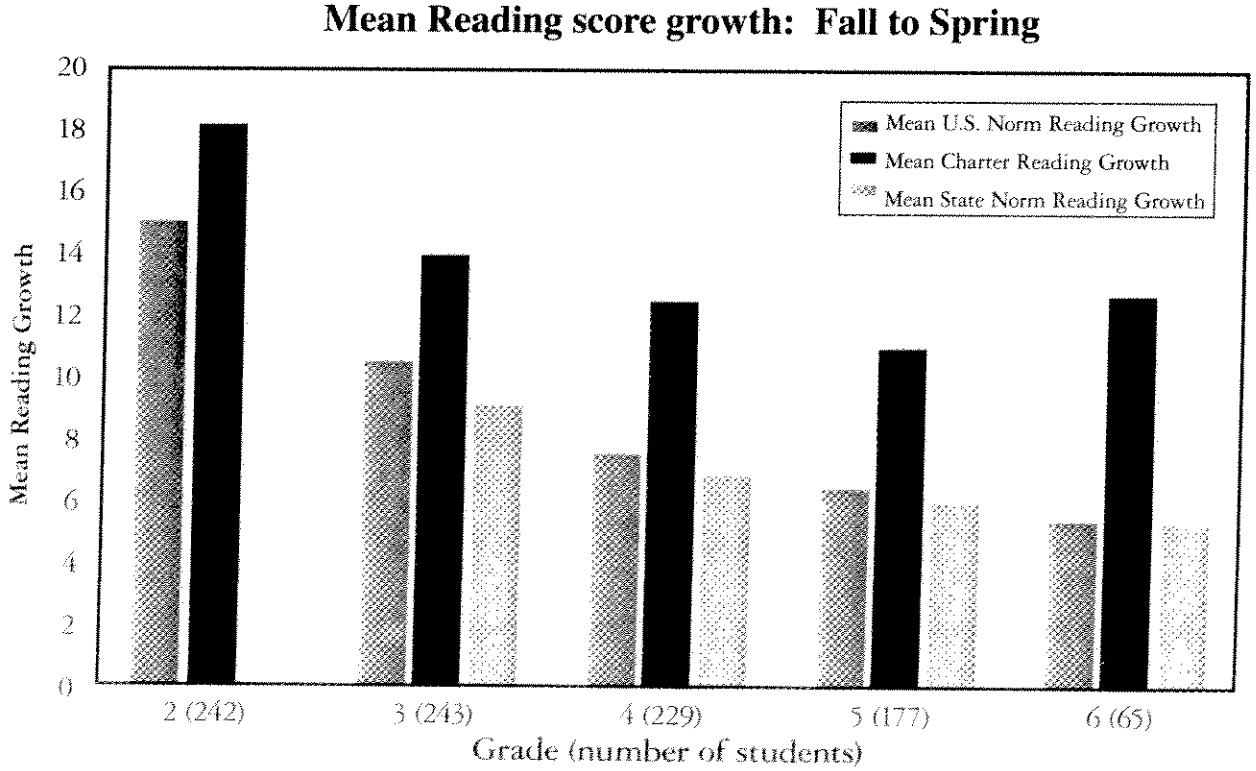


Figure 3:
Mean Fall-to-Spring Growth in Language Arts Achievement in Indiana Charter Elementary Schools Compared with National and State Norming Groups



HLM Analyses Table 4 displays the mean and standard deviation for the school-level variables used in this analysis. Table 5 reports mean growth in reading, mathematics and language arts by student-level demographic variables, which include free/reduced lunch status, gender, receipt of special education services and Title I status.

The full HLM analysis includes variables pertinent to both individual students as well as their school as a whole. Therefore, it is possible to ascertain which factors at each level contribute to the change in achievement test scores from the fall to the spring. In addition, the HLM framework accounts for the impact of individual schools above and beyond school-level variables. Table 6 reports the results of the full HLM analysis of change in reading, mathematics and language arts from fall to spring. As one can see, the score on the fall test is significantly related to growth from fall to spring for all three content areas. Furthermore, growth in mathematics and language arts from fall to spring is related significantly to the student-teacher ratio in the school. Finally, growth in mathematics achievement from fall-to-spring was significantly related to average attendance rates in the schools.

The slope for the continuous independent variables that significantly predicted growth in achievement can be used to gain an understanding of the nature of these relationships. The slopes relating growth in each goal area with initial fall scores are negative in all cases. This means that the higher a student scored in the fall, the lower the observed growth from fall to spring. With respect to growth in mathematics, the slope estimate for the student teacher ratio is -0.59. This value indicates that the greater the student-teacher ratio (i.e., more students per teacher), the lower the growth in math scores from fall to spring. The slope relating student-teacher ratio to language growth is -0.48, suggesting a similar relationship as with math: the higher the student-teacher ratio, the lower the growth in language scores. Finally, the slope relating average attendance rates and math growth is 2.18, so that the higher the attendance rates at the school, the greater the growth in math scores.

