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Do Principal Preparation Programs Influence Student Achievement Through the Building of Teacher-Team Qualifications by the Principal? An Exploratory Analysis

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Abstract

Purpose: The primary purpose of this study is to explore how the characteristics of the principal preparation programs of newly hired elementary school principals might influence school achievement through the development of well-qualified teams of teachers by the school. Of primary interest is whether elementary school principals from preparation programs with certain types of characteristics are more or less likely to build teams of well-qualified teachers who, in turn, positively affect overall student achievement. A secondary purpose is to establish a relationship between the overall school-level qualifications of teams of teachers and school-level student achievement on the Texas Assessment of Knowledge and Skills (TAKS) to underscore the importance of the first relationship.

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Research Design: This quantitative study utilizes ordinary least squares regression to analyze seven extracts of data from the Texas Education Agency, merged together to create a data set that matched teachers, principals, school characteristics, and student achievement to individual schools. First, the authors establish the relationship between school-level teacher-team quality and school-level student outcomes on the TAKS. Second, they examine the relationship between principal preparation program characteristics and the measures of teacher-team quality after controlling for principal characteristics, school characteristics, and student achievement. Furthermore, because the authors hypothesize that principals cannot quickly alter the quality of teams of teachers in schools, they examine school achievement and teacher-team quality over four years.

Keywords

principal, principal preparation, teacher quality, student achievement

At a time when expectations for accountability are increasing and policy makers are demanding research-based evidence that the work of teachers and leaders has a positive impact on schools and children, teacher effectiveness has become the primary focus. Most recently, U.S. Secretary of Education Arne Duncan has toured the country to underscore the critical link between teacher effectiveness and student achievement and to promote policies intended to improve teacher effectiveness. Concomitant with increased focus on teacher effectiveness is a call for examining the role that teacher preparation plays in preparing teachers to be effective (see Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2007, 2008), though much of the supporting research has focused on differences between the effectiveness of teachers from traditional preparation programs and those from alternative certification programs (see Darling-Hammond, Holtzman, Gatlin, & Vasquez-Heilig, 2005) rather than the actual experiences of prospective teachers in different types of programs.

Conspicuously absent among recent policy proposals to improve student achievement and increase teacher effectiveness, however, is an interest in the role of the principal in building and sustaining high-quality teams of teachers as well as the relationship between preparation and a principal's ability to support teacher effectiveness and student achievement. This absence is curious given contemporary views of school leadership's role in supporting student achievement (Leithwood & Jantzi, 2000). With the introduction of improved research designs and statistical methods, a growing body of empirical evidence demonstrates that principals have an important impact on schools,

teachers, and student achievement (Hallinger & Heck, 1998; Heck & Hallinger, 1999; Leithwood & Jantzi, 2000; Prestine & Nelson, 2005; Riehl, 2000; Waters, Marzano, & McNulty, 2003). Specifically, a growing number of researchers, such as Hallinger and Heck (1998), have found that principals indirectly influence student achievement through several key "avenues of influence": people, purposes, and goals of the school, structure of the school and social networks, and organizational culture (p. 171).

With respect to the influence principals have on the people working in their schools, research has indicated that effective school leaders hire, develop, and retain high-quality teachers (Papa, Lankford, & Wyckoff, 2002). Additional research has indicated that principals play a leading role in designing and supporting school social contexts that bolster professional learning (Goldring & Greenfield, 2002; Leithwood & Jantzi, 2008; Leithwood & Montgomery, 1984; Printy, 2008; Robinson, Lloyd, & Rowe, 2008; Rosenblum, Louis, & Rossmiller, 1994; Smylie & Hart, 1999), which has been associated with increased teacher retention (Ingersoll, 1999). Similarly, research conducted by the Center for Teaching Quality (Berry & Fuller, 2007a, 2007b, 2007c, 2008) indicated that principals can create positive working conditions that encourage teachers to remain at a school regardless of the student demographics or other factors often associated with high levels of teacher turnover.

Even within this growing body of research, little policy interest has focused on the principal. Even less policy attention has focused on understanding or supporting the relationship between preparation and principal outcomes, such as increased school-level teacher quality and improved student achievement. This lack of attention is mirrored by the research community. Although a growing number of studies have examined specific outcomes of principal preparation programs, including student achievement (Braun, Gable, & Kite, 2008), we could not find any that explicitly examined how principal preparation is related to student achievement as mediated through the qualifications of the team of teachers at a school.

In this study, we seek to gain a basic understanding of how principal preparation programs might affect student achievement through a principal's actions to improve the qualifications of his or her team of teachers at the campus. Little research has specifically examined the linkage between the characteristics of principal preparation programs and teacher quality, and we could not identify any studies that examined the relationship between principal preparation programs and teacher-team qualifications and student achievement. Thus, by exploring the relationships among principal preparation program characteristics, school-level teacher qualifications, and school-level student achievement, our research addresses a serious gap in the existing research literature.

In our effort to break new ground around the relationship between principal preparation characteristics and teacher-team quality, we begin with a review of relevant literature in four areas: teacher qualifications as they relate to student achievement, teacher selection, principal characteristics associated with building a high-quality teaching team, and principal preparation characteristics associated with principal behaviors around teacher quality and student achievement. Following this review, we overview key elements of our research project and then present our findings. We close with conclusions and implications for policy and further research.

Review of the Pertinent Literature

As with any thoughtful inquiry, the first challenge is to determine what exactly one is looking for. In our attempt to understand the role that principal preparation might play in a principal's ability to positively influence student achievement, it was important to also explore the variety of mediating factors involved in that relationship. Gaining such an understanding should shed light on a variety of questions concerning the development of quality leaders and point to further research along the lines of the specific ways preparation programs can influence student achievement. In the following subsections, we review research addressing the relationship among teacher qualifications and student achievement, the principal's role in selecting and retaining quality teachers, and principal characteristics that are associated with teacher quality and student achievement. Finally, we review some of the literature associating principal preparation programs to principal behavior, then link existing research to suggest that principal preparation programs could influence the ability of principals to improve achievement through the enhancing of the qualifications of the team of teachers at a school.

