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An Analysis of Student Achievement Growth, Teacher Working Conditions and Qualifications, and School Choice

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Abstract

Given the importance of teachers to student learning, it is important to understand how schools of choice differ in terms of the types and uses of human capital inside schools. Despite research that highlights important differences in the qualifications and staffing practices of schools of choice, there is no evidence about whether observed differences in teachers' qualifications, work contexts, and professional development across school types help understand the impact of school choice on student achievement. This paper explores the following question: How do variations in the work lives of teachers across charter, magnet, private, and traditional public schools contribute to differences in student achievement across these school types? This study highlights the difficulty researchers have faced in identifying characteristics of effective teachers or indicators of teacher quality as few characteristics of teachers, their assignments, or work contexts were related to student achievement gains. There is some evidence that the effects on student achievement growth of participating in reform-style professional development and activities that involve active learning differ by school choice. Despite the difficulties of explaining student achievement growth with teacher characteristics, the results here point to differences in achievement growth between different types of schools. Charter schools had larger student achievement gains than traditional public schools in math, reading, and language usage. Private and magnet schools had lower achievement gains in some subjects.

An Analysis of Student Achievement Growth, Teacher Working Conditions and Qualifications, and School Choice

For almost two decades, increasing school choice has been a prominent feature of education reforms. Charter schools have risen dramatically in number to over 4,000 schools in 40 states. While private and magnet schools have received less attention, they remain the most numerous forms of school choice. Extensive research on school choice, particularly charter schools, has accompanied this increased interest in school choice. Much of this research has tried to determine whether schools of choice have a greater effect on student learning than traditional public schools (Betts, Hill, & The Charter School Achievement Consensus Panel, 2006; Buddin & Zimmer, 2005). The mixed results of research on the relationship of school choice to student achievement has led to calls for research that focuses on the internal operations of schools of choice to explore not only *whether* schools of choice impact student learning, but also *how* they may do so (Betts et al., 2006; Hess & Loveless, 2005; Zimmer et al., 2003).

Given the importance of teachers to student learning, it is important to understand how schools of choice differ in terms of the types and uses of human capital inside schools. Previous research points to observable differences in the qualifications of teachers in charter, magnet, and private schools compared to their colleagues in traditional public schools (Baker & Dickerson, 2006; Cannata, 2008). Additional work has explored the pay, personnel practices, and professional community of charter schools (Cannata, 2007; Goldring & Cravens, 2008; D. C. Harris, 2006; Podgursky, 2008). Less research has focused on the working conditions and professional development of teachers across school types. Further, there is no evidence whether

observed differences in teachers' qualifications, work contexts, and professional development across school types help understand the impact of school choice on student achievement.

This paper begins to address this gap in existing literature by exploring the following question: How do variations in the work lives of teachers across charter, magnet, private, and traditional public schools contribute to differences in student achievement across these school types? We are also interested in whether the effect of teacher characteristics on student achievement varies across school types to investigate whether the in-school processes vary for schools of choice. In doing so, this paper will focus on teacher qualifications, the amount and type of professional development in which they engage, and their classroom and school contexts. We hypothesize that greater qualifications, better work conditions, and more effective professional development will be associated with higher student achievement in schools of choice. The next section outlines various reasons why school choice may lead to different personnel practices and the existing research on teachers and teaching in charter, private, and magnet schools. The second section describes the data and analytic model. The results are then presented, followed by implications for policy and practice.

Teachers, Teaching, and School Choice

The two key rationales for the proposition that schools of choice have a different composition of teachers or different work contexts than traditional public schools focus on the autonomy and flexibility given to school leaders in choice schools and the competitive pressure they feel to create efficient personnel practices. First, state and local policy constraints and union work rules are often blamed for the poor performance of public schools as they restrict whom schools can hire and how they can structure teachers' work. The flexibility available to schools

of choice, on the other hand, may allow these schools to hire the most effective teachers and organize their work in the most efficient manner. Private schools—and some charter schools—are free of state requirements such as teacher certification, required professional development, tenure, and class size mandates. Private and charter school teachers also usually do not have agreements with teacher unions, giving them further flexibility over teacher work contexts, salary, teacher hiring, and evaluation. A key argument for school choice is that giving greater flexibility to schools in staffing practices may lead to improved school outcomes by allowing school leaders to design schools around a focused mission (Hassel, 1999; Manno, Finn, Bierlein, & Vanourek, 1998; Wohlstetter & Griffin, 1998). While magnet schools do not have greater flexibility than traditional public schools, the presence of an identified instructional emphasis may also influence teacher work contexts. Thus exploring the extent to which the staffing practices of choice schools contributes to any observed differences in student achievement can help evaluate whether choice schools are meeting this ideal.

Second, because schools of choice do not have students assigned to them by default, they face competitive pressure to raise enrollments. This pressure may force schools of choice to use their resources—namely teachers—more efficiently (Podgursky, 2008). By hiring higher quality teachers, providing more effective professional development, and designing work environments in a more effective manner, schools of choice may make better use of their human capital. Schools of choice may increase their effectiveness by managing their human capital resources and organizing teachers' work so that they can focus on instructional matters. Indeed, preliminary work on charter management organizations suggests that many charter management

organizations use a human capital strategy to focus on student achievement (National Charter School Research Project, 2007).

Previous research on teacher qualifications and work contexts in schools of choice indicate that teachers in schools of choice have different qualifications than their peers in traditional public schools. Charter, private, and magnet school teachers tend to come from more selective colleges than their peers in traditional public schools, but charter and private school teachers are also more likely to be inexperienced and lack certification (Baker & Dickerson, 2006; Burian-Fitzgerald, Luekens, & Strizek, 2004; Cannata, 2008; Guarino, 2003; Hoxby, 2002; Podgursky & Ballou, 2001; Texas Center for Educational Research, 2003). There is no existing research on teachers' professional development across school types.

The evidence is mixed on the working conditions across school types. For example, private schools have smaller classes, while comparisons of class sizes in charter and magnet schools are inconclusive or depend on the school's grade level (Cannata, 2008; Christenson et al., 2003; Fuller, Gawlik, Gonzales, Park, & Gibbings, 2003; Gruber, Wiley, Broughman, Strizek, & Burian-Fitzgerald, 2002; P. R. Kane, 1987). Likewise, there is more consistent evidence that private and school teachers have greater influence over school policy than their counterparts in traditional public schools (Bauch & Goldring, 1996; Cook, 2002; Ingersoll, 2003; Schaub, 2000). Evidence on the relative influence of charter school teachers is more ambiguous (Bomotti, Ginsberg, & Cobb, 1999; Crawford, 2001; Crawford & Forsyth, 2004; Johnson & Landman, 2000; Malloy & Wohlstetter, 2003). Teachers in charter, magnet, and private schools report greater satisfaction with their school climate and teaching conditions than their peers in traditional public schools, but charter school teachers are also dissatisfied with the physical

facilities (Bomotti et al., 1999; Christenson et al., 2003; Royal, DeAngelis, & Rossi, 1997; Vanourek, Manno, Finn, & Bierlein Palmer, 1998).

