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WHAT MAKES SPECIAL-EDUCATION TEACHERS SPECIAL? TEACHER TRAINING AND ACHIEVEMENT OF STUDENTS WITH DISABILITIES *

by

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Abstract

We analyze the impact of both pre-service preparation and in-service formal and informal training on the ability of teachers to promote academic achievement among students with disabilities. We employ rich student-level longitudinal data from Florida over a five-year period to estimate "value-added" models of student achievement. We find little support for the efficacy of in-service professional development courses focusing on special education. However, we do find that teachers who hold advanced degrees are more effective in boosting mathematics achievement of students with disabilities than are educators with only a baccalaureate degree. Further, pre-service preparation in special education has statistically significant and quantitatively substantial effects on the ability of teachers of special education courses to promote gains in achievement for students with disabilities, especially in reading. In particular, certification in special education, an undergraduate major in special education and the amount of special education coursework in college are all positively correlated with the performance of teachers in special education reading courses.

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I. Introduction

Nearly 14 percent of public school students have disabilities and receive services under the Individuals with Disabilities Education Act (IDEA) (U.S. Department of Education (2006)). Achievement levels for these students are substantially below their typical peers. Nationwide, more than three-quarters of students with disabilities score below the overall mean achievement level, compared to half of students in the general population (Wagner, et al. (2006)). Similarly, in Texas the mean achievement level for fourth graders with disabilities is two-thirds of a standard deviation below that of their typical peers. The gap widens to over one-standard deviation by seventh grade (Hanushek, Kain and Rivkin (2002)).

Concern over the academic performance of students with disabilities has been heightened by the No Child Left Behind Act's (NCLB's) "adequate yearly progress" (AYP) standards. These standards must not only be achieved for the student population as a whole, but also by identifiable sub-groups of students, including those with disabilities. The result has been that over 13 percent of schools that do not meet AYP standards fail solely because they have not achieved the standards established for their students with disabilities (Soifer (2006)).

Research on the performance of the general student population has produced a general consensus that the most important school-based determinant of student achievement is teacher quality.[1] Thus the logical starting point for any policy to address the achievement of students with disabilities is the quality of teachers instructing special education students. However, precious little is known about the effect of teacher quality on the ability of teachers to promote

[1] For recent studies quantifying the contribution of teacher quality to student achievement see Rockoff (2004) and Rivkin, Hanushek and Kain (2005), Aaronson, Barrow, and Sander (2007) and Harris and Sass (2011).

achievement and enhance educational outcomes for students with disabilities. We seek to fill this void by focusing on the relationship between achievement of students with disabilities and various aspects of teacher training, including formal pre-service university education, in-service professional development, and informal training acquired through on-the-job experience.

Determining the relationship between teacher training and student outcomes is particularly important given the difficulty schools face in adequately staffing special education programs. Over 12 percent of teachers employed to provide special education services to children ages 6-21 are not fully certified compared to 10.5 percent of teachers in general education (Boe and Cook (2006), U.S. Department of Education (n.d.a)). High percentages of uncertified educators staffing special education programs enter teaching each year (Billingsley, Fall, and Williams (2006)). Evidence suggests that these uncertified teachers are less likely to stay in their positions (Miller, Brownell and Smith (1999)) and attrition rates among beginning teachers with minimal preparation is twice as high compared to those with more extensive preparation (Boe, Cook, and Sunderland (2006)). Thus our work has potentially important implications for a variety of policy issues including the composition of both general education and special education teacher training programs, "alternative" certification programs for special education teachers, and recruitment and retention policies for special education teachers.

II. Previous Literature

In recent years a growing body of literature has emerged that relates both direct and indirect measures of teacher human capital to the impact teachers have on student achievement, also known as teacher "value-added." While these studies have begun to shed light on the relationship between teacher training and teacher quality in the general student population, there

are few quantitative studies focusing on special education teachers. Indeed there exist only a handful of studies that investigate even the general effects of special education programs on achievement of students with disabilities. However, a number of previous studies have investigated the training of special education teachers and how that training influences their classroom practices. We discuss each of these three strands of literature in turn.

A. Teacher Training and Student Achievement in the General Student Population

Numerous studies in recent years have investigated the relationship between various teacher characteristics and the performance of students they teach (see Harris and Sass (2011) for a review). Most include general measures of teacher experience and attainment of advanced degrees, but relatively few contain specific measures of pre-service preparation or in-service professional development.

Three studies consider the impact of college coursework on subsequent teacher performance. Betts, Zau and Rice (2003), using data from San Diego, find that elementary school teachers with degrees in education outperform teachers who majored in science, but have lower value-added than teachers with other majors. In middle and high school, teachers with majors in the social sciences have higher value-added than their colleagues who graduated from colleges of education. Surprisingly, Betts, Zau and Rice find that math majors are no different in affecting student math scores compared with education majors. Aaronson, et al. (2007) find little or no difference in teacher effectiveness among Chicago Public School teachers with different college majors. Harris and Sass (2011) find that, after controlling for entrance exam scores, math majors are *less* effective at teaching high school math in Florida than are students with other majors. However, college major is unrelated to teacher performance in reading instruction or in math instruction in elementary and middle school. Similarly, the results for specific

coursework are quite mixed, with no significant differences when pre-college ability is taken into account.

Another group of studies takes a broader view of teacher preparation, comparing teachers who completed a traditional university based teacher preparation program with teachers who entered the profession from various "alternative routes," generally encompassing people whose college major was something other than education. Three recent studies focus on the Teach for America (TFA) program, which recruits graduates of elite colleges and universities to teach in high-poverty schools. Two of the three studies, Boyd, et al. (2006) and by Kane, Rockoff and Staiger (2006) analyze elementary and middle school TFA teachers in New York City while Xu, Hannaway and Taylor (2011) consider the relative effectiveness of TFA teachers at the high school level in North Carolina. Boyd et al. find TFA teachers are just as effective as traditionally prepared teachers in math but less effective than teacher preparation program completers in English Language Arts (ELA) instruction. The effectiveness differential in ELA is driven primarily by results for rookie teachers; after the first year, TFA teachers and traditionally-prepared teachers are equally effective in teaching ELA. Kane, Rockoff and Staiger perform a similar analysis, but possess an additional year of data and can thus produce more precise estimates of the effectiveness of alternatively certified teachers. In their study, TFA teachers are found to be more effective than traditionally prepared teachers in math, but no different in ELA instruction. Xu, Hannaway and Taylor find that TFA teachers are more effective than traditionally prepared teachers across eight math, science and English courses in which end-of-course exams are given. Two other studies, Sass (2011) and Constantine et al. (2009) conduct analyses of a more diverse set of alternative certification programs. Sass finds mixed evidence on the relative performance of alternatively certified and traditionally prepared teachers. He

finds that graduates of an online training program generally out-perform traditionally prepared teachers, particularly in mathematics education. In constrast, graduates of a two-semester community college based program generally have slightly lower value-added scores than do traditionally prepared teachers. Completers of district-based alternative certification programs are on par with their traditionally prepared colleagues in terms of their impact on student test scores. Constantine, et al., employing data from 20 districts in which students were randomly assigned across pairs of traditionally prepared and alternatively certified teachers, find no differences in the teachers' ability to promote student achievement.