Defining Teacher Qualifications

A controversial aspect of studying the recruitment and selection of high-quality teachers is defining and measuring teacher quality. Traditionally, teacher qualifications such as undergraduate college, certification status, and experience have been used as proxies for teacher quality (Fabiano, 1999; Rowan, Chiang, & Miller, 1997). A more accurate method of defining teacher quality, though, is to directly assess the achievement gains of the students taught by the teacher. Consequently, a number of researchers have measured teaching quality by associating student value-added achievement gains with specific teachers over time and assigning teacher quality ratings as a function

of student outcomes (see Boyd, Goldhaber, Lankford, & Wyckoff, 2007; Hanushek, Kain, & Rivken, 2006; Sanders & Rivers, 1996). Such analyses, however, are problematic for a number of reasons. First, as an increasing number of researchers have concluded (c.f., Baker, Barton, Darling-Hammond, Haertel, Ladd, Linn, Ravitch, Rothstein, Shavelson, & Shepard, 2010; Rothstein, 2007, 2010; McCaffrey, Sass, Lockwood, & Mihaly, 2009; and, Sass, 2008), researchers simply have not yet developed a value-added system that accurately identifies effective and ineffective teachers. Second, such analyses are rather difficult to accomplish given current limitations of school and district management information systems, which often do not integrate student achievement and personnel data.

Various studies have attempted to identify which teacher qualities most influence student learning (as mediated effects on student learning). Typical measures include college degree, certification status, experience, and student achievement; researchers have considered content area and educational preparation, teachers' own test scores, and the quality of undergraduate and graduate institutions attended (Angrist & Guryan, 2003; Coleman, 1966; Ehrenberg & Brewer, 1995; Figlio, 2002; Kersting, 2008; Lankford, Loeb, & Wyckoff, 2002). Indeed, large-scale education policy studies tend to focus on the relationships between easily classifiable teacher qualifications—as a means of clarifying "inputs" through which principals and other educational leaders could improve student learning—and student outcomes.

Researchers have found consistent findings regarding particular characteristics of teachers that are positively associated with student gains in achievement. The two most consistent findings are (a) teachers' own prior test scores, especially those related to verbal ability (Coleman, 1966; Ehrenberg & Brewer, 1995) and (b) the selectivity or competitiveness of the undergraduate institution attended by the teacher (Angrist & Guryan, 2003; Ehrenberg & Brewer, 1994; Figlio, 2002; Lankford et al., 2002; Reback, 2002). Indeed, one might assume some overlap between these two characteristics—teachers from selective institutions tend to do well on tests of verbal ability.

A third characteristic associated with student achievement is a teacher's years of experience in education. Despite some disagreement about the relationship between teacher experience and student achievement, there is a growing consensus that novice teachers—and especially beginning teachers—are less effective than more experienced teachers in increasing student achievement (Boyd, Goldhaber, Lankford, & Wyckoff, 2007; Brewer & Goldhaber, 1996; Ehrenberg & Brewer, 1994; Ferguson, 1991; Murnane & Phillips, 1981; Rowan, Correnti, & Miller, 2002). Similarly, studies on teacher subject matter knowledge indicate that although there is a positive

relationship, it is not as strong as one might suspect (Wilson, Floden, & Ferrini-Mundy, 2001); it is most important in mathematics and science (Goldhaber & Brewer, 2000; Ladd, Clotfelter, & Vigdor, 2007, 2010; Rowan et al., 1997; Wenglinsky, 2002), and the effect is more pronounced for upper than lower grades (Rice, 2003; Ladd, Clotfelter, & Vigdor, 2007, 2010; Wayne & Youngs, 2009).

A fourth teacher characteristic related to student achievement is being certified in the area in which one teaches. A surprisingly small amount of research has examined this relationship (Darling-Hammond, Berry, & Thoreson, 2001). A handful of studies have found that students taught by certified teachers have greater levels and gains in achievement than their peers taught by uncertified teachers, particularly in mathematics, science, and reading (Alexander & Fuller, 2004; Boyd et al., 2007; Laczko-Kerr & Berliner, 2002; Ladd, Clotfelter, & Vigdor, 2007, 2010). Surprisingly, there are even fewer studies on the relationship between teachers being assigned in field and student achievement gains. The available research has suggested that in-field status is more closely associated with student achievement gains than certification status (Wilson, 2008). For example, Alexander and Fuller (2004) found that Texas middle school teachers assigned in field evidenced greater gains in student achievement than teachers assigned out of field. Moreover, the large effect size of their findings suggested that in-field status has a fairly substantial effect on student achievement.

Selecting Quality Teachers

The issue of teacher quality is integrally related to teacher selection because not all teachers entering the field are of equal quality (Guarino, Santibañez, & Daley, 2006). Although little research has specifically examined the linkage between principals' recruitment and retention efforts and teacher quality, Brewer (1993) used High School and Beyond data from the early 1980s to argue that principals could affect student achievement through their selection of teachers. Specifically, Brewer found,

> The greater the percentage of teachers appointed by a principal with high academic goals, the higher the student test score gains; the greater the percentage of teachers appointed by a principal with low academic goals, the lower are student test score gains. (p. 287)

Strauss (2003), using extensive records on Pennsylvania school administrators, asserted that "indirectly through the teacher hiring process, the nature of administrative choice can make a difference in student achievement" (p. 2).

Some researchers have hypothesized that the quality of the leader's academic background may influence his or her hiring decisions. Baker and Cooper (2005) found not only that less academically able principals were more likely to hire less academically able teachers but also that principals from more selective undergraduate institutions were more likely to hire teachers from more selective undergraduate institutions, suggesting that by placing more academically able leaders in principalship positions districts were more likely to see an increase in the hiring of more academically able teachers.

Principal Characteristics and Teacher Quality

Evidence suggests that school leadership is second only to classroom instruction in influencing student learning (Leithwood, Louis, Anderson, & Wahlstrom, 2004). Indeed, as noted by Angelle (2006), "As the organization's instructional leader, the principal is the primary source of assistance and monitoring" (p. 320). Research further suggests that principals influence teachers through direct and indirect actions and that these actions are informed by their professional backgrounds; their beliefs about leadership, teaching, and supervision; and their responses to district and state policies (Youngs, 2007).

There is significant research on the relationship between effective leadership practices and school improvement efforts and outcomes (Leithwood et al., 2004; Leithwood & Jantzi, 2005; Waters et al., 2003) and growing research on principals' practices that affect teacher development and teacher retention (Berry & Fuller, 2007a, 2007b, 2007c). Existing research has tended to focus on principal beliefs, behaviors, and skills rather than more quantifiable attributes. As Braun et al. (2008) note, relevant background experiences that have been used in analyses of the principal's impact on teachers include the principal's teaching experience, the nature of the principal's teacher and administrator preparation programs, and the principal's participation in professional development.