Teachers and Student Achievement

There has been a great deal of policy and research interest in identifying characteristics of effective teachers (see, for example, Goe, 2007; Wayne & Youngs, 2003 for recent reviews). Although value-added research has highlighted the importance of teachers to student learning gains, few characteristics of teachers and teaching arrangements have been consistently linked to greater effectiveness (Hanushek, 1996). This section briefly reviews what is known about the relationship between teacher qualifications, professional development, and work contexts with student achievement gains.

Teaching experience is the most consistent qualification that is linked to positive student achievement gains (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006; Clotfelter, Ladd, & Vigdor, 2006; Goe, 2007; Hanushek, 1992; D. N. Harris, 2007; Jepsen, 2005; Nye, Konstantopoulos, & Hedges, 2004). Still, other studies have found no evidence for teacher experience effects or that the presence of effects varies by subject and grade level (Betts, Zau, & Rice, 2003; Ehrenberg & Brewer, 1994; Ferguson & Ladd, 1996; Goldhaber & Brewer, 2000; Jepsen, 2005; Rivkin, Hanushek, & Kain, 2005). These conflicting studies may be due to findings that teachers gain in effectiveness in the first few years, but after a few years of teaching experience subsequent experience has no effect (Boyd et al., 2006; D. N. Harris, 2007).

The impact of teacher certification on student achievement has been hotly debated. Overall, the evidence seems to indicate that students of teachers with alternative or provisional forms of certification perform just as well as students of teachers with full state certification

(Boyd et al., 2006; Constantine et al., 2009; Decker, Mayer, & Glazerman, 2004; Goldhaber & Brewer, 2000; T. J. Kane, Rockoff, & Staiger, 2006), but that lacking certification altogether or having an emergency certification may lead to lower student achievement (Goldhaber & Brewer, 2000; T. J. Kane et al., 2006). Given the role of advanced degrees in determining teacher pay, there is much interest in whether teachers with master's or other advanced degrees are more effective teachers. While there is some evidence that having a master's degree has a small positive impact on student achievement (Angrist & Lavy, 2001; Ferguson & Ladd, 1996), most research suggests that advanced degrees have either no impact or a negative impact on student achievement (Eberts & Stone, 1984; Ehrenberg & Brewer, 1994, 1995; Jacob & Lefgren, 2004; Jepsen, 2005; Rivkin et al., 2005; Rockoff, 2004).

The general lack of positive findings for advanced degrees may be due to the lack of specificity of the degree. Studies that focus on advanced degrees in mathematics tend to find that teachers with master's degrees in mathematics have higher student achievement gains in math (Goldhaber & Brewer, 2000; Goldhaber & Liu, 1997; Rowan, Chiang, & Miller, 1997). In addition to advanced degrees in math, there is evidence that taking mathematics coursework in undergraduate program has a positive effect on teacher quality in math (Monk, 1994). Yet research on the importance of subject matter training in subjects other than math are indeterminate or mixed (Betts et al., 2003; Wayne & Youngs, 2003).

In addition to teacher qualifications, the work context and professional development of teachers are other important ways schools can organize their human capital to improve student learning. Although there is some conflicting research on the benefits of small classes, most evidence indicates small class sizes, especially in the early grades, are associated with higher

student achievement (Ferguson & Ladd, 1996; Finn & Achilles, 1999; Greenwald, Hedges, & Laine, 1996; Hanushek, 1999; Krueger, 2002; Nye, Hedges, & Konstantopoulos, 2002). Although giving teachers influence over school decision-making is more strongly related to teacher turnover, there is some evidence that schools with collaborative decision-making have higher student achievement (Kannapel & Clements, 2005; Rowan et al., 1997). Finally, not only the amount, but the type of professional development teachers receive can impact student achievement (Cohen & Hill, 2001). Professional development that focuses on content knowledge, uses reform activities, involves active learning and collective participation of teachers across a team or grade level, and is coherent with other teacher learning activities contribute to teachers' enhanced knowledge and skills (Garet, Porter, Desimone, Birman, & Yoon, 2001). Professional development has stronger impacts on teacher practice, but small and significant effects on student achievement (Wallance, 2009). Some research has found evidence that the impacts of professional development on student achievement are not immediate and thus the professional development a teacher received in prior years may have more impact than current professional development (D. N. Harris, 2007).

Methods

Sample Characteristics and Data

To study the determinants of student achievement growth across different school types, we relied on a convenience matched sample of schools, and of the principals, teachers, and students in those schools. The schools for our study were selected from the set of schools with which the Northwest Evaluation Association (NWEA) had partnered to monitor student achievement through the administration of computerized adaptive tests in math, reading and

language arts every spring and fall of the school year. As of the spring of 2006, approximately 7,500 schools were in the NWEA files in our possession, but only about 270 were identified as charter, 140 as magnet, and 90 as private schools; the rest were traditional public schools. We linked the NWEA schools to the public NCES-CCD and PSS files to obtain school characteristics. After correctly classifying some schools that were incorrectly classified as magnet schools and other minor data problems, our sample frame was defined as the set of schools that could be found in the latest available CCD and PSS files (i.e. the 2005-06 files), tested by NWEA in 2005-06, with at least one grade having over 50% testing coverage in both math and reading, and at least 10 students tested. We excluded special education, vocational and alternative schools, schools that were no longer testing with NWEA, and schools that did not have all the variables that we needed for school matching. With all these requirements, our sample frame ended up consisting of 223 charter, 65 magnet, 33 private, and 5,864 traditional public schools as potential matches.

The process of matching traditional public schools to schools of choice consisted of three stages. Details of this matching process are in the Appendix. At the first stage, we used CCD data on the schools to identify the best match. The school match had to be in the same state, and be the closest possible to the school of choice in terms of geographical distance, grade range, ethnic composition, socio-economic status, and size. Due to differences in grade configurations between schools of choice and traditional public schools, there are cases where we had more than one match for a school of choice to match all the grade levels in the school. Some traditional public schools were also used as matches for more than one school of choice. The sample of

schools that were initially contacted for participation consisted of 321 schools of choice (i.e. 223 charter, 65 magnet, 33 private) and 345 traditional public schools.

The second stage of the matching process was obtaining school participation in the teacher and principal surveys. Traditional public schools were contacted only after their matched school of choice (or at least one of their matched schools of choice) had accepted to participate. However, when a traditional public school or its district declined participation, had recently closed or stopped testing with NWEA, we found a replacement for it. Unfortunately the replacement was almost always of lower match quality than the original match. In addition, despite our school-type verification process, a few schools were found to be misclassified: when a school of choice turned out to be a traditional public school, it was re-classified and placed in the pool of traditional schools; when a traditional public school turned out to be a school of choice, it was re-classified and a match or matches were found for it. After all these changes, our school sample changed to 217 charter, 60 magnets, 32 private, and 480 traditional public schools. Of these, only 117 (53.9%) charter, 34 (56.7%) magnet, 17 (53.1%) private, and 128 (26.7%) traditional public schools agreed to participate.

Teachers and principals of the schools that agreed to participate were asked to fill out online, confidential questionnaires. Principals and assistant principals had access to a different version of the principal questionnaire depending on the school type. There was only one version of the teacher questionnaire and it included measures of working conditions and classroom organization, instructional innovation, instructional conditions, influence on schoolwide decisions, professional development, principal leadership, career decisions, and qualifications. The questionnaire completion rates for the teachers were 2,108/2,636=80.0% for charter,

987/1,399=70.6% for magnet, 208/262=79.4% for private, and 2,872/3,963=72.5% for regular public schools. The completion rates for principals (and assistant principals) were 156/194=80.4% for charter, 38/66=57.6% for magnet, 19/19=100.0% for private, and 140/187=74.9% for regular public schools. Although 296 schools agreed to participate, only 281 schools (i.e., 103 charter, 22 magnet, 17 private, and 103 traditional) actually completed teacher and principal questionnaires.