Studies of the impact of in-service professional development on teacher value-added in the general student population are even more infrequent. Harris and Sass (2011) find mixed evidence on the effect of professional development course taking on the ability of teachers to increase student achievement in Florida. Professional development is positively associated with teacher effectiveness in some grades and subjects but not in others. There is also variability across types of professional development (content vs. pedagogy) and the timing of when the professional development is received, though no clear patterns emerge. Jacob and Lefgren (2004) exploit a "natural experiment" that occurred in the Chicago public schools where the level of professional development was based (exogenously) on prior school-level average test scores. Jacob and Lefgren are not able to distinguish the specifics of the professional development that teachers received, however. They find no significant impacts of the professional development on teacher effectiveness in either math or reading instruction.

B. Special Education Programs and Student Achievement

There exist only a handful of studies that analyze the impact of special education programs on the achievement of students with disabilities. Hanushek, Kain and Rivkin (2002)

investigate the effects of participation in special education programs using statewide individual-level data from Texas. They find that special education boosts the achievement of students with disabilities. An older study by Reynolds and Wolfe (1999) analyzed a much smaller sample of 1,200 children from low-income families in Chicago. They found that children with learning disabilities benefited less from special education services than did children with other kinds of disabilities. More recent work by Blackorby, et al. (2005), using data from the Special Education Elementary Longitudinal Study (SEELS), finds that students who spend most of their day in regular education classrooms tend to perform better on standardized tests. Similarly, students requiring accommodations tend to perform worse on exams than do other children with disabilities who do not receive accommodations. However, these differences likely reflect unmeasured characteristics of the students rather than the efficacy of placements or accommodations per se. Although these existing studies provide evidence on the efficacy of special education programs in general, none of them investigates the role that teachers play in promoting the achievement of students with disabilities.

C. Special Education Teacher Training and Classroom Practice

While there have been no studies that directly estimate the effects of pre-service education or in-service professional development on a teacher's contribution to achievement of students with disabilities, a number of studies investigate the relationship between the training of special education teachers and their classroom practice (Algozzine, Morsink, and Algozzine (1988), Sindelar, Daunic and Rennells (2004), Nougaret, Scruggs and Mastropieri (2005)). Using observations of classroom performance and principal ratings, Sindelar, Daunic and Rennells (2004) find that graduates of a traditional special education teacher program had superior classroom practices compared to their counterparts from a university-district partnership

and from a district "add-on" program. Nougaret, Scruggs and Mastropieri (2005) find similar results indicating that traditionally licensed teachers are better than emergency licensed teachers on several dimensions such as planning and preparation, classroom environment, and instruction.

Although recent evidence suggests a linkage between classroom practice and teacher value-added (Grossman, et al. (2010), Kane, et al. (2010)) among general education teachers, existing studies of classroom practice in special education suffer from some significant shortcomings. First, the samples of observed teachers are generally small (less than 50 teachers) and may not be representative of the larger population of special education teachers. Second, there exists potential selection bias from teachers choosing not to allow observation of their classes. Third, the literature focuses exclusively on special-education teachers, rather than the teachers who instruct special education students. About half of special-education students spend 80 percent or more of their school day in regular education classrooms and only about one-fourth spend 60 percent or more of their day outside regular education classrooms (U.S. Department of Education (2006)). Thus knowing what sorts of training make general education teachers more effective with special education students is crucial. Fourth, and most importantly, the existing research on special education teachers does not directly connect the education and training of teachers to student outcomes.

III. Econometric Model and Estimation Strategies

To empirically measure the impact of teacher education and training on student achievement we employ a "value-added" model of student achievement based on the general cumulative achievement models Boardman and Murnane (1979) and Todd and Wolpin (2003).

Student achievement gains for student i in period t, ΔA_{it},[2] are modeled as a linear function of student/family characteristics, $\mathbf{X}_{it}$, peer characteristics, $\mathbf{P}_{-ijmt}$ (where the subscript –i denotes students other than individual i in the classroom), teacher characteristics, $\mathbf{T}_{kt}$ (where k indexes teachers), and a vector of school-level inputs for school m at time t, $\mathbf{S}_{mt}$, that include factors such as school leadership[3] and a mean-zero error, ε_{it}:

$$\Delta A_{it} = \boldsymbol{\beta}_1 \mathbf{X}_{it} + \boldsymbol{\beta}_2 \mathbf{P}_{-ijmt} + \boldsymbol{\beta}_3 \mathbf{T}_{kt} + \boldsymbol{\beta}_4 \mathbf{S}_{mt} + \varepsilon_{it} \quad (1)$$

This specification, though typical in the empirical literature, requires a number of restrictive assumptions. Detailed discussions of the model assumptions and their validity are provided in Boardman and Murnane (1979), Todd and Wolpin (2003) and in Harris, Sass and Semykina (2010).

One issue in the specification of empirical models of student achievement that is especially relevant to students with disabilities is the treatment of student heterogeneity. Given the great diversity in ability among special education students, it is particular important to control for student characteristics ($\mathbf{X}$), when estimating the effects of teacher characteristics on student achievement gains ($\boldsymbol{\beta}_3$). We employ a rich set of observable student characteristics,

[2] Employing achievement gains as the dependent variable implicitly assumes that the effects of prior schooling inputs do not decay over time. Alternatively, one can allow for partial decay by adding lagged achievement to both sides of equation (1) and estimating the impact of prior achievement on current achievement. Results from estimating such a model are reported in appendix table A1. The estimates of the key parameters are very similar to those from the achievement-gains model.

[3] We rely on school-level observables, like principal experience and tenure at a school, to capture differences in school quality, rather than employ school fixed effects. The use of school fixed effects in the special education context is problematic since there are typically very few special education teachers per school, making it difficult to identify the effects of teacher characteristics on student achievement. Estimates of the gains model with school fixed effects are reported in appendix table A2. Estimates of the partial decay model with school fixed effects are reported in appendix table A3. Estimates from the school-fixed-effects models are similar in magnitude to those without school fixed effects, but the estimates are much less precise, as expected.

including both standard demographic measures like race/ethnicity, gender and student mobility, as well as indicators for 18 different disability categories.[4]

Another specification issue that is of particular importance when measuring achievement gains for students with disabilities is the potential for non-uniform growth along the achievement scale. Whether due to the structure of the scale used to measure student achievement, ceilings/floors in the test instrument or non-linearities in the underlying achievement function, expected gains in achievement may be different at different points along the achievement scale. For example, ceteris paribus, the expected achievement gain for a student who starts at the low end of the achievement scale may be different than for a student who begins at the 25th percentile. This is of particular concern for the population of special education students, many of whom may be functioning at relatively low achievement levels. To address this potential problem we supplement equations (1) with a set of indicator variables representing the decile of the achievement distribution in which a student's prior-year achievement-test score fits.