In an attempt to understand the relationships between principals' characteristics and student outcomes, Brewer (1993) measured the percentage of teachers hired by a particular principal with either high or low standards for measuring teacher quality. He found that student outcomes were better in schools where larger shares of teachers were hired by principals who held high academic standards as one primary goal for the school. Similarly, Baker and Cooper (2005) used national data from the Schools and Staffing Survey to explore the link between principals' background education and that of the teachers they hired. Using the selectivity of a principal's undergraduate institution as a proxy both for the individual ability of the principal and for teacher quality, they found that principals who attended more selective

undergraduate institutions were more likely to attract and hire teachers with similar backgrounds—even when employed in high-poverty schools. Taken together, the findings of Baker and Cooper (2005) and of Brewer (1993) suggest not only that a principal's educational background and ability influence his or her selection of teachers but also that the quality of a leader, as indicated by that leader's undergraduate institution, may be a key indicator of the quality of the team of teachers that the leader hires and develops.

Principal Preparation, Teacher Selection, and Teacher Qualifications

Applying the same logic, a leader's graduate education may play a similar role in signaling the quality of an educational leader and his or her ability to build and retain a high-quality teaching team. Although the body of literature on principal preparation programs has grown exponentially over the past decade, the vast majority of such studies lacks a theoretical perspective and fails to include any type of evidence about program efficacy (Smylie & Bennett, 2005). A great number of these studies, in fact, have focused on program content and processes without linking these to any type of important program outcomes.

Although the literature focused on quality preparation is in its infancy, studies increasingly are building a case that certain program attributes are associated with quality preparation as measured by actual outcomes, such as the behavior of principals (Darling-Hammond, LaPointe, Meyerson, Orr, & Cohen; 2007; Young, 2008; Young, Fuller, Brewer, Carpenter, & Mansfield, 2007; Young & Grogan, 2008). In addition, research has indicated that preparation programs located in doctoral and research institutions simply have more institutional capacity to prepare leaders effectively than other institutions (Baker, Orr, & Young, 2007). Furthermore, principals from preparation programs located at doctoral and research institutions were more likely to become employed as school leaders and had faster rates of career advancement than those from other preparation programs, suggesting differences in principal effectiveness (Fuller & Orr, 2006; Orr, 2011).

Taken together, these findings suggest that certain attributes of principal preparation programs may be critical antecedent influences on principals' effectiveness at improving student achievement through increasing the likelihood that their teachers will be well qualified. Thus, available research suggests a strong relationship between teacher qualifications and student achievement as well as a strong, though indirect, relationship among principals' practices,

teacher qualifications, and student achievement. As summarized above, research indicates that principals can influence student achievement by hiring teachers with high academic goals and by designing and fostering school contexts that support teacher professional learning and retention. Finally, taken as a whole, the research reviewed above suggests that principal preparation may be associated with principal behaviors related to the hiring of well-qualified teachers who, in turn, increase student achievement.

The Research Project

The existing literature provides discussions of the relationship among teacher preparation, teacher qualifications, and student achievement. Yet there has been little discussion of the relationships among principal preparation, school-level teacher-team qualifications, and student achievement. The purpose of this study is to develop a better understanding of the relationship between principal preparation and effective practice. Specifically, we are interested in understanding what program characteristics are positively associated with a principal's ability to develop a strong and effective cadre of stable teachers. Of course, the ultimate goal of developing such a group of teachers is to increase student achievement, which is why we first establish that our measure of school-level teacher-team quality is positively associated with student achievement.

Research Questions

In this study, we sought to answer the following two research questions:

1. What is the relationship between school-level measures of teacher-team quality and changes in school-level student achievement at the elementary school level after controlling for school characteristics, local labor market differences, and inclusion in the different cohorts?
2. What is the relationship between principal preparation program characteristics and changes in school-level teacher-team quality at the elementary school level after controlling for principal individual characteristics, school-level student demographics, school-level achievement, and the location of the local labor market?

We addressed these research questions through the use of state administrative databases from the Texas Education Agency (TEA) that capture principal

and teacher preparation programs, qualifications, and employment histories as well as a large volume of information on each school in the state that employs public school educators. The data and methodology employed in the study are described in more detail in the sections below.

Data Sources

This study relied on seven extracts of data from the TEA that were merged to create a data set in which teachers, principals, and school characteristics are matched to individual schools. One data set included information on principal personal characteristics, preparation program attended, experience as a K-12 educator, and state principal certification test scores. It included principal employment data for all Texas principals from 1995 to 2008. The data linked each school and its characteristics with a principal and provided the demographic characteristics of each principal (e.g., race/ethnicity, gender, and age). The second data set included principal certification data for all individuals obtaining principal certification after 1992. Specifically, this data set identified the preparation program from which the individual obtained certification.

The third set of data included the 1994 Carnegie classification for all university-based principal preparation programs. The 1994 Carnegie system is preferred for analysis purposes by most scholars of postsecondary institutional diversity because it is an indication of institutional purpose and resource capacity (Baker et al., 2007). As such, we did not use this classification as a direct measure of institutional quality, though Toutkoushian and Smart (2001) found that the Carnegie classification of an institution tends to have an important influence on student gains in learning and knowledge development, with these gains being highest in research and doctoral institutions.[1] Furthermore, as mentioned above, some research suggests that doctoral and research institutions have a greater capacity to prepare principals effectively and may be more effective because their graduates have greater placement and career advancement rates.

The fourth set of data included the certification scores for all teachers and administrators taking a certification examination since 1987. We used these data at the individual principal level and at the principal preparation program level. At the individual level, we used the data to identify individuals who failed the certification test on the first attempt as well as those individuals who scored in the top and bottom quintile of all test takers. At the preparation program level, we identified the percentage of graduates from each program with initial certification scores on the principal certification examination in the top and bottom quintile of all test takers.

The fifth data set included teacher employment data for all teachers in Texas public schools from 1995 to 2008. This data set linked teachers to the school or schools in which they were employed and also included teacher demographic characteristics (race/ethnicity, gender, and age).

The sixth data set included the certification status of each teacher in every Texas public school from 2003 to 2008. Specifically, the data set identified whether the individual holds full state certification and whether the individual holds full state certification in the subject to which he or she is assigned to teach. In this study, we used the percentage of core course teachers who were not fully certified to teach the subject they are assigned to teach in elementary schools. Although we investigated other teacher qualification measures such as the percentage of core course teachers in elementary schools who were not certified, percentage of core course teachers in elementary schools who were not assigned in field, and percentage of core course teachers in elementary schools with fewer than 5 years of experience, we found that our selected measure of teacher qualifications was most strongly associated with student achievement.