The third stage of the matching process that affected the final sample used in this paper is the matching of teachers that participated in the study to the students that they teach, not an easy task. After the match was done, student achievement (i.e. test score) records were retrieved from the Growth Research Database (GRD) administered by NWEA. This was done for math, reading, and language for both the fall 2007 and spring 2008. Relative to the total number of students tested by NWEA in both periods in all three subjects, we estimate that approximately 78% of all the tested students were matched to at least one teacher. Although we lost schools of all type in this student-teaching matching process, there was a particularly big drop in the number of charter schools. Finally, missing values in certain regressors and in the dependent variable resulted in further loss of observations.

Table 1 includes descriptive statistics on the schools used in this sample. The sample is different for math, reading, and language arts due to which students were tested in these subjects and variation in the ability to match teachers in particular subjects to their students.

TABLE 1 ABOUT HERE

Analytic Methods

NWEA administers state-aligned, computerized adaptive assessments in *both the fall and spring* of each academic year in reading, language usage, and mathematics. These assessments reference a single, cross-grade, and equal-interval scale developed using Item Response Theory methodology (Hambleton, 1989; Ingebo, 1997; Lord, 1980). The RIT scale is based on strong measurement theory, and is designed to measure student growth in achievement over time. NWEA research provides evidence that the scales have been extremely stable over twenty years (Kingsbury, 2003; Northwest Evaluation Association, 2002, 2003). The longitudinal nature of the achievement data allow for analyzing both achievement status and growth.

To explain student achievement growth we use three-level Hierarchical Linear Model (HLM) regressions assuming that students are nested within teachers and teachers within schools. Principals contribute to the models with variables at the school level in a one-to-one relationship. For the schools that had multiple principals or a combination of principals and assistant principals, the analysis variables are collapsed as simple averages across the multiple principals and assistant principals so that only one value per school is obtained.

The dependent variable in all models is the change in test score from fall 2007 to spring 2008 divided by the number of months between tests. The division by the time between tests is necessary as this time is not always the same for all students. This also simplifies the analysis as we make the implicit assumption that the initial testing time is the same for all the students. The need of the score change has as a consequence some loss in the number of usable observations for the analyses as both testing season score values were needed but they were not always both available. For the available data, inspection of the score change per month variable revealed

almost perfectly normal distributions for math, reading and language. The main reason for choosing the score change rather than the score level as the dependent variable is to avoid the need to control for student achievement fixed effects while using simpler models. In the models, we assume that the score change per month is not simply driven by an exogenous time trend but that it depends on measurable variables.

For our HLM regressions, we have student achievement growth represented by the following level-1 equation:

$$\Delta\text{Achievement}_{ikj} = \pi_{0kj} + \pi_{1kj}\,(\text{Student Characteristics})_{ikj} + \varepsilon_{ikj}$$

where $\Delta\text{Achievement}_{ikj}$ is the observed score change per month (in math, reading, or language arts) for student *i* between the fall and spring tests, during which the student was taught the subject by teacher *k* in school *j*. The term π_{0kj} is the students' mean achievement growth within teacher *k* and school *j*, conditioned on student characteristics such as gender, ethnicity, and grade, which remain constant between testing seasons. We are not including other student level variables such as English language learner (ELL), special education student, and free and reduced-price lunch (FRL) eligible student because we do not yet have reliable measures for those variables, but we are working to create these variables. As usual, the error term ε_{ikj} is assumed to be independently and normally distributed with a zero mean and constant variance.

The students' mean achievement growth per month is assumed to depend on teacher-level characteristics according to the following level-2 equation:

$$\pi_{0kj} = \beta_{00kj} + \beta_{01kj}\,(\text{Teacher qualifications})_{ikj} + \beta_{02kj}(\text{Teacher working conditions})_{ikj} + \beta_{03kj}(\text{Professional development})_{ikj} + r_{0ikj}$$

where β_{00kj} is the mean achievement growth per month across teachers within school *j*, conditioned on teacher characteristics such as teacher qualification measures, measures that reflect the teacher's work life, and/or professional development. Teachers' qualifications include certification, years of experience, highest degree earned, and major in the subject tested. Teacher working conditions include number of students taught, percentage of students with special needs, and teacher influence over school decisions. Professional development measures include whether the professional development involves collective participation, active learning, reform-oriented activities, coherent, and total hours of professional development in the subject assessed. Some of the teacher measures are scales created from the teacher questionnaire items through careful factor and reliability analyses and details are in the following section. The teacher characteristics were measured once, in the Spring of 2008 and capture what happened between testing seasons. The error term, $r_{0ikj,}$ is assumed to have the usual distribution.

The mean achievement growth across teachers is assumed to depend on school-level characteristics according to the following level-3 equation:

$$\beta_{00kj} = \gamma_{000} + \gamma_{001}\,(\text{School Type})_{ikj} + \gamma_{002}\,(\text{Other School Characteristics})_{ikj} + u_{00j}$$

where γ_{000} is the mean achievement growth per month across schools. We have separated school type to emphasize its importance. School type consists of a set of dummy variables for charter, magnet, and private schools, with traditional public schools as reference. The purpose is to detect differences in the estimated mean across school types. Other school characteristics include school demographics taken from the principal survey, including the racial-ethnic composition of the school, percentage of student eligible for free or reduced-price lunch, and percentage of

students with an Individual Education Plan. The error term, u_{00j}, is assumed to have the usual distribution.

To detect differences in the effect of certain teacher measures on student achievement growth per month, we also estimate models that are modified by including interactions between those measures and the charter dummy variable. We did not consider interactions with the magnet or private school dummy variables to simplify the models and because of the small number of schools of those types which may render the estimated coefficients of those dummy variables imprecise.

In each instance, the models are estimated with all the available observations. This means that, due to missing values for the included variables mainly at the teacher levels, the sample of student achievement records used in the estimation may not be the same for each regression model. This also means that the teacher and the schools used in the estimations may vary across the models. Despite this, we think the overlap across the samples used is significant and enough to produce results that are comparable across models. In future estimations, we can restrict all estimations to a common sample of student observations.

Variables

Teacher qualifications

Teacher certification is the certification teachers hold in their main assignment field. Regular and standard state certification is combined with probationary certification that is issued after teachers satisfy all requirements except for a probationary period. The dummy variable for less than full certification includes teachers with provisional certification given to teachers who are still participating in an alternative certification program, temporary certifications that require

additional coursework, teachers who are not certified, emergency certifications or waivers, and those who do not fall into any of the above categories.

Experience is measured as a dummy variable indicating whether the teacher has three or fewer years of experience.

The highest degree earned is categorized as bachelor's, advanced degree (master's, education specialist, or doctorate), and teachers who could not be categorized in either the bachelor's or advanced degree categories.