There are some particular challenges in estimating such value-added models for students with disabilities. Foremost is the fact that students with disabilities often take regular education and special education courses in the same subject at a point in time. This makes it difficult to determine who is responsible for instruction. For example, an elementary school student may

[4] We also estimated student achievement models that control for unobserved time-invariant student/family characteristics by replacing time-invariant (or quasi-time invariant) student characteristics with student fixed effects. Results are reported in appendix table A4 (without school fixed effects) and table A5 (with school fixed effects). Given our decision to stratify the estimation samples by course taking pattern (see below), the estimates of the determinants of student achievement are very imprecise, particularly for the cases in which students receive some instruction outside of regular education courses. In such cases identification of the effects of teacher credentials comes from students who have the same course taking pattern in a subject for two or more years and who encounter teachers with different characteristics. Given that course-taking patterns can vary over time (e.g. a student may be pulled out for math in one year, but not the next) and students who do maintain the same course taking pattern are likely to encounter the same special education teachers multiple times within a given school type (elementary/middle/high), it is not surprising that the student fixed effects results are generally imprecise.

participate in daily language arts instruction time in the regular education classroom with one teacher but also be pulled out for extra help in reading two or three times a week with another teacher. Table 1 illustrates the course taking patterns in Florida for students with disabilities during the 2004/05 school year, broken down by grade level and by subject. In all but middle school English-Language Arts, the modal pattern is taking one or more subject-relevant regular education courses from a single teacher and no special education courses in the subject. At the elementary school level the second most common pattern is having one teacher for regular education courses in the subject and another teacher for special education courses in the subject, with nearly 20 percent of students falling into this category. In middle and high school there tends to be less mainstreaming, with fewer than 10 percent of special education students having both a single teacher in subject-relevant regular education courses and a single teacher in subject-relevant special education courses. The third most common category includes students who take special education courses in the relevant subject from a single teacher and do not participate in any regular education courses in the subject. About $1/6^{th}$ of elementary students with disabilities fall into this category. The proportion grows to roughly 1 in 5 in middle and high school. While there are significant numbers of students who have more than one teacher in regular education courses or more than one teacher in special education courses, the proportions are not large at the elementary level. The problem of multiple teachers is more acute in high school where students are more likely to be taking multiple courses in a subject, such as two regular education math courses or one remedial math class and one regular algebra class.

Another problem related to the course taking patterns of students is the issue of non-random assignment across different types of courses. As illustrated in Table 2, students with disabilities who take only regular education courses tend to have higher achievement (about one-

third of a standard deviation below the population mean for all students) than students who take a mix of regular education and special education courses (0.9 standard deviations below the mean achievement level) and those that take special education courses in the relevant subject exclusively (1.3 standard deviations below the mean). There are also marked differences across classroom settings in the types of disabilities that students possess. Over 25 percent of students with disabilities who receive subject-relevant instruction only in regular education classrooms have speech or language disabilities, whereas less than five percent of students with disabilities students that receive some of their subject-area instruction in special education classes possess speech or language disabilities. In contrast, two percent of students with disabilities who receive subject-relevant instruction only in regular education courses are intellectually impaired whereas 13 percent of students who receive math or reading instruction solely in special education courses possess intellectual disabilities. Similarly, 20 percent of students who receive subject-relevant instruction only in special education classrooms have a social/emotional disability whereas only 10 percent of students with disabilities who receive some subject-area instruction in regular education classrooms are classified as having social or emotional disabilities.

To deal with the dual problems of multiple instructors and non-random course-taking patterns, we pursue the following strategy. First, we limit our analysis to students who have at most one teacher for their regular education coursework and one teacher for their special education coursework. This eliminates students taking multiple regular education or special education courses taught by different teachers (designated as having 2+ teachers in Table 1). It also eliminates students in co-taught classes (which are included in the "Single Teacher Cannot

be Identified" category in Table 1).[5] However, it allows us to clearly identify the instructor responsible for regular education coursework and for special education coursework. Further we analyze each of the three resulting course-taking patterns (regular education from one teacher and no special education courses, special education from one teacher and no regular education courses, regular education from one teacher and special education from one teacher) separately. This avoids the problems of non-random assignment to courses and facilitates comparisons of the effectiveness of teacher training in different environments.

There is also a potential for selection bias if students with disabilities are not randomly assigned among teachers within a given course taking pattern. For example, if students with disabilities who exclusively attend regular education courses are more likely to be assigned to teachers with strong special education credentials and there are negative peer effects among students with disabilities in a classroom, this could impart a downward bias on the estimated impact of special education training on teacher effectiveness.[6] Similarly, if more severely impaired students are more likely to be placed with regular education teachers with strong special education credentials, the measured effectiveness of such teachers would understate their true effectiveness. We adopt three strategies to mitigate any such bias. First, we control for student heterogeneity by employing very detailed disability categories as controls. Second, we include indicators for deciles of prior-year student achievement. Third, we include the proportion of classroom peers with disabilities as an additional control.

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[5] If there was more than one "primary instructor" for a given course offering, the instructor information was deleted and therefore was treated as missing. This was done to avoid complications with trying to assess the relative contributions of two teachers in the same classroom.

[6] Negative externalities could arise from disruptive behavior (Fletcher (2009)) or simply from a teacher's instructional time being spread across more high-needs students.

IV. Data

One of the primary factors limiting quantitative research on the effectiveness of special education teachers is the difficulty in matching students with disabilities and their teachers. Since students with disabilities often have multiple teachers, even in elementary school, the information required to determine the teachers responsible for instruction are typically not available. To overcome this obstacle we employ a unique statewide database from Florida. The Florida Education Data Warehouse (FLEDW) contains individual-level longitudinal data for the universe of public school students and teachers in the state from 1995 forward, including about 400,000 special education students each year. While statewide longitudinal databases exist in North Carolina and Texas and the SEELS data provide information on a sample of students nationwide, the Florida data are unique in that students and teachers can be linked to specific classrooms at all grade levels, K-12.[7] Furthermore, the Florida data contain the entire enrollment record for each student, including the minutes per week spent in each classroom. Thus we can determine each and every teacher a student is exposed to and time spent with each. Also, each teacher of record is indicated so we can distinguish courses that are co-taught by a regular-education teacher and a special-education teacher.[8]

Another limitation to value-added analysis in special education is a lack of test scores for some students. While the vast majority of students with disabilities participate in statewide

[7] The SEELS data do link information on students and teachers and also contain a rich set of variables measuring the student's family environment. However, the data only include test scores at two points in time, thereby precluding the use of student fixed effects to control for unobserved student heterogeneity.