This measure needs further explanation as it served as the basis for answering one of the two research questions. First, core course teachers include those teachers assigned to teach reading, mathematics, science, social studies, or self-contained classrooms. Most elementary school teachers in Texas are designated as elementary self-contained, which simply means that they teach all core courses to the same group of students throughout the day. Second, to be fully certified, the teacher must hold a full state teaching certificate appropriate for both the school level at which the teacher is employed and the subject the teacher is assigned to teach. Teachers who are on a probationary certificate because they are enrolled in an alternative certification program and have yet to fulfill all the requirements to obtain full state certification are considered to be not fully certified. This is important because as many as 40% of teachers on probationary certificates fail to obtain their full state certificate. Similarly, a teacher who is on a 1-year certificate because of transferring to Texas from another state is considered to be not fully certified. Again, this is important because more than one third of such teachers never fulfill the requirements to obtain full state certification. In addition, a teacher who holds a full state certificate in a subject other than the one to which he or she is assigned to teach is considered to be not fully certified. Finally, a teacher who holds a full state certificate appropriate for a school level other than the one in which he or she is employed is considered not fully certified.

The school-level percentage of teachers designated as not fully certified was calculated through several steps. First, we identified only those teachers assigned to teach one of the four core course areas in a Texas public elementary school. Importantly, we used the full-time equivalent (FTE) of the assignment for each teacher. Thus, if a teacher was assigned to teach reading for one half of the day and music for the rest of the day, then that particular teacher was counted as only .50 FTE. Second, we summed all of the FTEs of teachers assigned to teach core course subjects at each individual campus. Third, we summed the FTEs of teachers determined by the state to be not fully certified at each elementary school. This determination was made by matching certificates to assignments to see whether the teacher's certificate matched the teacher's assignment. In the case where a teacher taught multiple subjects such as reading for .50 FTE and mathematics for .50 FTE across the entire school day (FTE = 1.0), the analysis matches all the teacher's certificates to all of his or her assignments. Thus, the teacher could be fully certified for both assignments and be considered fully certified for 1.0 FTEs. In this analysis, the teacher would contribute 0.0 FTEs to the school sum of the FTEs not fully certified because the teacher was fully certified for the entire 1.0 FTE. On the other hand, the teacher could hold only a reading certificate and not a math certificate. In such a case, the teacher would be considered fully certified in reading for .50 FTE and not fully certified for .50 FTE. Thus, the teacher would contribute .550 FTE to the school sum of teacher FTEs not fully certified. Finally, we divided the number of core course teacher FTEs not fully certified by the total number of core course teacher FTEs at each elementary school. We then multiplied by 100 to obtain the percentage of teacher FTEs not fully certified at each elementary school campus.

The final data set included the *z* scores of school-level scale scores in reading and mathematics at Grades 3, 4, and 5. The school-level scale scores were calculated by TEA by transforming the raw scores through a basic conversion. We used *z* scores because the Texas Assessment of Knowledge and Skills (TAKS) scale scores are not vertically aligned and thus are not comparable across grade levels. To calculate the overall school *z* score, we employed the following steps. First, using the school-level scale scores in reading and mathematics for each elementary school campus in the state for Grades 3 to 5, we calculated the *z* score for each subject area and grade level separately. So we calculated the *z* score for the Grade 3 reading test, the *z* score for the Grade 3 mathematics test, and so forth. We averaged the reading and mathematics *z* scores at each grade level and then averaged these grade-level *z* scores across the three grade levels. Thus, we arrived at a *z* score that reflected the level of student achievement in Grades 3 to 5. Importantly, we included

only schools with at least 30 students in each grade because schools with smaller numbers of students have a much greater degree of measurement error and variability than schools with at least 30 students in each grade level. The details of the TAKS, including scale scores, and the general testing program can be found at http://www.tea.state.tx.us under "Testing/Accountability."

All of these data sets were merged so that principals, teachers, and student achievement were linked at the school level for the 2003 to 2008 school years. Thus, for each public elementary school in Texas from 2003 to 2008, we were able to identify the characteristics of the principal, the preparation program characteristics of that principal, the qualifications of the team of teachers on that campus, the student demographics of that campus, the total enrollment of that campus, and the student achievement of that campus.

Sample

Because we wanted to examine the relationship between principal preparation programs on teacher-team characteristics, we chose to include only schools with an individual who had never been employed as a principal in a Texas public school and who had obtained principal certification between 1994 and 2002. Focusing on only beginning principals is important because the effect of preparation on a principal's behavior is likely to quickly fade as the person gains more on-the-job experience. Furthermore, the person must have become employed as a principal in one of three base years—2003, 2004, or 2005. Originally, we attempted to focus on all schools with new principals in 2003 and to examine the changes in school achievement and teacher-team attributes through 2008. However, the number of schools with beginning principals who stayed for all 6 years was far too small to allow us to fully explore relationships across all of our variables of interest. To increase the sample size, we reduced our time frame to 4 years and created three cohorts of beginning principals: (a) 2003–2006, (b) 2004–2007, and (c) 2005–2008. Because we wanted to examine the effect of principal preparation programs on principals' hiring over time, we selected the cohort for each school that included the longest principal tenure. So, for example, if a school had a principal stay for 2 years, 2002–2004, and another principal stay for 4 years, 2004–2008, we selected the 2004–2008 cohort.

We also removed from the data set those schools whose principals stayed fewer than 3 years. We removed these schools because principals need time to influence the qualifications of the team of teachers on their campuses. The three cohorts included a total of 806 unique elementary schools for both

regression analyses. Thus, the same set of schools was included for both analyses.

Before moving to a description of our data analysis, there are several important pieces of information to convey about leadership preparation programs in Texas. First, all programs must be approved and accredited by the state education agency. All programs are also subject to the Accountability System for Educator Preparation that holds all programs accountable for the certification exam scores of all graduates. Programs with passing rates less than 70% for all graduates and graduates from racial/ethnic subpopulations are put on probation, and the program can be terminated if passing rates continue to be lower than 70%.

Some selected characteristics of the preparation programs included in the study are shown in Table 1. These characteristics indicate the number of beginning principals included in the study from each program, the Carnegie classification of each program, principal certification exam outcomes, and the average number of graduates obtaining principal certification each year.

Data Analysis

Data were analyzed through a two-step process. First, we established the relationship between school-level teacher-team qualifications and school-level student outcomes. Second, we examined the relationship between principal attributes and the measures of teacher-team quality. Furthermore, because we hypothesized that principals cannot immediately alter the quality of teams of teachers in schools, we examined school achievement and teacher-team quality over a 4-year period.