In addition to assessing the relationships among the student- and school- level variables, the HLM also provides an estimate of the impact each school had on the growth in test scores from fall to spring. These results appear in Table 7. It is important to remember when interpreting these values that the average impact of all schools is scaled to be 0. This means that schools with an estimate greater than 0 can be thought of as having a positive impact on growth, while schools with a negative estimate have a negative impact.

As one can see in Table 7 the only statistically significant school effect was for growth in language achievement in School F. Hence School F had a significantly greater effect on language growth than did the typical charter school, after accounting for the school- and student-level variables included in the analysis. Tekwe, et al. (2004) recommend that school effects be examined in light of its ratio to the standard error, in addition to the use of statistical hypothesis testing procedures. For illustrative purposes, and to provide some meaning to these effect size measures, we have adopted their convention of assigning "grades" to the impact that a school has on student growth in learning, relative to impact of other charter schools. Tekwe, et al. (2004) suggest the following heuristic in assigning grades based on the standard error ratio:

Ratio	Assigned Grade
Greater than 2	A
Less than 2, greater than 1	B
Less than 1, greater than -1	C
Less than -1, greater than -2	D
Less than -2	F

This method of characterizing school impact on student growth uses the fact that an average school effect is 0, along with the statistical truism that the ratio of the estimate to the standard error can be thought of as asymptomatically standard normal for large samples. This latter fact means that it is possible to assign some meaning, in terms of the larger population, to this ratio. It should be noted, however, that the assignment of such "grades" is arbitrary in the sense that other equally valid categorization schemes could be developed. However, in much the same way that effect size guidelines provide researchers with a common frame of reference for interpreting the magnitude of effects in other statistical contexts, so do these arbitrary "grades" give those interested in assessing a school's impact on student learning a way to interpret the results of the HLM. Using this methodology, then, grades for each school are reported in Table 8.

The results in Table 8 show that most schools received a grade of C for Reading. This means that these schools experienced growth that was near the average for all of the charters. The exceptions to this finding are School F, which had somewhat higher growth rates and School B and C, which had somewhat lower growth rates. In contrast, the results for growth in mathematics achievement were much more variable across schools. Four of the 10 charters had growth close to the average (0); Schools D, F and J experienced somewhat higher growth rates, while Schools B, D and G had somewhat lower growth rates. With respect to growth in language scores, School F achieved an A, indicating much higher growth than average, School A had a B, also indicating higher than average growth, while, in contrast, School B had an F, which suggests that the growth in language scores for those students was well below average for the charters. Finally, School C and G had lower than average language growth.

Discussion

The purpose of this study was to provide the first analysis of student achievement in the Indiana charter elementary schools. Both descriptive and longitudinal analysis of student achievement on the Northwest Evaluation Association's Measures of Academic Progress was reported for students in the first cohorts of Indiana charter schools in fall, 2003 and spring, 2004, the first academic year for which longitudinal comparisons were possible.

The descriptive results illustrate a pattern of achievement that is at once discouraging and promising. As shown in Table 3, many students who enrolled in newly authorized charter schools faced significant academic challenges. Many youngsters, particularly at the higher elementary grades, report to a charter school already well behind in basic academic skills. This particular "selection effect" is most acute in the urban charter schools. Indeed, with the possible exception of Schools A and J, the dominant impression is one of double-digit deficits compared to state and national

samples. Clearly this shows that the Indiana charter elementary schools are not "creaming off" more able students from the regular public school systems, which is a popular, albeit unfounded, criticism of charter schools, at least in Indiana.

The promising aspect of the descriptive data is the fact that students in the charter elementary schools, with only a few exceptions, are learning at a pace that is at least commensurate with growth in the state and national norm groups. Indeed, growth in reading achievement from fall to spring in the charter schools outpaces growth in the norm samples at every grade. This reflects the fact that reading is an explicit instructional goal in the charter schools, and the target of sustained intervention. It also reflects the fact that students in the charters have more room to grow, as it were, given the deficits that they bring to their academic studies compared to peers in the norm groups. Indeed, the value-added analysis showed that for all three content areas, the score obtained by a student in the fall testing was significantly and negatively related to growth from fall to spring. That is, students who demonstrated higher achievement scores in the fall semester tended to experience smaller gains in achievement over the course of the academic year.