[8] Not only are each classroom and teacher identified, but "pull-out" sessions with speech-language pathologists (SLPs) are assigned separate course identifiers and each SLP has an employee identifier so we can also determine the exposure to SLPs for students with speech/language impairments. In the present analysis, however, we simply exclude all academic courses taught by someone other than a teacher (these are included in the "Teacher Cannot be Idenified" category in Table 2). Other related service providers, such as occupational therapists, are identified in the data but are not linked to specific courses. Thus we can not match them to specific students.

achievement exams, about four percent of students with disabilities in Florida are exempted. The proportion of special education students who are exempted varies widely across districts with some having exemption rates as high as 16 percent.[9] Similarly, certain categories of students with disabilities, such as those with cognitive impairments are more likely to be exempted from testing. For students who take standardized tests each year we use student test-score gains, on the Stanford Achievement Test (known as the FCAT-NRT in Florida), normalized by grade and year as the outcome.[10] Scores for both math and reading in each of grades 3-10 are available for the FCAT-NRT beginning in school-year 1999/00. This means we can compute test score gains from 2000/01 through the last year of available data, 2004/05.

Another challenge to estimating the impact of teachers on educational outcomes for students with disabilities is separating out the influences of teachers and peers on individual achievement. One of the premises behind the IDEA's requirement that students be educated in the "least restrictive environment" is that students with disabilities can benefit from being exposed to non-disabled peers. Thus to evaluate the effectiveness of teachers one must also account for the composition of peers within a classroom. Fortunately, since the FLEDW contains data on all public school students within Florida and identifies each course they take we can measure classroom peer characteristics along multiple dimensions, including mobility,

[9] See NCLB accountability reports at http://schoolgrades.fldoe.org/ and http://www.astronaut.brevard.k12.fl.us/Astronaut.txt

[10] In addition to FCAT-NRT the State of Florida administers the "Sunshine State Standards" Florida Comprehensive Achievement Test (FCAT-SSS). The FCAT-SSS is a criterion-based exam designed to test for the skills that students are expected to master at each grade level. The FCAT-SSS was given in consecutive grades beginning in 2000/01 and thus provides one less year of data. However, we run most of the analyses presented in the paper using FCAT-SSS data and obtain very similar results.

race/ethnicity, gender and age. Weighted peer variables are constructed based on the time a student spends in each subject-relevant classroom.

Not only is the FLEDW a rich source of student information, it also provides a wealth of information on teachers as well. For each Florida public school teacher the FLEDW provides their basic demographic characteristics (age, sex, race/ethnicity) and years of teaching experience. The FLEW also provides data on each teacher's certification status (professional or temporary), subject area certification (eg. special education) and whether they possess an advanced degree. Through matching of files from the Department of Education's Staff Information Database we can identify each and every professional development course each teacher participates in during their career. Further, we can determine the subject matter of each course (eg. math pedagogy) and the number of hours of instruction. We can therefore precisely measure the amount and type of professional development each teacher receives. For the sub-sample of Florida public school teachers who attended a Florida public community college or university since 1995 the FLEDW contains their complete transcript information, including each course they took and the degrees they earned. We can therefore quantify the number and types of teacher preparation courses taken.[11] Because Florida has a uniform course numbering system, we are able to create variables that describe each course according to its content. In particular we can distinguish special education courses form other teacher preparation courses.

[11] We have no information on courses taken at private universities in Florida or courses taken at public or private institutions of higher education outside of Florida. Similarly, we do not possess information on any course work prior to 1995. To minimize problems associated with missing coursework information, we treat the number of college credits as missing if the teacher did not graduate from a public university in Florida in 1995 or later.

V. Results

Initial estimates of the student achievement model are presented in Table 3. Like previous results for the general student population (Harris and Sass (2011), Jacob and Lefgren (2004) and Glaserman, et al. (2009)), we find no systematic evidence that participation in special education in-service professional development (PD) has a positive effect on a teacher's ability to enhance gains in achievement for students with disabilities. In only 4 of 32 possible cases (current plus 3 lags of PD x 2 teacher types x 2 subjects x 2 models) is there a positive and significant correlation between special education PD and student achievement gains. The only category in which there is some evidence of consistent positive effects of special education PD is for reading teachers in regular education classrooms instructing students who do not also receive reading instruction in a special education classroom. There the estimates indicate that special education PD received three years in the past has a small positive impact on student achievement gains.

Similar to research on regular education students, we find that on-the-job training gained through experience does have positive effects on the productivity of teachers who instruct special education students. As with prior research on the general education population, our results indicate that achievement gains for special-education students tend to rise with the experience of their teacher and the largest gains from experience occur early in a teacher's career. However, in math the gains from experience appear to be somewhat smaller for teachers of special education courses compared to teachers of regular education courses. On the reading side, the payoff for experience beyond the first few years appears to be less for teachers of special education courses than for teachers of regular education courses.

While our estimates of the effects of formal in-service professional development and in-formal training acquired through on-the-job experience are generally similar to findings from the general education literature, we uncover some interesting differences with respect to the attainment of advanced degrees by teachers. Prior studies of the general student population generally find little support for the notion that attainment of advanced degrees enhances teacher productivity in promoting achievement among regular education students.[12] In contrast, we find that special education students who receive all of their math instruction in a regular education course exhibit greater achievement gains when their teacher holds an advanced degree. Likewise, for students who receive some or all of their math instruction in a special education course, achievement gains are higher when their teacher holds a post-baccalaureate degree. We also find a positive and significant correlation between student achievement gains in reading and advanced degree attainment in cases where students receive all of their instruction in a special education course. The positive effects of advanced degree attainment could be due to differences in the impact of post-graduate training on teaching special-education students vis-à-vis regular-education students. Alternatively, it may be the case that the content of post-baccalaureate degrees earned by teachers of special education courses is different from the content of graduate coursework of teachers who teach regular education courses. We explore this issue further below.