We hypothesize that although principal preparation program characteristics directly influence principal behaviors, principal behaviors do not directly affect student achievement. Rather, principal behaviors indirectly influence student achievement through different avenues of influence, the most important being the recruitment, selection, and retention of a well-qualified team of teachers. Our hypothesis follows directly from the work of Brewer (1993)—that principals influence the quality of a school's team of teachers, which in turn affects student achievement. Given that the positive effects of recruiting high-quality teachers can be offset by increased teacher attrition rates (Boyd et al., 2007), we also examine school turnover rates along with aggregate measures of teacher quality. Finally, in our model we consider other influences on teacher qualifications and thus control for school characteristics (e.g., percentage of economically disadvantaged, Black, bilingual, and mobile

Table 1. Characteristics of Principal Preparation Programs Included in the Study

Program Number	Principals in Study	Carnegie Classification	% Pass Certification Exam	Bottom Quintile %	Prog.	Top Quintile %	Prog.	Above Avg. Pass Rate	Avg. Production
14503	7	Master's II	0.845	0.205	1	0.311	1	0	17.5
15502	6	Master's I	0.760	0.317	1	0.126	0	0	19.8
15504	10	Master's I	0.966	0.066	0	0.401	1	1	27.9
15505	13	Master's I	0.876	0.173	0	0.226	0	1	93.6
15950	4	Alternative	0.887	0.127	0	0.31	1	1	11
19502	10	Master's I	0.840	0.184	0	0.224	0	0	29.7
21501	5	Research I	0.943	0.086	0	0.328	1	1	37.9
22501	19	Master's I	0.786	0.285	1	0.154	0	0	90.2
31502	16	Master's I	0.706	0.363	1	0.135	0	0	63.6
57504	2	Master's I	0.874	0.132	0	0.253	0	0	33.1
61501	31	Doctoral I	0.921	0.126	0	0.276	0	1	164.3
61502	49	Doctoral I	0.845	0.2	1	0.22	0	0	155.5
68502	20	Master's I	0.854	0.171	0	0.247	0	0	45.9
71501	9	Master's I	0.801	0.241	1	0.177	0	0	85.1
72501	31	Master's I	0.870	0.167	0	0.257	0	0	155.2
95501	3	Baccalaureate	0.896	0.133	0	0.289	0	0	22.3
101502	29	Baccalaureate	0.915	0.103	0	0.301	1	1	117.5
101503	11	Doctoral II	0.598	0.475	1	0.066	0	0	76.5
101508	10	Master's I	0.894	0.142	0	0.303	1	0	43.5
101509	30	Master's I	0.835	0.19	0	0.223	0	0	170.4
101510	7	Master's I	0.912	0.123	0	0.245	0	0	15.6

(continued)

Table 1. (continued)

Program Number	Principals in Study	Carnegie Classification	% Pass Certification Exam	Bottom Quintile %	Prog.	Top Quintile %	Prog.	Above Avg. Pass Rate	Avg. Production
101950	3	Alternative	0.857	0.13	0	0.223	0	1	46.7
105501	33	Master's I	0.946	0.079	0	0.364	1	1	113.4
108501	46	Master's I	0.749	0.305	1	0.145	0	0	143.5
116501	66	Doctoral I	0.855	0.194	0	0.229	0	0	282.1
123501	13	Master's I	0.904	0.124	0	0.246	0	0	53.4
133501	2	Baccalaureate	0.821	0.207	1	0.262	0	0	15
137501	30	Master's I	0.709	0.363	1	0.111	0	0	146
152501	9	Research II	0.919	0.11	0	0.331	1	0	44.3
152502	4	Baccalaureate	0.874	0.148	0	0.238	0	1	25.9
161503	3	Doctoral II	0.926	0.107	0	0.322	1	0	9.4
174501	37	Master's I	0.842	0.212	1	0.213	0	1	231
178504	20	Master's I	0.824	0.237	1	0.194	0	0	73.9
178950	1	Alternative	0.796	0.231	1	0.237	0	0	20.8
191501	23	Master's I	0.898	0.133	0	0.249	0	0	76.4
212503	9	Master's I	0.903	0.129	0	0.307	1	1	46.7
220501	10	Doctoral II	0.858	0.181	0	0.238	0	0	35.1
220503	34	Doctoral I	0.873	0.16	0	0.231	0	1	125.9
220950	6	Alternative	0.915	0.102	0	0.299	1	1	39.5
221502	9	Master's I	0.881	0.17	0	0.247	0	0	18.3
226501	9	Master's I	0.895	0.148	0	0.293	0	0	30.4
227501	16	Research I	0.953	0.071	0	0.385	1	1	37

(continued)

Table 1. (continued)

Program Number	Principals in Study	Carnegie Classification	% Pass Certification Exam	Bottom Quintile %	Prog.	Top Quintile %	Prog.	Above Avg. Pass Rate	Avg. Production
227950	8	Alternative	0.931	0.089	0	0.342	1	1	27
232502	11	Master's 1	0.706	0.363	1	0.126	0	0	31.7
235502	15	Master's 1	0.869	0.157	0	0.242	0	0	80.6
236501	28	Master's 1	0.913	0.111	0	0.254	0	1	134.4
237501	20	Master's 1	0.672	0.388	1	0.118	0	0	195.9
240502	11	Master's 1	0.702	0.359	1	0.085	0	0	46.9
243501	8	Master's 1	0.896	0.131	0	0.265	0	0	26.5

students) that researchers have found to influence school measures of student achievement (see, e.g., Guarino et al., 2006).

As mentioned previously, we organize our analysis into two major parts. First, we examine the relationship between teacher-team characteristics and student achievement. Subsequently, we examine the relationship between principal attributes and the same teacher-team characteristics employed in the first part of the analysis.

In both analyses, we employ ordinary least squares (OLS) regression because we have aggregated all measures to the school level. Such aggregation can produce biased measures especially for our student value-added outcome measures (see Hanushek, Rivken, & Taylor, 1996). An alternative specification would apply multilevel or linear mixed models to more precisely estimate the influence of individual teachers selected by principals on the individual value-added outcomes of students assigned to those teachers. Yet even these methods can be significantly problematic for sorting out teacher effects and, subsequently, school and principal effects (Rothstein, 2007).

Furthermore, there are conceptual reasons for our aggregation of both student outcomes and teacher-team characteristics to the school level in this exploratory analysis. In this study, we focus on the school level rather than the student, teacher, or classroom level because the principal operates at the school level and controls the qualifications of the entire team of teachers hired and retained during that principal's tenure. Furthermore, state accountability systems, which may influence principals' leadership behaviors such as teacher hiring, evaluate school performance primarily via school aggregate measures of student outcomes. Our goal herein is to provide exploratory evaluation of these school aggregate relationships without yet disentangling the more specific processes by which these school aggregate effects may occur. Future analyses may focus on smaller subsets of schools within specific labor markets to determine specific teacher effects on individual student value added and whether the school aggregate of those specific effects is in part a function of principals' teacher hiring preferences and team building.