The value-added analysis also demonstrates the importance of school-level variables, such as student-teacher ratio and average daily attendance, on the change in student performance. For example, for both mathematics and language arts, the school-level student-teacher ratio is related to growth in achievement. For both subject areas this relationship is negative, which means that students who attend schools with higher student-teacher ratio tend to have lower gains from the fall to spring. Similarly, in the case of growth in mathematics achievement, it was found that the average daily attendance was positively related to growth, so that students attending schools with higher attendance rates experience a greater growth in scores. Of course, it should not surprise that students will show growth in learning when they attend school regularly and when they command more teacher attention as a result of lower pupil-teacher ratio.

Interestingly, however, these school-level variables did not predict changes in reading achievement, yet it was in reading that students experienced the greatest growth. An examination of the standard deviations of the growth scores in these three subject areas reveals that the variation in the reading score gains was larger than that for either mathematics or language. This increased variation could be part of the explanation for the lack of significant findings. Another possible explanation for the lack of significant predictors for reading growth is that most of the schools experienced growth over time, so that no particular school-level characteristic could be identified as being a particularly important predictor of growth.

One notable outcome of this study is that there were no significant effects among the student-level variables. That is, once school-level variables are accounted for, there is no additional influence of such variables as free/reduced lunch status, eligibility for special education services, or gender on academic achievement. As Table 5 illustrates, mean achievement growth is highly similar across these student-level categories. This is noteworthy, particularly with respect to free/reduced lunch status, given the fact that family socioeconomic status is often considered a risk factor for poor educational outcomes (Levanthan & Brooks-Gunn, 2004; Willie, 2001). Moreover, the fact that students who were receiving special education services showed growth comparable to non-eligible students suggests that charter schools may be providing instruction appropriate to encourage academic growth for these students.

Collectively these findings support a conclusion that, during the study, the Indiana charter elementary schools demonstrated a positive effect on educational *equity*, which Anderson (1989) defines as the reduction of the influence of students' entering characteristics on their eventual academic achievement. Students who are poor, and students who require special services, could not be distinguished from peers on the basis of academic achievement.

In terms of school effects, results in Table 8 suggest that two schools (Schools B and C) appear to perform uniformly worse (less than a grade of "C") than their counterparts across all three subject areas. These schools have large and predominantly African-American enrollment and are located in urban centers. Yet there is significant variation across schools to temper any conclusions about an "urban school effect" or to draw any conclusions about achievement and ethno-racial status.

For example, School B and School D are located in the same urban setting and are demographically similar, with large, predominantly African-American student populations, but School D reports "passing scores" with respect to growth in academic learning while School B does not. Similarly, School H is also a large school serving a predominantly African-American student population in the same urban setting as School C, yet the academic profile of School H is somewhat more favorable than School C.

Clearly the extent to which pupils are learning in the charter schools is not something that can be explained solely in terms of gross school-level categories such as school size or ethno-racial enrollment, or where schools are located. There is no such thing as a general "charter school effect." Rather, the sources of charter school effectiveness must be found among a range of more local variables, including the extent of transition stress at start-up, the stability of educational leadership, school and classroom practices, and the like. This fine-grained analysis of educational processes within schools will pay dividends in future research.

A number of caveats are in order. First, even those schools that have a "passing" grade with respect to growth in student learning have significant room for improvement. Indeed, only one school (School F) reports a grade of B or better across all three content areas, and some schools experienced low growth compared both to other charters and to the national and state norms. Of course, we do not want to risk the impression that it is possible for all schools to get A's and B's. This is not possible given that each school is compared against the average of all other schools in the value-added assessment. Thus, if all schools were demonstrating exceptional growth in learning they might all get a grade of "C" because they are performing equally well and equal to the group mean (making their level of achievement "average").

Second, charter school students who show impressive rates of growth in learning from fall to spring may still fall considerably below the mean level of achievement of peers in the state and national norming samples. Hence demonstrating a positive impact on student growth in learning is a minimal expectation for charter schools.

Third, the present study does not address definitively a question of interest to many educational policy analysts: How do charter schools stack up against other regular public schools? Are students in charter schools learning more, or less, than they would have learned in the regular public schools? To address these questions definitively the White Paper of the National Charter School Research Project (Charter School Achievement Consensus Panel, 2006) recommends using randomized designs comparing achievement of students "assigned" to charter versus non-charter schools. Alternatively, two non-experimental strategies are recommended: 1) compare trends in individual student's test scores in charter and

regular public schools for two or more years, taking into account certain student characteristics; or 2) use student's achievement scores before and after entering a charter school to determine if the rate of learning is higher or lower in charter versus regular public schools.

To answer these questions will require access to individual student-level data in regular public schools that share sampling characteristics of the charter schools. This is not yet possible in Indiana. Still, the present study does use a student-level, value-added approach that analyzes achievement trends within an academic year, controlling for observable student-level and school-level variables, a design that many consider an improvement extant research on charter schools (Miron & Nelson, 2004).