Finally, we consider the effects of pre-service preparation of teachers instructing students with disabilities. In the model used to produce the estimates presented in Table 3, special education certification is used as a proxy for the pre-service preparation of teachers. Typically

[12] One exception is the recent work of Clotfelter, Ladd and Vigdor (2010) who find a small positive effect of masters degrees earned while teaching on the effectiveness of high school teachers.

teachers who achieve certification in special education either majored in special education in college or completed substantial coursework in special education prior to teaching.[13] For teachers of special education reading courses we find a positive and statistically significant relationship between special education certification and reading achievement. The effects are roughly equivalent to the difference in productivity between a rookie teacher and one with 1-2 years of experience. We also find a somewhat smaller, but still statistically significant, positive effect for teachers of special education math courses, but only for those students who receive instruction in both regular and special education courses. The relationship between special education certification and the ability of instructors in regular education courses to promote achievement gains for students with disabilities in much weaker. Only in the case of reading achievement among students who take both regular and special education courses relevant to reading to we observe a positive and statistically significant relationship between special education certification and the achievement gains of students with disabilities.

In order to better understand the relationship between pre-service training and the productivity of teachers instructing students with disabilities, we re-estimated the student achievement model, replacing special education certification with various direct measures of pre-service training, including hours of special education coursework and degrees obtained. While these variables provide a more precise measure of pre-service training, they also suffer from two limitations. First, we only possess transcript information for teachers who attended public universities in Florida. Thus our pre-service measures do not capture special education

[13] To obtain subject area certification in exceptional student education in Florida, teachers must either have majored in exceptional student education or have taken at least 30 semester hours of special education courses. (http://www.fldoe.org/edcert/rules/6A-4-01795.asp). In addition, they are required to pass a subject area exam (http://www.fldoe.org/edcert/add_subject_pro.asp).

coursework completed in private universities in Florida or in public universities in other states. Second, we do not have information on the pre-service preparation of older special education teachers, as the available college transcript information begins in 1999. Thus use of college coursework or degree attainment reduces the size of our analysis sample by roughly 80 percent.

The first panel of Table 4 reproduces the estimates of special education certification effects from Table 3 and the second panel provides estimates of the same model on the sub-sample teachers for which college transcript information is available. The estimated effects of special education certification for teachers of special education reading courses remain positive and statistically significant and are roughly twice the magnitude of the full-sample estimates. In contrast, the insignificant effects of special education certification for teachers of regular education courses in the full sample are negative and statistically significant in the reduced sample.

It seems unlikely that the negative correlation between special education certification and student achievement gains of students with disabilities in regular education classrooms represents any sort of causal mechanism; it is hard to imagine why pre-service training in special education would lower a teacher's productivity in teaching special education students. There are two likely explanations. First, it may simply be the case that there are relatively few special-education-certified teachers teaching regular education courses and what we are measuring are really idiosyncratic effects of that small number of teachers. Roughly eleven percent of regular education classroom teachers in the full sample hold a certification in special education (see Table 2). Given the full sample includes approximately 50,000 teachers who teach regular education courses, this implies that about 2,200 of them hold a certification in special education. In contrast, the college-transcript sample includes about 8,400 teachers of regular education

courses, eight percent of which (about 670 teachers) are special education certified. It is also possible that we are observing a bias caused by sorting of teachers. Billingsley and Cross (1991) find that the stress of working with students with special needs and the lack pupil progress relative to effort expended are common reasons for teachers to switch from special to regular education. Thus the negative correlation between special education certification and the performance of regular education teachers instructing students with disabilities could indicate that these teachers no longer enjoy teaching special education students or are not particularly effective in teaching students with disabilities.

The remaining four panels of Table 4 represent specifications that replace special education certifications with more direct measures of pre-service training: number of credits completed in exceptional childhood education, obtaining one's first bachelors degree in special education, obtaining any bachelors degree in special education and possessing an advanced degree in special education. The amount of coursework in special education, obtaining one's first bachelor's degree in special education or having a bachelor's degree in special education among all undergraduate degrees is positively associated with learning gains in reading for students enrolled in special education courses who are also enrolled in a regular education course. There is also a marginally significant positive correlation between college coursework in education and achievement gains for students in special education who are also receiving math instruction in a regular education course. Finally, we obtain mixed results for advanced degrees in special education. Recall that the model includes an indicator for attainment of any type of advanced degree, so the indicator for advanced degrees in special education represents the differential between holding a post-baccalaureate degree in special education and an advanced degree in some other major. For math, teachers of special education courses who hold an

advanced degree in special education are more effective in promoting achievement among students who do not take any regular education math courses than are teachers with an advanced degree in some other subject. Just the opposite is true for reading teachers serving the same population; those who hold an advanced degree in special education are about as productive as a teacher who holds no advanced degree.

Finally, we consider the possibility of heterogeneous effects across different students. While there are many ways one might break apart the sample into sub-groups, we consider two general categories, disability type and grade level. Estimates of the effects of teacher educational attainment and certification on student achievement gains for these sub-groups are presented in Table 5.[14] We find that estimated effects for students with specific learning disabilities (SLD), which are the largest disability group, are similar to results for the full sample. In contrast, for students with other types of disabilities, the estimates of advanced degrees and special education certification are less precise; special education certification is statistically significant only for special education teachers of students who take both regular and special education courses in reading. In elementary school, special education certification is associated with greater learning gains of special education students enrolled in regular and special education courses, both in math and in reading. For middle and high school students who take both regular and special education courses in reading/language arts, their achievement gains are higher when taught by a special education certified teacher. Special education certification is not associated with greater learning gains in math.

[14] The full set of regression estimates are presented in appendix tables A6-A9.

VI. Summary and Conclusions

Ours is the first study to quantify the relationship between teacher training and the achievement of students with disabilities. Although some of our findings are consistent with past research on the general population of students and teachers, we uncover some important differences for the sub-population of students with disabilities and their teachers.

Consistent with research on regular education students, we find that in-service professional development for teachers has little effect on their ability to increase the achievement gains of students with disabilities. This suggests current expenditures on professional development might be more efficiently used in other ways to enhance teacher quality and promote student achievement. Further, as with teachers serving the general student population, value added increases with the first few years of experience. Thus there are potential gains from reducing attrition among early-career special education teachers.

While past research on the achievement of students in the general population has found little or no correlation between advanced degree attainment of teachers and the performance of their students, students in special education courses have higher achievement gains when their teacher holds a post-baccalaureate degree. The effects are particularly strong in the case of reading achievement.

We also find differences in the efficacy of pre-service education between regular and special education. Research on general education students and their teachers consistently finds that teacher effectiveness is unrelated to the type of pre-service education they receive. In prior research, neither specific coursework nor type of college degree seems to influence the performance of teachers serving general education students. In contrast, we find that for reading instruction, teachers of special education courses are more effective if they have pre-service

training in special education. This is true whether we measure training by hours of coursework, attainment of a bachelor's degree in special education or by certification in special education. This suggests that reducing certification requirements for special education teachers via alternative certification programs may be counterproductive.