Changes in school-level achievement. In our first analysis, we utilize OLS to examine how school-level teacher-team qualifications and changes in these characteristics are associated with changes in school aggregate performance after controlling for school demographics, school characteristics, principal stability, location of the school in one of five major urban areas, inclusion in a particular cohort, and student achievement in the first year of the cohort. In this analysis, the dependent variable is the average z scores for the TAKS scale scores in reading and mathematics for all elementary school grade levels in the 4th year of the particular cohort. In our analysis, we control for a

host of school variables often found to have an impact on student achievement (Guarino et al., 2006). Specifically, we control for the percentage of economically disadvantaged, Black, bilingual, and mobile students as well as for the 4-year changes in these percentages. Also at the school level, we control for both the size of the school in the base year and the change in school size over the 4-year time period. We also include a binary variable that controls for whether or not a principal remained at the school for only 3 years rather than for the full 4 years. The teacher turnover rate and change in the teacher turnover rate are also included as control variables to rule out the effect of teacher turnover on student achievement. Because each local labor market is unique in terms of teacher supply, demand, and quality, we also control for a school being located in one of the six metro area local labor markets across the state. These six labor markets included more than 60% of all the schools in the final analysis. Finally, we control for whether a school was included in the 2004 or 2005 cohort as opposed to the 2003 cohort. Our variables of interest are the percentage of core course teacher FTEs not fully certified and the 4-year change in the percentage of core course teacher FTEs not fully certified.

To examine the relationship between teacher-team characteristics and student achievement, as described above, we estimate a series of regression models for the dependent variable of school aggregate test performance, controlling for prior level of student performance:

> Change in Student Performance = f (school characteristics, changes in school characteristics, teacher turnover rate, change in teacher turnover rate, labor market inclusion, cohort, percentage of core course teacher FTEs not fully certified, change in the percentage of core course teacher FTEs not fully certified, prior performance)

In other words, changes in student achievement are a function of school characteristics, teacher turnover rate, location of the school, first year of cohort, teacher qualifications, and prior levels of achievement.

The regression analysis was conducted in two ways. First, we placed all variables into the model simultaneously, thus allowing all variables to compete equally in explaining the variance in the dependent variable. Second, we entered the variables in blocks, with the last block including only our measure of teacher-team qualifications and the measure of prior achievement. There were no differences in the final regression coefficients or the variance explained by the model, thus we report only results from the first method.

Changes in teacher-team quality measures. The purpose of our second set of analyses is to examine the relationship between characteristics of principal preparation programs and teacher-team characteristics that are associated with improved student achievement. We examine this relationship using OLS regression analysis with the dependent variable as the percentage of core course teacher FTEs not fully certified in Year 4. We employ a number of control variables, including the percentage of economically disadvantaged students, bilingual students, Black students, and mobile students in Year 1. In addition, we include the 4-year changes for each of these measures. We also include a measure of student achievement—the average *z* scores for schools based on the scale scores for reading and mathematics for all elementary school grade levels in Year 1 as well as the change in this measure over 4 years. With respect to school location, we include a binary variable indicating whether a school was located in any one of the six metro areas of the state. Next, we include personal characteristics of principals by employing binary variables that indicate whether the principal was female and whether the principal was White. We also include other characteristics of the principal such as the number of years of education experience, age, and performance on the principal certification exam. Although we test all of these factors, not all of them are in the final model. We also control for whether the principal was at the school for 3 years rather than 4. Because the principals were from different cohorts, we include binary variables for the 2004 and 2005 cohort to control for time effects.

Finally, we examine a number of different characteristics of principal preparation programs, including the average number of graduates per year, the percentage of graduates not passing the state principal certification examination, the percentage of graduates scoring in the bottom quintile of all test takers on the state principal certification examination, the percentage of graduates scoring in the top quintile of all test takers on the state principal certification examination, above-average performing principal preparation programs based on certification test scores, affiliation with the University Council of Educational Administration, and the Carnegie classification of the university housing the preparation program. We chose the principal and principal preparation program characteristic variables based on our reading of the literature in this area that suggested such variables were or could be associated with the hiring outcomes of teachers (Baker & Cooper, 2005; Brewer, 1993).

Our OLS regression analyses were in the following form:

Change in Percentage of Core Course Teacher FTEs Not Fully Certified = f (school characteristics in Year 4, change in school

characteristics from Year 1 to Year 4, student achievement, principal characteristics, location in one of six metro areas, principal education experience, principal tenure principal preparation program characteristics, and initial level of teacher-team qualifications)

In other words, the change in the percentage of core course teacher FTEs not fully certified is a function of school characteristics, student achievement, principal characteristics, principal tenure, school location, principal preparation program characteristics, and the initial percentage of core course teacher FTEs not fully certified.

The regression analysis was conducted in two ways. First, we placed all variables into the model simultaneously, thus allowing all variables to compete equally in explaining the variance in the dependent variable. Second, we entered the variables in blocks, with the last block including only characteristics of principal preparation programs. There were no differences in the final regression coefficients or the variance explained by the model, thus we report only results from the first method.

Limitations

It is important to point out three important limitations to this research. First, definitions of teacher quality continue to be highly contested, especially at the elementary level. A number of researchers (see Hanushek, Kain, & Rivken, 1998, 2004) contend that certified elementary teachers are no more effective than uncertified elementary teachers. Much of this research, however, focused on the effect of individual teachers on student scores, whereas this study focuses on the overall qualifications of the team of teachers and overall student achievement of all students in the school. This is an important distinction because recent evidence suggests that effective teachers have a strong and lasting peer effect on the effectiveness of other teachers in the school (Jackson & Bruegmann, 2009). Furthermore, in the case of Hanushek's work in Texas, he and his colleagues employed only measures of full state certification rather than measures such as in-field assignment and not being fully certified. Regardless of the arguments made about the relationship between teacher qualifications and teacher effectiveness as defined by growth in student achievement, we find a statistically significant and negative relationship between the percentage of core course teacher FTEs not fully certified and gains in student achievement.

Second, our measures of principal preparation program quality are severely limited. We experimented with a number of variations of all the available measures. Yet almost all of our measures are based on the number of graduates, graduates' performance on the state certification examination, or the Carnegie classification of the college or university housing the preparation program. What we do not have is any indication of the actual content of the preparation program courses or any measures of the knowledge and skills taught in the principal preparation programs. Indeed, we do not even know whether the principal preparation programs included in the study even address the issues of teacher recruitment, selection, and retention. Thus, we acknowledge that our measures, especially when used alone, have limited predictive validity. But we do argue such measures serve as guideposts for future research to follow.