Major in subject tested represents whether the teacher has an undergraduate or graduate major in either mathematics, reading, or language usage. Teachers with degrees in mathematics or computer science are considered to have a math degree. Teachers with degrees in an English-related field (e.g., English literature, composition, communications, journalism, linguistics) are considered to have a degree in language usage. Teachers with degrees in an English-related field or in education are considered to have a degree in reading.

Teacher work context

The number of students taught is the total number of students the teacher teaches in a week.

The percentage of LEP students is the percentage of limited-English proficiency or English language learners the teacher teaches per week.

The percentage of FRL students is the percentage of students with an Individualized Education Plan the teacher teaches per week.

The class organization represents whether the teacher's class is organized as departmentalized instruction or subject specialist (the teacher instructs several classes of

different students in one or more subjects which is typical in secondary schools), self-contained (the teacher instructs the same group of students in multiple subjects which is typical in elementary schools), team teaching (two or more teachers are in the same class at the same time), and pull-out class (the teacher instructs selected students who are released from their regular classrooms to address specific needs).

Influence over school decisions is a measure of the teacher's perception of his or her influence over schoowide policies. Reliability is .85. The factor loadings of each item are: Hiring professional staff (.62), Planning the use of discretionary school funds (.67), Determining which books and instructional materials are used in classrooms (.72), Establishing the curriculum and instruction program (.72), Determining the content of in-service programs (.77), Setting standards for student behavior (.68), and Determining goals for improving the school (.79).

Professional development

The total hours of professional development in the subject tested represents the teacher's reported number of hours of professional development focused either on mathematics instruction or reading/English/Language arts instruction.

Collective participation in professional development is a measure of the extent to which teachers participated in collective development with their school or grade level. Reliability is .78. The factor loadings of each item are: I participate in professional development activities together with most or all of the teachers in my school (.85) and I participate in professional development activities together with most or all of the teachers at my grade level in my school (.85).

Active learning in professional development is a measure of the extent to which teachers professional development consisted of activities that allowed them to be actively involved in

their own learning. Reliability is .88. The factor loadings for each item are: Participants observe demonstrations of teaching techniques (.76), Participants practice what they learn and receive feedback (.84), Participants lead group discussions (.73), Participants conduct a lesson, unit or skill demonstration (.86), Participants develop and practice using student materials (.84), and Participants review student work or score assessments (.63).

Reform activities in professional development is a measure of the frequency with which teachers' participate in professional development activities that are not standard workshops or traditional forms of professional development. Reliability is .75. The factor loadings for each item are: Plan lessons with other teachers (.55), Consult with other teachers about individual students (.68), Exchange feedback with other teachers based on observations of each other's classrooms (.73), Exchange feedback with other teachers based on student work (.81), Act as a formal or informal coach or mentor to teachers or staff (.50), Receive formal or informal coaching or mentoring from teachers or staff (.57), and Get observed/evaluated by the school's principal or school head (.30).

Coherence in professional development is a measure of the extent to which teacher's professional development activities were coherently related to each other. Reliability is .87. The factor loadings for each item are: Are coherently related to each other (.86), Allow me to focus on an instructional problem over an extended period of time (.93), and Lead me to think about an aspect of my teaching in a new way (.82).

Findings

Table 2 shows the means for various teacher qualifications, work context, and professional development across charter, magnet, private, and traditional public schools. There

are noticeable differences in the qualifications of teachers across school types. Charter school teachers are much more likely to be in their first three years of teaching compared to teachers in other types of schools. Charter and private school teachers are more likely than traditional public school teachers to have advanced degrees, while magnet school teachers are more likely than traditional public school teachers to have advanced degrees. Private and charter school teachers are also less likely to have standard state certification than traditional public school teachers. Private school teachers are more likely than traditional public school teachers to lack certification altogether while charter school teachers are more likely to have provisional or probationary certification and to lack certification.

TABLE 2 ABOUT HERE

Teachers' work contexts also vary by school type. Charter and private school teachers have lower student workloads than magnet and traditional public school teachers, although of those students they have lower percentages of limited English proficient (LEP) or students with Individual Education Plans (IEP). Magnet school teachers also have fewer percentages of students with IEPs than traditional public school teachers. Charter and private school teachers are more likely to have self-contained classes and less likely to have pull-out classes than traditional public school teachers while magnet teachers are more likely to have departmentalized instruction. Private school teachers feel they have more influence over school decisions.

Charter school teachers participate in more hours of professional development in mathematics instruction than traditional public school teachers. Both private and magnet school teachers participate in fewer hours of professional development focused on reading/language arts instruction than traditional public school teachers and private school teachers also participate in

fewer professional development hours in mathematics instruction. Private school teachers not only participate in fewer hours of professional development, they also participate in professional development that has fewer reform activities, less active learning, and less collective participation, although it is more coherent. Charter and magnet school teachers participate in more professional development that consists of reform activities than traditional public school teachers. Charter school teachers' professional development is also more coherent than traditional public school teachers' professional, while magnet school teachers' professional development is less coherent.

Given the difficulties described above in matching schools of choice to traditional public schools and the further loss of data due to matching students to their teachers, the findings about student achievement are preliminary. Table 3 shows the effects of being in a charter, magnet, or private school on student achievement growth once student and school demographic characteristics are controlled. Note that there is an important omitted variable—a student-level flag indicating the student was eligible for free or reduced-price lunch (FRL). Given that schools of choice on average had higher rates of FRL students, the positive effect for charter schools is likely an overestimate. Still, charter schools had a positive and statistically significant effect on student achievement growth in math, reading, and language usage. Magnet schools did not have an effect in any subject and private schools had a negative statistically significant effect on language usage achievement growth. The second half of Table 4 presents the variance components. While much of the variance is at the student level, there is a statistically significant amount of variance at the teacher and school levels, indicating the three level model of students within teachers within schools was appropriate.

TABLE 3 ABOUT HERE

Table 4 presents the results of the full three-level model with the teacher qualifications, work context, and professional development included. Magnet schools had smaller achievement gains in reading and private schools had smaller achievement gains in reading and language usage. The charter school effect remains positive and statistically significant for all three subjects even when teacher characteristics are included in the model. Thus despite observable differences in the teacher characteristics across schools, charter school students made larger achievement gains than traditional public school students in all subjects. Indeed, the charter school effects for reading and language usage effects and the effect of magnet schools on reading and private schools for language usage are slightly larger once teacher characteristics are controlled. This may be due to the finding that some of the areas where teacher characteristics differ between schools of choice and traditional public schools are characteristics that were associated with student achievement growth. For example, charter school teachers had fewer LEP and IEP students, but teachers with greater percentages of LEP students made larger gains in reading and teachers with greater percentages of IEP students made larger gains in language usage. These positive results for the effect of LEP on achievement growth are surprising and may be due to teachers with larger percentages of LEP students spending relatively large amounts of time on reading and that these students start out at much lower levels. Likewise, teachers with more IEP students may spend relatively more time on language instruction. The percentage of IEP students had the predicted negative effect on math achievement growth.

TABLE 4 ABOUT HERE

Other features of teachers' work lives also impacted achievement growth. Students of teachers who had self-contained classrooms or a team teaching arrangement had larger growth in reading achievement than students with teachers in departmentalized instruction, even controlling for the grade level of the student and school. Students whose teachers felt they had more influence over schoolwide decisions experienced greater achievement growth in language usage. The effect of teacher influence on math and reading achievement growth was marginally significant and was smaller. The effect of the number of students taught by the teacher was effectively zero and not statistically significant for all subjects.