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Table 1
Frequency and Percentages of Special Education and Regular Education Courses and Teachers Taken by Subject and Grade Level, 2004/05

	Elementary	Middle	High
Courses Taken/Teachers	Frequency (Percent)	Frequency (Percent)	Frequency (Percent)
Math			
No Special Ed. Courses Regular Ed. Courses from 1 Teacher	75,005 (42.22)	35,573 (40.15)	42,560 (42.39)
No Special Ed. Courses Regular Ed. Courses from 2+ Teachers	8,886 (5.00)	7,653 (8.64)	18,068 (17.99)
Special Ed. Courses from 1 Teacher No Regular Ed. Courses	30,713 (17.29)	28,348 (31.99)	23,734 (23.64)
Special Ed. Courses from 1 Teacher & Regular Ed. Courses from 1 Teacher	33,346 (18.77)	5,596 (6.32)	2,142 (2.13)
Special Ed. Courses from 1 Teacher & Regular Ed. Courses from 2+ Teachers	3,355 (1.89)	629 (0.71)	265 (0.26)
Special Ed. Courses from 2+ Teachers & Any Number of Regular Ed. Teachers	8,399 (4.73)	5,811 (6.56)	3,146 (3.13)
Single Teacher Cannot be Identified in 1 or more Courses	16,884 (9.50)	2,630 (2.97)	3,031 (3.02)
Not Taking Any Courses in Subject	1,069 (0.60)	2,365 (2.67)	7,466 (7.44)
Reading/English Language Arts			
No Special Ed. Courses Regular Ed. Courses from 1 Teacher	68,406 (38.50)	19,366 (21.86)	35,579 (35.43)
No Special Ed. Courses Regular Ed. Courses from 2+ Teachers	12,439 (7.00)	19,786 (22.33)	27,373 (27.26)
Special Ed. Courses from 1 Teacher No Regular Ed. Courses	28,874 (16.25)	19,542 (22.06)	19,351 (19.27)
Special Ed. Courses from 1 Teacher & Regular Ed. Courses from 1 Teacher	35,281 (19.86)	7,895 (8.91)	3,568 (3.55)
Special Ed. Courses from 1 Teacher & Regular Ed. Courses from 2+ Teachers	4,985 (2.81)	2,883 (3.25)	1,123 (1.12)
Special Ed. Courses from 2+ Teachers & Any Number of Regular Ed. Teachers	9,067 (5.10)	15,224 (17.18)	8,492 (8.46)
Single Teacher Cannot be Identified in 1 or more Courses	18,436 (10.38)	2,773 (3.13)	2,960 (2.95)
Not Taking Any Courses in Subject	169 (0.10)	1,136 (1.28)	1,966 (1.96)

Note: General academic special education courses as well as regular education self-contained classes are counted as both math and reading/language arts courses.

Table 2
Summary Statistics for Florida Public School Students with Disabilities and Their Teachers by Course Taking Pattern and Subject, 1999/2000-2004/2005 [Only Students with One of More Achievement Test Scores]

	Math			Reading		
	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.
Student-Level Variables						
(Normed) Achievement Level	-0.37	-1.25	-0.85	-0.34	-1.27	-0.87
(Normed) Achievement Gain	0.02	0.03	0.00	-0.03	0.00	0.04
Number of Schools Attended	1.04	1.06	1.07	1.04	1.06	1.06
"Structural" Mover	0.18	0.18	0.05	0.16	0.16	0.06
"Non-Structural" Mover	0.17	0.20	0.16	0.16	0.19	0.16
Female	0.35	0.30	0.33	0.36	0.29	0.32
Black	0.23	0.36	0.26	0.22	0.36	0.26
Hispanic	0.16	0.20	0.20	0.15	0.18	0.20
Free/Reduced-Price Lunch	0.49	0.71	0.64	0.47	0.70	0.63
Limited English Proficiency	0.04	0.04	0.06	0.03	0.03	0.06
Speech/Language Disability	0.26	0.02	0.04	0.29	0.03	0.04
Specific Learning Disability	0.57	0.60	0.77	0.54	0.58	0.78
Intellectual Disability	0.02	0.13	0.04	0.02	0.13	0.04
Physical Disability	0.02	0.02	0.01	0.02	0.02	0.01
Emotional Disability	0.10	0.20	0.10	0.10	0.21	0.10
Other Disability	0.04	0.03	0.04	0.04	0.03	0.04
Teacher-Level Variables						
Regular Ed. Teacher						
Experience	8.37		8.93	8.33		8.86
Sp. Ed. In-service Hours$_t$	3.42		3.09	3.53		3.28
Sp. Ed. In-service Hours$_{t-1}$	2.95		2.69	3.08		2.90
Sp. Ed. In-service Hours$_{t-2}$	2.46		2.40	2.57		2.46
Sp. Ed. In-service Hours$_{t-3}$	2.22		2.29	2.29		2.38
Advanced Degree	0.31		0.29	0.31		0.30
Professional Certification	0.82		0.86	0.82		0.86
Special Ed. Certification	0.11		0.11	0.12		0.12
Exceptional Child Ed. Credits	0.39		0.38	0.36		0.42
First BA - Special Ed.	0.08		0.08	0.07		0.09
Any BA - Special Ed.	0.08		0.09	0.08		0.09
Adv. Deg. - Special Ed.	0.08		0.08	0.08		0.08

Special Ed. Teacher				
Experience	6.44	8.38	6.36	8.38
Sp. Ed. In-service Hours$_t$	11.66	6.42	11.71	6.25
Sp. Ed. In-service Hours$_{t-1}$	9.44	5.30	9.62	5.18
Sp. Ed. In-service Hours$_{t-2}$	7.03	4.16	7.06	4.19
Sp. Ed. In-service Hours$_{t-3}$	5.14	3.27	5.16	3.25
Advanced Degree	0.34	0.32	0.34	0.32
Professional Certification	0.77	0.85	0.77	0.85
Special Ed. Certification	0.85	0.39	0.85	0.37
Exceptional Child Ed. Credits	2.78	1.37	2.76	1.30
First BA - Special Ed.	0.69	0.33	0.69	0.31
Any BA - Special Ed.	0.71	0.34	0.71	0.32
Adv. Deg. - Special Ed.	0.09	0.09	0.09	0.09

Note: disability categories presented here are aggregates of the 18 specific disability categories used in the analysis.