Finally, our outcome measure for growth in student learning relies on the *z* scores of the scale scores on a state-mandated test that is used to rate schools and often principals. Because these are high-stakes tests, there is the possibility of test score inflation. Ideally, we would include more accurate measures of achievement growth as well as multiple measures of growth, given that high-stakes test results are not always accurate indicators of student learning and standardized tests do not capture all of the student outcomes that educators and parents desire from their schools.

Findings

In our data analyses, we explored (a) the relationship between school-level measures of teacher-team quality and changes in school-level student achievement at the elementary school level, after controlling for school characteristics, local labor market differences, and inclusion in the different cohorts, and (b) the relationship between principal preparation program characteristics and changes in school-level teacher-team quality at the elementary school level, controlling for individual principal characteristics, school-level student demographics, school-level achievement, and the location of the local labor market. We organize the presentation of our findings around these overarching questions.

School-Level Teacher-Team Qualifications and Student Achievement

In addressing the first question, we designed our analyses to examine the relationship between the change in the percentage of core course teacher

Table 2. Variable Names and Descriptions Employed in Regression 1

Variable	Description
Change: Avg. TAKS *z* scores	Change in the average *z* scores of the TAKS reading and mathematics scale scores in Grades 3, 4, and 5; described above
Avg. TAKS *z* scores (Yr. 1)	Average *z* scores of the TAKS reading and mathematics scale scores in Grades 3, 4, and 5 in Yr. 1
Avg. TAKS *z* scores (Yr. 4)	Average *z* scores of the TAKS reading and mathematics scale scores in Grades 3, 4, and 5 in Yr. 1
% Eco Disadv Students (Yr. 1)	% of economically disadvantaged students; calculated by the number of students eligible for the free or reduced-price lunch program divided by the number of total students
Change: % Eco Disadv Students	Change in the % economically disadvantaged students: Yr. 4—Yr. 1
% Black Students (Yr. 1)	Calculated by number of Black students in the school divided by total school enrollment
Change: % Black Students	Change in the % Black students: Yr. 4—Yr. 1
% Mobile Students (Yr. 1)	Calculated by number of students moving out of or into the school after October 31, divided by total school enrollment
Change: % Mobile Students	Change in the % mobile students: Yr. 4—Yr. 1
% Bilingual Education Students (Yr. 1)	% Black students; calculated by the number of Black students in the school divided by total school enrollment
Change: % Bilingual Education Students	Change in the % bilingual education students: Yr. 4—Yr. 1
School Size (Yr. 1)	Total school enrollment in Yr. 1 as of October 31
Change: School Size	Change in the total school enrollment: Yr. 4—Yr. 1
Teacher Turnover Rate (Yr. 1)	Calculated by the number of teacher FTEs not returning to a school divided by the total number of teacher FTEs employed by the school originally

(continued)

Table 2. (continued)

Variable	Description
Change: Teacher Turnover Rate	Change in the teacher turnover rate: Yr. 4—Yr. 1
% Teachers Not Fully Certified (Yr. 1)	% of core course teacher FTEs not fully certified as described above
Change: % Teachers Not Fully Certified	Change in the % of core course teacher FTEs not fully certified: Yr. 4—Yr. 1
Principal Tenure: 3 Years	Binary variable indicating if the principal stayed only 3 years
School in Metro Area	School was located in one of six major metro area: Austin, Dallas, El Paso, Fort Worth, Houston, or San Antonio; coded as 1, all other schools coded as 0
Inclusion in 2004 Cohort	School was included in the 2004 cohort, so base year is 2004; coded as 1, all other principals coded as 0
Inclusion in 2005 Cohort	School was included in the 2005 cohort, so base year is 2005; coded as 1, all other principals coded as 0

TAKS = Texas Assessment of Knowledge and Skills; FTE = full-time equivalent.

Table 3. Means and Standard Deviations for Variables Employed in Regression 1

Variable	*M*	*SD*
Change: Avg. TAKS *z* scores	0.022	0.477
Avg. TAKS *z* scores (Yr. 1)	−0.042	0.905
Avg. TAKS *z* scores (Yr. 4)	−0.019	0.894
% Eco Dis Students (Yr. 1)	59.15	28.51
Change: % Eco Dis Students (Yr. 4—Yr. 1)	2.60	6.99
% Black Students (Yr. 1)	13.26	17.94
Change: % Black Students (Yr. 4—Yr. 1)	0.15	4.06
% Mobile Students (Yr. 1)	19.04	7.25
Change: % Mobile Students (Yr. 4—Yr. 1)	0.48	4.60
% Bilingual Education Students (Yr. 1)	19.51	20.17
Change: % Bilingual Education Students (Yr. 4—Yr. 1)	2.27	6.13
School Size (Yr. 1)	569.71	198.67
Change: School Size (Yr. 4—Yr. 1)	10.56	103.36

(continued)

Table 3. (continued)

Variable	*M*	*SD*
Teacher Turnover Rate (Yr. 1)	21.88	12.34
Change: Teacher Turnover Rate (Yr. 4—Yr. 1)	−3.94	14.29
Principal Tenure: 3 Years	0.187	0.390
School in Metro Area	0.606	0.489
Inclusion in 2004 Cohort	0.322	0.467
Inclusion in 2005 Cohort	0.356	0.479
% Tchr FTEs Not Fully Certified (Yr. 1)	7.61	9.99
Change: % Tchr FTEs Not Fully Certified (Yr. 4—Yr. 1)	−2.54	9.60

N = 806.

FTEs not fully certified and the change in student achievement from Year 1 to Year 4. The variable names and descriptions are included in Table 2, whereas the means and standard deviations of the variables employed in the analysis are presented in Table 3.

The results for the OLS regression analysis are shown in Table 4. As mentioned previously, the dependent variable in the analysis is change in the average *z* score for the TAKS reading and mathematics scale scores across 3rd, 4th, and 5th grades from Year 1 to Year 4.

Our model explained about 22% of the variance in the change in average TAKS reading and mathematics *z* scores that are based on scale scores. Although a number of variables other than the academic achievement in the base year are statistically significant, the majority of the variance explained by the model is because of prior achievement. Of the 10 school characteristics, 5 are statistically significantly associated, with both the percentage of economically disadvantaged students in the school in Year 1 and the change in the percentage of economically disadvantaged students over the 4 years statistically significantly and negatively related to increases in student achievement. The effects of both variables were rather strong. This is in concert with almost every other research study that has examined student achievement and the percentage of economically disadvantaged students.