Despite observed differences in teacher qualifications across school types, few of these differences were related to student achievement gains. The exception was the effect of having less than regular or standard certification in the teacher's main assignment field. Teachers lacking regular certification had students with smaller achievement gains in math. Teacher experience, highest degree, or a subject-specific major were not associated with student achievement gains.

The total amount of teacher professional development was not related to achievement gains in any subject. Most features of professional development were also not related to student achievement growth, with the exception of participation in reform-style or non-traditional forms of professional development. Teachers with greater reform-style professional development had smaller student achievement gains in language usage, although this effect was small.

Table 5 includes interactions between teacher qualifications, work context, and professional development and charter schools to see if these characteristics have different effects in charter and traditional public schools. These models are included because one research

question for this study is whether the in-school processes vary by school type. The low numbers of magnet and private schools participating made it inappropriate to also include interactions for magnet and private schools. Including interactions between teacher characteristics and charter school does not improve model fit, but once charter school interactions with teacher characteristics are included, the charter school effect is no longer significant and is near zero or negative for all subjects. The main effects for magnet and private schools are similar to the previous model. Also similar to the model without interactions is that few teacher qualifications are related to higher student achievement growth. One difference is that teachers with a major in English/language arts or education had larger achievement gains in reading and that having less than full certification was no longer significant. The results for teachers' work contexts are also similar to the previous model without interactions. Teachers with more LEP students and in self-contained classrooms had larger student gains in reading and teachers with more IEP students had larger student gains in language usage.

TABLE 5 ABOUT HERE

The main effects for features of professional development are different from the no interaction model and the interaction estimates indicate that the effect of some features of professional development vary between charter and traditional public schools. The effect of total hours of professional development in math on math achievement growth was positive and statistically significant, although quite small. The effect of participating in reform-style professional development activities on math achievement growth was negative and statistically significant for non-charter schools, but was positive for charter schools. The main effect for participating in more active-learning professional development activities on achievement growth

in language usage was not significant and near zero, but was positive and larger for charter schools.

Conclusions

This study highlights the difficulty researchers have faced in identifying characteristics of effective teachers or indicators of teacher quality (Goe, 2007; Hanushek, 1996). Few characteristics of teachers, their assignments, or work contexts were related to student achievement gains. Teachers that lacked certification or had emergency certification had students with lower achievement gains in math and higher achievement gains in language usage. The teacher's influence over schoolwide decisions was positively associated with student gains in language usage. Teachers who provided instruction in self-contained classrooms had larger student gains in reading than teachers who provided instruction in departmentalized instruction, even controlling for student grade level.

There is some evidence that the effects on student achievement growth of participating in reform-style professional development and activities that involve active learning differ by school choice. While participating in reform-style professional development activities had a negative effect on student achievement growth in math for non-charter school teachers, charter school teachers that participated in reform-style activities had larger achievement gains in math. Likewise, participating in professional development that had opportunities for active teacher learning had no effect on student growth in language usage for non-charter schools, it was positively associated with growth in charter schools. This suggests that not only does the frequency with which teachers engage in these types of professional development experiences differ by school type, but there is also a qualitative difference to how teachers experience reform-

style or active learning professional development between charter and non-charter schools. For example, teachers in all types of schools may be consulting with other teachers, exchanging feedback, or working in a mentoring relationship, but the ways charter school teachers engage in these activities appear to lead to larger achievement gains in math than in other types of schools.

Despite the difficulties of explaining student achievement growth with teacher characteristics, the results here point to differences in achievement growth between different types of schools. In math, charter schools had larger achievement gains than traditional public schools, while private and magnet schools had similar gains to traditional public schools. In reading, charter schools had greater achievement gains than traditional public schools, while private and magnet schools had smaller achievement gains. In language usage, charter schools again had larger achievement gains than traditional public schools, while private schools again had smaller achievement gains.

Given the noticeable differences in teacher qualifications, work contexts, and professional development across these types of schools, one would expect these differences to help explain these school type differences in achievement growth. One explanation for the null findings is that these characteristics may take time to have an effect on student achievement. One year of growth may be too small of a timeframe to find effects of teacher work contexts or professional development on student achievement growth. For example, given previous research on features of professional development that are associated with greater student learning (Garet et al, 2001), it would appear that charter school teachers participate in somewhat more effective professional development and private school teachers participate in less effective professional development. Yet the findings from this study are not consistent with this previous work. It may

be that the components of a teacher's prior year's professional development is more strongly related to student growth than current professional development (D. N. Harris, 2007) as it may take time for teacher learning to impact practice and ultimately student learning.

The results presented here are still preliminary. Still, this study points to the difficulty of explaining student achievement gains by characteristics of their teachers. Charter, private, and magnet schools did have teachers with different qualifications, work contexts, and professional development than traditional public schools. Understanding how the in-school organizational and operational processes vary between schools of choice and traditional public schools may require new measures that illuminate these processes even further.

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Tables

Table 1

Characteristics of Schools in the Final Sample: Schools of Choice and Traditional Public Schools

	Schools of choice				Traditional public schools			
Variable	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Math sample								
Percent of American Indian/Alaskan Students	0.749	1.467	0	12.587	2.466	11.718	0	98.46
Percent of Asian/Pacific Islander Students	2.655	4.400	0	22.560	3.488	5.233	0	23.19
Percent of Hispanic Students	9.678	15.858	0	65.160	9.734	19.107	0	90.2
Percent of Black Non-Hispanic Students	34.601	34.821	0	99.810	21.826	26.878	0	97.03
Percent of White Non-Hispanic Students	52.319	34.381	0	100	62.486	32.861	1.54	99.39
Students per Grade in School	71.202	71.525	9.667	418.667	116.788	110.334	20.125	725.5
Percent of Free and Reduced Price Lunch Students	46.992	27.175	0	99.22	36.169	25.092	0	90.21
Number of schools	86				71			
Reading sample								
Percent of American Indian/Alaskan Students	0.746	1.459	0	12.587	2.511	11.887	0	98.46
Percent of Asian/Pacific Islander Students	2.650	4.375	0	22.56	3.554	5.292	0	23.19
Percent of Hispanic Students	9.729	15.773	0	65.16	10.393	19.484	0	90.2
Percent of Black Non-Hispanic Students	34.334	34.708	0	99.81	22.431	27.028	0	97.03
Percent of White Non-Hispanic Students	52.543	34.244	0	100	61.110	32.630	1.54	99.39
Students per Grade in School	70.745	71.236	9.667	418.667	111.501	108.878	20.125	725.5
Percent of Free and Reduced Price Lunch Students	46.625	27.182	0	99.22	37.399	24.690	0	90.21

Number of schools	87				69			
Language usage sample								
Percent of American Indian/Alaskan Students	0.696	1.544	0	12.59	1.233	2.354	0	12.99
Percent of Asian/Pacific Islander Students	1.820	3.182	0	22.56	1.974	1.849	0	7.49
Percent of Hispanic Students	7.981	14.351	0	62.13	8.967	20.494	0	90.2
Percent of Black Non-Hispanic Students	35.883	35.990	0	99.81	17.420	25.461	0	97.03
Percent of White Non-Hispanic Students	53.621	35.554	0	100	70.405	29.886	2.28	99.39
Students per Grade in School	67.561	66.711	9.667	418.67	117.141	120.142	20.125	725.5
Percent of Free and Reduced Price Lunch Students	48.949	27.701	0	99.22	30.748	23.344	0	90.21
Number of schools	74				45			

Note: The percent of free and reduced-price lunch student does not apply to the private schools, so the number of schools is reduced to 75 for math, 76 for reading, and 63 for language usage. All the school characteristics come from the 2005-06 public NCES-CCD and PSS files.