Table 3
Estimated Effects of Teacher Experience, In-Service Training, Educational Attainment and Certification Status on the Math and Reading Achievement Gains of Students with Disabilities in Florida by Course Taking Pattern, 1999/2000-2004/2005

	Math			Reading		
	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.
Regular Ed. Teacher						
1-2 Years of Experience	0.0310***		0.0250**	0.0264***		0.0060
	(5.84)		(2.17)	(4.11)		(0.57)
3-4 Years of Experience	0.0297***		0.0438***	0.0168**		0.0231*
	(4.68)		(3.25)	(2.20)		(1.93)
5-9 Years of Experience	0.0440***		0.0286**	0.0307***		0.0158
	(7.11)		(2.28)	(4.24)		(1.40)
10-14 Years of Experience	0.0511***		0.0256*	0.0431***		0.0210*
	(7.61)		(1.93)	(5.65)		(1.78)
15-24 Years of Experience	0.0465***		0.0425***	0.0531***		0.0268**
	(7.11)		(3.30)	(7.09)		(2.63)
25+ Years of Experience	0.0501***		0.0412***	0.0429***		0.0326***
	(6.94)		(3.00)	(4.95)		(2.63)
Sp. Ed. In-service Hours$_t$	0.0000		0.0000	0.0002		0.0002
	(0.51)		(0.01)	(1.53)		(1.25)
Sp. Ed. In-service Hours$_{t-1}$	-0.0000		0.0003	-0.0000		-0.0001
	(0.30)		(1.29)	(0.28)		(0.31)
Sp. Ed. In-service Hours$_{t-2}$	0.0001		-0.0003	0.0002*		0.0000
	(0.85)		(1.32)	(1.74)		(0.26)
Sp. Ed. In-service Hours$_{t-3}$	0.0002		0.0002	0.0003***		-0.0000
	(1.54)		(0.09)	(3.34)		(0.16)
Advanced Degree	0.0101***		0.0037	-0.0040		0.0034
	(3.01)		(0.61)	(1.05)		(0.64)
Professional Certification	0.0154***		0.0090	0.0175***		0.0221**
	(3.14)		(0.80)	(2.90)		(2.20)
Sp. Ed. Certification	-0.0003		0.0165	-0.0061		0.0149*
	(0.04)		(1.58)	(0.89)		(1.81)
Special Ed. Teacher						
1-2 Years of Experience		0.0187**	0.0192*		0.0436***	0.0116
		(2.23)	(1.66)		(3.50)	(1.11)
3-4 Years of Experience		0.0194*	0.0174		0.0339**	0.0054
		(1.92)	(1.31)		(2.41)	(0.45)

5-9 Years of Experience		0.0268***	0.0284**		0.0311**	0.0260**
		(2.77)	(2.29)		(2.43)	(2.31)
10-14 Years of Experience		0.0232**	0.0380***		0.0190	0.0246**
		(2.20)	(2.87)		(1.28)	(2.09)
15-24 Years of Experience		0.0298***	0.0255**		0.0319**	0.0219*
		(2.61)	(1.99)		(2.19)	(1.91)
25+ Years of Experience		0.0098	0.0102		0.0230	0.0027
		(0.77)	(0.69)		(1.22)	(0.21)
Sp. Ed. In-service Hours$_t$		0.0001	0.0002		-0.0000	-0.0000
		(0.39)	(1.29)		(0.05)	(0.07)
Sp. Ed. In-service Hours$_{t-1}$		-0.0001	0.0000		0.0000	-0.0000
		(0.72)	(0.06)		(0.18)	(0.25)
Sp. Ed. In-service Hours$_{t-2}$		-0.0002*	0.0001		-0.0002	0.0003**
		(1.69)	(0.99)		(1.32)	(2.14)
Sp. Ed. In-service Hours$_{t-3}$		0.0002	-0.0002		0.0001	-0.0001
		(1.56)	(0.99)		(0.30)	(1.14)
Advanced Degree		0.0103*	0.0101*		0.0128*	-0.0002
		(1.77)	(1.74)		(1.80)	(0.05)
Professional Certification		0.0074	0.0203*		0.0138	0.0082
		(0.84)	(1.78)		(1.02)	(0.83)
Sp. Ed. Certification		-0.0033	0.0166**		0.0233*	0.0261***
		(0.35)	(2.47)		(1.91)	(4.40)
Number of Observations	247,627	81,326	65,479	180,131	58,580	73,685
R-squared	0.179	0.319	0.205	0.161	0.174	0.149

Models include the following time varying student/class/school characteristics: number of schools attended by the student in the current year, "structural" move by student, "non-structural move" by student, indicators for race/ethnicity of student, gender, free-lunch status, limited-English proficiency, indicators for primary disability category, weighted class size, weighted fraction of classroom peers who are female, weighted fraction of classroom peers who are black, weighted fraction of classroom peers who are Hispanic, weighted average age (in months) of classroom peers, weighted fraction of classroom peers who changed schools, indicator for a new school, indicator for a new principal at a school, principal's years of administrative experience and principal's experience squared. All models also include grade-by-year indicators. * indicates statistical significance at the .10 level and ** indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test.

Table 4
Estimated Effects of Alternative Measures of Special Education Coursework on the Math and Reading Achievement Gains of Students with Disabilities in Florida by Course Taking Pattern, 1999/2000-2004/2005

	Math			Reading		
	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.
Full Sample						
Regular Ed. Teacher Special Ed. Certification	-0.0003 (0.04)		0.0165 (1.58)	-0.0061 (0.89)		0.0149* (1.81)
Special Ed. Teacher Special Ed. Certification		-0.0033 (0.35)	0.0166** (2.47)		0.0233* (1.91)	0.0261*** (4.40)
Sample with Collegiate Transcript Data						
Regular Ed. Teacher Special Ed. Certification	-0.0211 (1.46)		0.0278 (0.61)	-0.0542*** (3.11)		-0.0080 (0.22)
Special Ed. Teacher Special Ed. Certification		0.0023 (0.11)	0.0234 (0.92)		0.0581** (1.98)	0.0629*** (2.76)
Regular Ed. Teacher Exc. Child Ed. Credits	-0.0083** (2.57)		0.0027 (0.21)	-0.0058 (1.32)		-0.0060 (0.60)
Special Ed. Teacher Exc. Child Ed. Credits		0.0035 (0.99)	0.0106* (1.65)		0.0009 (0.22)	0.0129** (2.29)
Regular Ed. Teacher First BA - Special Ed.	-0.0257* (1.93)		-0.0010 (0.02)	-0.0380** (2.07)		-0.0439 (1.04)
Special Ed. Teacher First BA - Special Ed.		0.0006 (0.04)	0.0364 (1.31)		0.0189 (1.08)	0.0569** (2.35)
Regular Ed. Teacher Any BA - Special Ed.	-0.0276** (2.07)		-0.0110 (0.21)	-0.0383** (2.10)		-0.0486 (1.18)
Special Ed. Teacher Any BA - Special Ed.		-0.0043 (0.28)	0.0419 (1.59)		0.0147 (0.82)	0.0611*** (2.63)
Regular Ed. Teacher Adv. Deg. - Special Ed.	-0.0598 (1.50)		0.1190 (0.92)	0.0265 (0.82)		-0.1022 (1.23)
Special Ed. Teacher Adv. Deg. - Special Ed.		0.0919* (1.94)	0.0052 (0.05)		-0.1394*** (2.64)	0.0393 (0.46)

See notes to Table 4.