Moreover, the Indiana charter schools hold great promise for the study of charter school effects. The pervasive use of MAP among so many Indiana schools (regular public, charter public and parochial) does permit a comparative analysis of how well charter school children are faring compared against the normative benchmarks at each grade. In addition, the admission of students to many Indiana charter schools requires a lottery. The lottery effectively randomizes assignment of students to condition: charter versus regular public schools. Random assignment of students and a common metric of achievement are two features that hold promise for future research. The commitment of Indiana charter schools to a systematic data collection regime, whereby students are assessed at least twice a year and over the course of a student's career in a charter school, on a common metric will facilitate this sort of longitudinal research.

In summary, the present study presents a descriptive profile of student achievement in the Indiana charter elementary schools, and analyzes longitudinal growth within an academic year. It attempts to show whether charter schools are meeting a minimal expectation that students demonstrate learning over the course of an academic year regardless of presenting levels of preparation or ability. These data are compared against large samples of grade-level peers in national and state comparison groups, and comparisons are made as well among the cohort of Indiana charter schools.

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Table 4:
Mean and standard deviation of selected school level variables

Variable	Mean (Standard Deviation)
Student teacher ratio	18.8 (4.9)
Average teacher experience	5.3 (2.5)
Average attendance rate	95.6 (1.1)

Table 5
Means and Standard Deviations of Reading, Mathematics and Language Growth by Selected Student Level Variables

	Reading		Mathematics		Language	
	Mean	SE	Mean	SE	Mean	SE
Sex						
Male	14.02	1.63	12.49	1.43	6.84	1.68
Female	13.47	1.63	11.66	1.44	7.39	1.69
Free/Reduced Lunch						
Yes	13.29	1.63	11.89	1.44	6.74	1.68
No	14.19	1.71	12.26	1.49	7.49	1.75
Special Education Eligible						
Yes	12.92	1.92	11.86	1.63	6.33	1.92
No	14.56	1.49	12.29	1.35	7.90	1.58
Title I Eligible						
Yes	13.89	2.49	11.60	1.22	5.27	2.44
No	13.59	1.29	12.55	2.06	8.96	1.41

Table 6
Summary of Full HLM Analysis of Change in Reading, Mathematics and Language: Fall 03 to Spring 04

	Reading		Mathematics		Language	
Variables	**F**	**p-value**	**F**	**p-value**	**F**	**p-value**
Fall score	429.89	< .0001	211.45	<.001	297.97	<.0001
Student-teacher ratio	2.07	.15	7.62	.01	3.73	.05
Teacher experience	1.14	.29	0.75	.39	0.64	.42
Attendance	2.11	.15	4.18	.04	0.45	.50
Title 1	0.02	.90	0.26	.61	2.79	.10
Free/reduced lunch	0.79	.37	0.022	.64	.065	.42
Sex	0.59	.44	2.47	.12	0.73	.39
Special Education	1.59	.21	.019	.66	1.75	.19

Table 7
Estimated Impact of Charter Schools on Growth in Reading, Mathematics and Language: Fall 03 to Spring 04

	Reading		Mathematics		Language	
Charter Schools	Estimate	SE	Estimate	SE	Estimate	SE
School A	1.66	2.05	0.90	1.90	2.94	2.21
School B	-3.33	1.77	-2.50	1.67	-4.05	1.93
School C	-3.41	2.01	-3.21	1.92	-3.41	2.22
School D	2.54	2.67	3.53	2.61	2.36	3.01
School E	-1.90	2.62	-1.22	2.58	-2.16	2.97
School F	2.26	1.84	2.41	1.71	3.96*	1.98
School G	-2.44	2.66	-3.38	2.57	-2.96	2.97
School H	.086	2.19	-0.79	2.15	1.18	2.48
School I	1.24	2.55	1.22	2.46	-0.25	2.84
School J	2.43	2.76	3.05	2.72	2.28	3.14

Table 8
"Grades" for Charter Schools on the Basis of Growth in Reading, Mathematics and Language

	Reading		Mathematics		Language	
Charter Schools	Ratio	Grade	Ratio	Grade	Ratio	Grade
School A	0.81	C	0.48	C	1.33	B
School B	-1.88	D	-1.50	D	-2.10	F
School C	-1.70	D	-1.67	D	-1.53	D
School D	0.95	C	1.35	B	0.78	C
School E	-0.73	C	-0.47	C	-0.73	C
School F	1.28	B	1.41	B	2.00	A
School G	-0.92	C	-1.32	D	-1.00	D
School H	0.39	C	-0.37	C	0.48	C
School I	0.49	C	0.50	C	-0.09	C
School J	0.88	C	1.12	B	0.76	C