Table 2

Descriptive Statistics on Teacher Qualifications, Work Context, and Professional Development

	Charter schools		Magnet schools		Private schools		Traditional public schools	
Characteristic	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Qualifications								
Experience: 3 years or less	0.371*	0.483	0.184	0.387	0.178	0.384	0.183	0.387
Highest degree: Bachelor's	0.655*	0.476	0.354*	0.479	0.701*	0.459	0.4	0.490
Highest degree: Master's, Ed. Specialist, Doctorate	0.340*	0.474	0.641*	0.450	0.239*	0.427	0.599	0.490
Highest degree: Other	0.006*	0.076	0.004	0.065	0.06*	0.238	0.001	0.038
Regular or probationary certification	0.787*	0.410	0.942	0.233	0.809*	0.394	0.947	0.224
Provisional or temporary certification	0.166*	0.372	0.036	0.185	0.045	0.208	0.039	0.195
None, emergency, or other certification	0.047*	0.212	0.022	0.147	0.146*	0.354	0.014	0.116
Major: Mathematics	0.046	0.209	0.051	0.219	0.024	0.154	0.044	0.206
Major: Elementary education, English	0.771	0.420	0.706*	0.456	0.740	0.439	0.779	0.415
Major: English	0.126*	0.332	0.103	0.305	0.048*	0.214	0.095	0.294
Work context								
Number of students taught	79.63*	119.902	95.007	112.862	61.662*	88.970	91.966	115.804
Percent LEP students taught	0.06*	0.173	0.106	0.194	0.029*	0.137	0.095	0.184
Percent IEP students taught	0.173*	0.265	0.16*	0.257	0.072*	0.163	0.195	0.276
Class organization: Departmentalized	0.44*	0.497	0.571*	0.495	0.391*	0.489	0.498	0.500
Class organization: Self-contained	0.428*	0.495	0.288*	0.453	0.527*	0.501	0.35	0.477
Class organization: Team teaching	0.052	0.221	0.061	0.239	0.048	0.215	0.054	0.226
Class organization: Pull-out	0.08*	0.272	0.08	0.272	0.034*	0.181	0.098	0.298
Influence over school decisions	3.219	0.914	3.168	0.821	3.588*	0.648	3.213	0.786
Professional development								
Total hours	3.481*	1.252	3.31	1.321	2.794*	1.345	3.274	1.280

Total hours in reading/language arts	1.906	1.435	1.61*	1.516	1.436*	1.343	1.824	1.463
Total hours in mathematics	1.097*	1.202	0.958	1.313	0.701*	1.062	0.971	1.252
Reform activities	3.768*	0.857	3.706*	0.886	3.358*	0.873	3.598	0.943
Active learning	2.928	0.848	2.939	0.883	2.619*	0.776	2.923	0.853
Collective participation	3.896*	0.974	3.504*	0.953	3.489*	0.927	3.631	0.955
Coherence	4.153	1.030	4.185	1.030	4.32*	0.844	4.162	1.019
N								

Note: The mean value of the variables for Charter, Magnet and Private schools has been compared to the mean value of the Traditional public schools. An asterisk (*) indicates a statistically significant difference in means at 5% significance level. The test for binary variables is a test for difference at the .05 level.

Table 3

Student Achievement Growth Per Month in Math, Reading, and Language Usage: Baseline Model

	Math		Reading		Language usage	
School type	Estimate	Error	Estimate	Error	Estimate	Error
Intercept	1.947***	0.071	2.056***	0.070	2.111***	0.078
Charter	0.134***	0.049	0.131***	0.047	0.179***	0.054
Magnet	-0.068	0.072	-0.133	0.071	-0.008	0.091
Private	0.02	0.100	-0.163	0.097	-0.192*	0.097
N	32960		32962		25480	
Variance components	Estimate	Error	Estimate	Error	Estimate	Error
Student level	1.1326***	0.009	1.621***	0.013	1.167***	0.011
Teacher level	0.092***	0.007	0.060***	0.006	0.064***	0.006
School level	0.042***	0.008	0.040***	0.007	0.038***	0.008

Note: All models include controls for grade level, ethnicity, and gender at the student level and grade configuration, enrollment, racial-ethnic composition, percent eligible for free or reduced-price lunch, and percent with an IEP at the school level.

* p<.05; *** p<.001

Table 4

Student Achievement Growth Per Month in Math, Reading, and Language Usage: Main Effects Model

	Math		Reading		Language usage	
Variable	Estimate	Error	Estimate	Error	Estimate	Error
Intercept	1.966***	0.127	1.826***	0.124	1.957***	0.128
Charter	0.137**	0.052	0.162***	0.047	0.212***	0.052
Magnet	-0.115	0.075	-0.149*	0.070	-0.041	0.086
Private	-0.012	0.106	-0.231*	0.099	-0.228*	0.097
Qualifications						
Experience: 3 years or less	0.024	0.033	0.005	0.031	-0.019	0.032
Highest degree: Masters, Ed. Specialist, Doctorate	0.020	0.027	-0.004	0.026	0.041	0.028
Highest degree: Other	0.145	0.390	0.172	0.370	-0.15	0.342
Less than full certification	-0.10*	0.042	-0.034	0.041	0.049	0.040
Major in subject tested	0.008	0.045	0.072	0.040	0.020	0.036
Work context						
Number of students taught	0.0002	0.000	0.00004	0.000	0.0002	0.000
Percent LEP students taught	-0.100	0.124	0.295***	0.108	0.040	0.118
Percent IEP students taught	-0.189*	0.089	-0.098	0.094	0.301**	0.109
Class organization: Self-contained	-0.006	0.043	0.092*	0.040	0.040	0.046
Class organization: Team teaching	-0.029	0.065	0.122*	0.060	-0.009	0.067
Class organization: Pull-out	-0.001	0.111	0.181	0.111	0.086	0.118
Influence over school decisions	0.038	0.020	0.031	0.018	0.066***	0.020
Professional development						
Total PD hours in subject tested	0.021	0.011	0.013	0.010	0.012	0.010
Reform activities	-0.021	0.017	-0.010	0.016	-0.034*	0.017
Active learning	-0.006	0.019	-0.003	0.017	0.006	0.018
Collective participation	-0.006	0.016	0.009	0.015	-0.001	0.016
Coherence	-0.014	0.016	-0.015	0.015	-0.023	0.016
N	28516		27701		21946	
Variance components	Estimate	Error	Estimate	Error	Estimate	Error
Student level	1.125***	0.010	1.612***	0.014	0.030***	0.007
Teacher level	0.092***	0.007	0.060***	0.007	0.059***	0.006

School level	0.041***	0.008	0.033***	0.007	0.030***	0.007

Note: All models include controls for grade level, ethnicity, and gender at the student level and grade configuration, enrollment, racial-ethnic composition, percent eligible for free or reduced-price lunch, and percent with an IEP at the school level.