Table 5
Estimated Effects of Educational Attainment and Certification Status on the Math and Reading Achievement Gains of Students with Disabilities in Florida by Course Taking Pattern, 1999/2000-2004/2005

	Math			Reading		
	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.	Only Reg. Ed.	Only Sp. Ed.	Reg. Ed. & Sp. Ed.
			Full Sample			
Regular Ed. Teacher						
Advanced Degree	0.0101***		0.0037	-0.0040		0.0034
	(3.01)		(0.61)	(1.05)		(0.64)
Professional Certification	0.0154***		0.0090	0.0175***		0.0221**
	(3.14)		(0.80)	(2.90)		(2.20)
Sp. Ed. Certification	-0.0003		0.0165	-0.0061		0.0149*
	(0.04)		(1.58)	(0.89)		(1.81)
Special Ed. Teacher						
Advanced Degree		0.0103*	0.0101*		0.0128*	-0.0002
		(1.77)	(1.74)		(1.80)	(0.05)
Professional Certification		0.0074	0.0203*		0.0138	0.0082
		(0.84)	(1.78)		(1.02)	(0.83)
Sp. Ed. Certification		-0.0033	0.0166**		0.0233*	0.0261***
		(0.35)	(2.47)		(1.91)	(4.40)
Number of Observations	247,627	81,326	65,479	180,131	58,580	73,685
R-squared	0.179	0.319	0.205	0.161	0.174	0.149
			Specific Learning Disabled (SLD) Students			
Regular Ed. Teacher						
Advanced Degree	0.0103**		0.0005	-0.0069		0.0049
	(2.41)		(0.08)	(1.32)		(0.83)
Professional Certification	0.0096		0.0091	0.0190**		0.0268**
	(1.56)		(0.71)	(2.39)		(2.39)
Sp. Ed. Certification	-0.0003		0.0102	-0.0042		0.0121
	(0.04)		(0.90)	(0.46)		(1.33)

Special Ed. Teacher						
Advanced Degree		0.0156**	0.0102		0.0192**	-0.0014
		(2.28)	(1.60)		(2.23)	(0.24)
Professional Certification		-0.0026	0.0217*		0.0052	0.0021
		(0.24)	(1.67)		(0.32)	(0.19)
Sp. Ed. Certification		-0.0072	0.0216***		0.0277*	0.0290***
		(0.63)	(2.86)		(1.86)	(4.32)
Number of Observations	145,534	53,150	50,575	180,131	58,580	73,685
R-squared	0.195	0.333	0.206	0.161	0.174	0.149
			Non-SLD Students			
Regular Ed. Teacher						
Advanced Degree	0.0116***		0.0339**	0.0002		0.0098
	(2.61)		(2.43)	(0.05)		(0.78)
Professional Certification	0.0271***		0.0057	0.0173**		0.0084
	(3.80)		(0.24)	(2.05)		(0.37)
Sp. Ed. Certification	0.0050		0.0197	-0.0096		0.0228
	(0.59)		(0.90)	(1.03)		(1.23)
Special Ed. Teacher						
Advanced Degree		-0.0020	0.0220*		0.0003	0.0056
		(0.22)	(1.66)		(0.02)	(0.47)
Professional Certification		0.0274**	0.0226		0.0307*	0.0229
		(2.12)	(0.95)		(1.83)	(1.02)
Sp. Ed. Certification		0.0060	-0.0226		0.0159	0.0230*
		(0.43)	(1.43)		(0.91)	(1.67)
Number of Observations	98,238	27,488	11,428	78,518	21,494	12,462
R-squared	0.152	0.303	0.211	0.160	0.191	0.172
			Elementary School Students			
Regular Ed. Teacher						
Advanced Degree	0.0121**		0.0045	-0.0028		0.0119*
	(2.03)		(0.64)	(0.50)		(1.93)
Professional Certification	0.0296**		0.0217	0.0395***		0.0115
	(2.66)		(1.51)	(3.57)		(0.88)
Sp. Ed. Certification	-0.0059		0.0177	-0.0059		0.0086
	(0.54)		(1.32)	(0.56)		(0.80)

Special Ed. Teacher						
Advanced Degree		0.0259*	0.0056		0.0035	-0.0004
		(1.75)	(0.86)		(0.29)	(0.07)
Professional Certification		0.0183	0.0201		0.0181	0.0197
		(0.76)	(1.40)		(0.92)	(1.60)
Sp. Ed. Certification		0.0095	0.0176**		0.0048	0.0247***
		(0.32)	(2.33)		(0.22)	(3.60)
Number of Observations	71,830	17,781	53,025	65,255	16,726	55,402
R-squared	0.164	0.254	0.199	0.154	0.168	0.145
Non-Elementary School Students						
Regular Ed. Teacher						
Advanced Degree	0.0079*		0.0075	-0.0110**		-0.0255**
	(1.92)		(0.62)	(2.08)		(2.36)
Professional Certification	0.0152***		0.0012	0.0198***		0.0631**
	(2.70)		(0.06)	(2.62)		(3.76)
Sp. Ed. Certification	0.0024		-0.0009	-0.0054		-0.0051
	(0.32)		(0.05)	(0.57)		(0.35)
Special Ed. Teacher						
Advanced Degree		0.0087	0.0305**		0.0165*	0.0024
		(1.27)	(2.48)		(1.83)	(0.23)
Professional Certification		0.0050	0.0262		0.0166	-0.0166
		(0.53)	(1.47)		(1.01)	(1.60)
Sp. Ed. Certification		0.0002	0.0106		0.0221	0.0343***
		(0.02)	(0.75)		(1.52)	(2.80)
Number of Observations	175,794	63,481	12,430	114,865	41,791	18,265
R-squared	0.187	0.348	0.250	0.155	0.157	0.161

Models include the following time varying student/class/school characteristics: number of schools attended by the student in the current year, "structural" move by student, "non-structural move" by student, indicators for race/ethnicity of student, gender, free-lunch status, limited-English proficiency, indicators for primary disability category, weighted class size, weighted fraction of classroom peers who are female, weighted fraction of classroom peers who are black, weighted fraction of classroom peers who are Hispanic, weighted average age (in months) of classroom peers, weighted fraction of classroom peers who changed schools, indicator for a new school, indicator for a new principal at a school, principal's years of administrative experience and principal's experience squared. All models also include grade-by-year indicators. * indicates statistical significance at the .10 level and ** indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test.