Note: The omitted category for highest degree is Bachelor's. The omitted category for certification is regular or probationary. The omitted category for class organization is differentiated instruction.

* p<.05; ** p<.01; *** p<.001

Table 5

Student Achievement Growth Per Month in Math, Reading, and Language Usage: Interactions Model

	Math		Reading		Language usage	
Variable	Estimate	Error	Estimate	Error	Estimate	Error
Intercept	1.962***	0.150	1.873***	0.151	2.298***	0.163
Charter	0.017	0.203	-0.001	0.207	-0.368	0.200
Magnet	-0.107	0.074	-0.143*	0.071	-0.032	0.082
Private	-0.025	0.107	-0.217*	0.101	-0.228*	0.096
Qualifications						
Experience: 3 years or less	0.105*	0.052	-0.016	0.050	-0.010	0.061
Highest degree: Masters, Ed. Specialist, Doctorate	0.031	0.036	0.035	0.035	0.061	0.042
Highest degree: Other	0.179	0.387	0.201	0.367	-0.043	0.336
Less than full certification	-0.083	0.091	0.074	0.093	0.207	0.112
Major in subject tested	-0.037	0.063	0.133*	0.058	0.069	0.057
Work context						
Number of students taught	0.0002	0.000	-0.00002	0.000	0.0004	0.001
Percent LEP students taught	-0.299	0.173	0.294*	0.139	-0.064	0.175
Percent IEP students taught	-0.193	0.103	-0.168	0.109	0.336*	0.134
Class organization: Self-contained	0.055	0.057	0.108*	0.054	-0.038	0.071
Class organization: Team teaching	-0.042	0.084	0.113	0.074	-0.065	0.091
Class organization: Pull-out	0.026	0.145	0.219	0.126	0.005	0.143
Influence over school decisions	0.052	0.027	0.017	0.025	0.034	0.030
Professional development						
Total PD hours in subject tested	0.035*	0.014	0.010	0.013	0.010	0.016
Reform activities	-0.052*	0.021	0.010	0.021	-0.028	0.025
Active learning	-0.009	0.026	-0.031	0.024	-0.037	0.028
Collective participation	-0.001	0.021	-0.00003	0.020	-0.006	0.023
Coherence	-0.020	0.022	-0.020	0.021	-0.041	0.025
Charter school interactions						
Experience: 3 years or less	-0.124	0.067	0.037	0.064	-0.017	0.071
Highest degree: Masters, Ed. Specialist, Doctorate	-0.023	0.056	-0.075	0.053	-0.025	0.056

Highest degree: Other [1]	n/a		n/a		n/a	
Less than full certification	-0.018	0.104	-0.145	0.104	-0.204	0.119
Major in subject tested	0.079	0.088	-0.112	0.080	-0.082	0.071
Number of students taught	0.000	0.001	0.001	0.001	-0.0007	0.001
Percent LEP students taught	0.361	0.244	0.055	0.219	0.260	0.233
Percent IEP students taught	-0.034	0.208	0.200	0.215	-0.012	0.226
Class organization: Self-contained	-0.115	0.075	-0.002	0.074	0.098	0.082
Class organization: Team teaching	0.036	0.130	0.037	0.125	0.057	0.132
Class organization: Pull-out	-0.063	0.226	-0.059	0.276	0.294	0.261
Influence over school decisions	-0.027	0.039	0.022	0.036	0.048	0.039
Total PD hours in subject tested	-0.035	0.022	-0.001	0.020	0.001	0.021
Reform activities	0.080*	0.034	-0.045	0.032	-0.016	0.034
Active learning	0.003	0.039	0.060	0.034	0.082*	0.037
Collective participation	-0.011	0.033	0.021	0.031	0.021	0.032
Coherence	0.014	0.032	0.018	0.030	0.042	0.032
N	28516		27701		21946	

Variance components	Estimate	Error	Estimate	Error	Estimate	Error
Student level	1.125***	0.010	1.612***	0.014	1.147***	0.011
Teacher level	0.089***	0.007	0.060***	0.006	0.055	0.006
School level	0.040***	0.008	0.034***	0.007	0.030***	0.007

Note: All models include controls for grade level, ethnicity, and gender at the student level and grade configuration, enrollment, racial-ethnic composition, percent eligible for free or reduced-price lunch, and percent with an IEP at the school level.

Note: The omitted category for highest degree is Bachelor's. The omitted category for certification is regular, standard, or probationary certification. The omitted category for class organization is differentiated instruction.

[1] n/a indicates no interaction could be estimated because all teachers in this category are in traditional public schools.

* p<.05; ** p<.01; *** p<.001

Appendix

The process of matching traditional public schools to schools of choice consisted of three stages. At the first stage, we used CCD data on the schools to identify the best match. Our first selected sample, which would be contacted for participation, consisted of all available 321 schools of choice and 345 best matched traditional public schools. For each school of choice, a match was selected from the pool of 5,864 traditional public schools according to several dimensions. The school match had to be in the same state, and be the closest possible to the school of choice in terms of geographical distance, grade range, ethnic composition, socio-economic status, and size. The geographical distance between the schools was calculated using the longitude and latitude coordinates of the schools. Distance was a very important criterion because we wanted the school of choice and the matched traditional school to "compete" for the students in roughly the same area. Grade range match was evaluated in terms of both reported grades and also tested grades; we tended to pick schools with the greatest tested grade overlap. For ethnic composition, we sought to minimize the difference in the school percentages of American Indian/Alaskan, Asian/Pacific Islander, Hispanic, Black Non-Hispanic, and White Non-Hispanic students. For socio-economic status we used the school percentages of free and reduced-price lunch (FRL) students when available; we ignored this for private schools. For school size we used the school average of students per grade. For the actual matching process, we did not use propensity score matching (PSM) because the different models that we tried did not consistently produced the same matches or produced too few good matches; because we could not decide on an acceptable value of propensity score differences to choose the matches; because we wanted a method by which we could give more weight to certain matching

dimensions than to others; and because we thought our match quality measure was easier to interpret than a difference in pscores.

We chose a more direct and flexible method that allowed us more control of the process but is compatible with PSM: we created an index that indicated how different were the school of choice and the potential traditional school in terms of ethnic composition, socio-economic status, and school size. The index gave equal weight to ethnic composition and socio-economic status and much lower weight to school size. Then we sorted the matches by distance brackets and the index, and chose the match with the smallest index and the greatest tested grade overlap within the closest distance bracket. An extra dimension that we had to consider was whether the potential traditional school match had a history of reporting their students to NWEA in a format that would facilitate the eventual matching process of the students to their teachers. Between two equally good matches to a school of choice, we chose the one that was better for teacher-student matching. Given that our sample was chosen from the limited set of NWEA available schools and that the matching had to be in multiple dimensions, excellent matches were not always possible. We many times had to choose several matches for one school of choice to roughly complete this school's grade range; other times we had to pick a school that was very distant because there were simply no close schools; sometimes we had to choose not-so-good matches as long as they were close to the school of choice; for magnets, when a good match was not available in the area, we chose a not-so-good match as long as the match was in the same school district as the magnet. In addition, when good matches were not available for a school of choice, we sometimes had to choose the same traditional school that had already been chosen for another school of choice. We, basically, ended up with mostly one-to-one matches, but sometimes

several-to-one and one-to-several matches. Table A1 describes the selected sample of schools at this stage.

TABLE A1 ABOUT HERE

The selected 321 schools of choice (i.e. 223 charter, 65 magnet, 33 private) and 345 matches were contacted to seek their participation in the study. Given the nature of the sample design, schools of choice and their districts, when applicable, were contacted first. Traditional public schools were contacted only after their matched school of choice (or at least one of their matched schools of choice) had accepted to participate. When schools of choice did not agree to participate for any reason, we lost that school. However, when a traditional public school or its district declined participation, had recently closed or stopped testing with NWEA, we found a replacement for it. Unfortunately the replacement was almost always of lower match quality than the original match; and sometimes the replacement did not work, and another replacement was needed. In addition, despite our school-type verification process, a few schools were found to be misclassified: when a school of choice turned out to be a traditional public school, it was re-classified and placed in the pool of traditional schools; when a traditional public school turned out to be a school of choice, it was re-classified and a match or matches were found for it. After all these changes, our school sample changed to 217 charter, 60 magnets, 32 private, and 480 traditional public schools. Of these, only 117 (53.9%) charter, 34 (56.7%) magnet, 17 (53.1%) private, and 128 (26.7%) traditional public schools agreed to participate. Although 296 schools agreed to participate, only 281 schools (i.e., 103 charter, 22 magnet, 17 private, and 103 traditional) actually completed teacher and principal questionnaires. Table A2 provides descriptive statistics of the schools in the sample at this second stage of matching.

TABLE A2 ABOUT HERE

As the purpose of our analysis was to try to explain the determinants of student achievement, the next step in building our data was to match the teachers that participated in the study to the students that they teach, not an easy task. After the match was done, student achievement (i.e. test score) records were retrieved from the Growth Research Database (GRD) administered by NWEA. This was done for math, reading, and language for both the fall 2007 and spring 2008. Relative to the total number of students tested by NWEA in both periods in all three subjects, we estimate that approximately 78% of all the tested students were matched to at least one teacher. Table A3 shows the number of students that were matched to a teacher in each testing season for each subject, and the number of schools in which the students were. Because in our analyses we use the achievement data together with the teacher and the principal data, the table shows the number of students and of schools for which we have teacher and/or principal questionnaire data. In the table, we can appreciate the big drop in the number of charter schools due to the teacher-student matching process. The reader should be aware that not all the students and schools reported in the table end up being used in the analyses, the reason being the presence of missing values in certain regressors and in the dependent variable. Table 1 in the body of the paper shows descriptive statistics on the final sample of schools.

TABLE A3 ABOUT HERE

Table A1

Characteristics of Schools in the Original Sample: Schools of Choice and Traditional Public Schools

	Schools of choice				Traditional public schools			
Variable	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Percent of American Indian/Alaskan Students	1.61	6.59	0	100	2.07	10.01	0	100
Percent of Asian/Pacific Islander Students	4.22	12.11	0	100	2.96	4.97	0	31.79
Percent of Hispanic Students	13.41	19.42	0	97.79	14.29	19.05	0	94.83
Percent of Black Non-Hispanic Students	29.59*	33.68	0	100	19.19	27.96	0	99.62
Percent of White Non-Hispanic Students	51.17*	34.18	0	100	61.49	31.52	0	99.5
Percent of Free and Reduced Price Lunch Students	46.9*	31.76	0	99.22	41.72	27.07	0	99.66
Students per Grade in School	68.53*	92.7	7.25	607	131.64	121.22	15.57	725.5
Distance to School of Choice					26.58	63.24	0.15	625.74
Grade Overlap with School of Choice					65.61	26.12	11.1	100
Tested Grade Overlap with School of Choice					72.13	31.44	14.3	100

Note: The schools of choice include 223 charter, 65 magnet and 33private schools, for a total N of 321. The percent of free and reduced-price lunch student does not apply to the private schools, for a reduced N of 288 for this variable for schools of choice. The N for traditional public schools is 345. All the school characteristics come from the 2005-06 public NCES-CCD and PSS files.

* Indicates a statistically significant difference from traditional public schools at the .05 level.

Table A2

Characteristics of Schools in the Sample of Schools that Participated in the Survey: Schools of Choice and Traditional Public Schools

	Schools of choice				Traditional public schools			
Variable	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Percent of American Indian/Alaskan Students	1.09	2.28	0	14.66	1.96	9.76	0	98.46
Percent of Asian/Pacific Islander Students	2.73	5.20	0	44.27	3.55	5.23	0	27.95
Percent of Hispanic Students	11.78	18.78	0	97.79	11.97	19.20	0	90.2
Percent of Black Non-Hispanic Students	30.00	33.26	0	99.81	18.10	25.29	0	97.03
Percent of White Non-Hispanic Students	54.41	34.17	0	100	64.42	30.29	1.54	99.39
Students per Grade in School	61.47	70.94	7.25	510	121.94	123.65	20.125	725.5
Percent of Free and Reduced Price Lunch Students	43.75	30.79	0	99.22	35.10	23.93	0	90.21

Note: The N for schools of choice is 142. The percent of free and reduced-price lunch student does not apply to the private schools, so the number of schools is reduced to 125 for that variable. The N for traditional public schools is 103. All the school characteristics come from the 2005-06 public NCES-CCD and PSS files.

Table A3

Students and Schools by Testing Season, Per Availability of Teacher and Principal Questionnaire

Matched for Math

		With Teacher Questionnaire		With Principal Questionnaire	
Testing Season	School Type	Students	Schools	Students	Schools
Fall-2007	Charter	17,421	68	18,368	63
	Magnet	8,506	31	9,288	22
	Private	898	11	1,031	11
	Traditional	21,176	99	24,996	87
	Total:	48,001	209	53,683	183
Spring-2008	Charter	17,117	68	18,067	63
	Magnet	7,818	28	8,306	20
	Private	879	11	1,040	11
	Traditional	23,586	100	26,278	88
	Total:	49,400	207	53,691	182

Matched for Reading

		With Teacher Questionnaire		With Principal Questionnaire	
Testing Season	School Type	Students	Schools	Students	Schools
Fall-2007	Charter	17,686	69	18,428	63
	Magnet	7,497	31	8,488	22
	Private	936	11	1,069	11
	Traditional	21,860	96	25,341	86
	Total:	47,979	207	53,326	182
Spring-2008	Charter	17,490	69	18,205	63
	Magnet	7,038	28	7,896	20
	Private	919	11	1,080	11
	Traditional	23,387	98	26,203	87
	Total:	48,834	206	53,384	181

Matched for Language Arts

		With Teacher Questionnaire		With Principal Questionnaire	

Testing Season	School Type	Students	Schools	Students	Schools
Fall-2007	Charter	18,165	69	18,934	63
	Magnet	8,559	31	9,449	22
	Private	917	11	1,050	11
	Traditional	21,875	96	25,705	86
	Total:	49,516	207	55,138	182
Spring-2008	Charter	17,992	69	18,732	63
	Magnet	7,539	28	8,125	20
	Private	913	11	1,074	11
	Traditional	23,869	98	27,034	87
	Total:	50,313	206	54,965	181