Both the initial percentage of Black students and the change in the percentage of Black students over the 4 years are also statistically significantly and negatively related to changes in student achievement. These findings are not quite as strong as the finding for economically disadvantaged students. In addition, the percentage of bilingual education students in Year 1 is statistically significantly related to the change in student achievement, and the relationship is negative.

Table 4. Ordinary Least Squares Regression Results for Regression 1

	Unstandardized Coefficients		Standardized Coefficients		
Variable	*B*	*SE*	β	*t*	*p* value
(Constant)	0.661	0.099		6.688	.000
% Eco Disadv Students (Yr. 1)	−0.010	0.001	−.614	−8.723	.000
Change: % Eco Disadv Students	−0.012	0.002	−.181	−5.096	.000
% Black Students (Yr. 1)	−0.002	0.001	−.089	−2.092	.037
Change: % Black Students	−0.009	0.004	−.079	−2.179	.030
% Mobile Students (Yr. 1)	−0.002	0.003	−.026	−0.572	.568
Change: % Mobile Students	−0.007	0.004	−.069	−1.895	.058
% Bilingual Education Students (Yr. 1)	0.003	0.001	.104	2.038	.042
Change: % Bilingual Education Students	0.002	0.003	.028	0.746	.456
School Size (Yr. 1)	0.000	0.000	.034	0.899	.369
Change: School Size	0.000	0.000	−.050	−1.489	.137
Teacher Turnover Rate (Yr. 1)	0.001	0.002	.015	0.278	.781
Change: Teacher Turnover Rate	−0.001	0.002	−.022	−0.429	.668
Principal Tenure: 3 Years	−0.066	0.038	−.055	−1.753	.080
School in Metro Area	0.009	0.035	.009	0.245	.806
Inclusion in 2004 Cohort	0.006	0.037	.006	0.171	.865
Inclusion in 2005 Cohort	−0.033	0.036	−.034	−0.916	.360
% Teacher FTEs Not Fully Certified (Yr. 1)	−0.009	0.003	−.186	−3.554	.000

(continued)

Table 4. (continued)

Variable	Unstandardized Coefficients		Standardized Coefficients		
	B	*SE*	β	*t*	*p* value
Change: % Teachers Not Fully Certified	−0.005	0.002	−.099	−2.137	.033
Avg. TAKS *z* scores (Yr. 1)	−0.401	0.029	−.774	−13.895	.000

N = 806. Dependent variable: change in average TAKS reading and mathematics *z* scores in Grades 3, 4, and 5.

The average TAKS *z* scores in Year 1 is strongly and negatively associated with the change in average TAKS *z* scores. This factor has, by far, the strongest association with the change in student achievement of all variables in the model.

Of most interest to this study is the relationship between the teacher-team qualifications and the change in student achievement. The OLS regression results show that both the initial percentage of core course teacher FTEs not fully certified and the change in the percentage of core course teacher FTEs not fully certified are statistically significantly and negatively associated with changes in the average TAKS *z* scores. Most important to this study is the finding that the actual change in the percentage of core course teacher FTEs not fully certified is negatively associated with changes in student achievement. Because this study includes only schools that had the same principal for at least 3 of the 4 years, this finding suggests that principals positively influence changes in student achievement by increasing the qualifications of the team of teachers on their campus. Clearly, however, some principals are able to improve the teacher-team qualifications more than other principals. Thus, the question becomes, what factors are associated with changes in the teacher-team qualifications at a school over time? This question is addressed in Regression 2.

Principal Preparation Program Characteristics and Teacher-Team Qualifications

Our second research question explores the relationship among principal preparation program characteristics, school demographics, school characteristics, principal characteristics, and changes in the qualifications of the team of teachers in a school.

Table 5. Variable Names and Descriptions Employed in Regression 2

Variable	Description
Prin: Female	Principal is female (1 = *female*, 0 = *not female*)
Prin: White	Principal is White (1 = *White*, 0 = *not White*)
Prin: Education Experience	Years of experience in all education roles
Carnegie Classification: Research/ Doctoral	Carnegie classification of undergraduate program of college or university housing the principal preparation program is research or doctoral; programs meeting this designation were coded as 1, all others coded as 0
Carnegie Classification: Regional	Carnegie classification of undergraduate program of college or university housing the principal preparation program is master's university or college; these are regional institutions; programs meeting this designation were coded as 1, all others coded as 0

The variable names and descriptions included in Regression 2 but not Regression 1 are listed in Table 5. In addition, Table 6 includes the names and descriptions of all of the principal characteristics and principal preparation program characteristics employed in our analyses, including those not included in the final model. Table 7 includes the means and standard deviations for all of the variables included in the final model.

As with the previous section, we employ OLS regression analyses—in this case to examine the relationships among principal preparation program characteristics, school demographics, school characteristics, principal characteristics, and changes in the qualifications of the team of teachers in a school. To reiterate how we developed this model, our decisions to include particular variables were driven by variables suggested by previous research on the relationship between principals and teacher qualifications. In particular, the studies by Baker and Cooper (2005) and Brewer (1993) informed our decisions to include particular variables, although other research informed the development of the theoretical relationship between principal preparation programs and the qualifications of teachers hired by principals. We explored a large combination of variables, and the combination included in the final model explained the largest percentage of the variance in the change in the percentage of core course teacher FTEs not fully certified.

Table 6. Variable Names and Descriptions for Principal and Principal Preparation Program Characteristics

Variable	Description
Prin: Female	Principal is female (1 = *female*, 0 = *male*)
Prin: Hispanic	Principal is Hispanic (1 = *Hispanic*, 0 = *mot Hispanic*)
Prin: Black	Principal is Black (1 = *Black*, 0 = *not Black*)
Prin: White	Principal is White (1 = *White*, 0 = *not White*)
Prin: Age	Age of principal at time of first employment
Prin: Education Experience	Tears of experience in all education roles
Prin: Years Teaching in Texas	Number of years teaching in Texas public schools from 1995 to 2003
Prin: Bottom Quintile on Cert Exam	Principal scored in the bottom quintile of all test takers on the certification exam
Prin: Bottom Quintile on Cert Exam	Principal scored in the top quintile of all test takers on the certification exam
Prep Prog: % Passing Cert Exam	Percentage of graduates who passed the state certification exam on the first attempt
Prep Prog: % Graduates Scoring in Bottom Quintile	Percentage of graduates who scored in the bottom quintile of all test takers on the state principal certification exam on their first attempt
Prep Prog: % Graduates Scoring in Top Quintile	Percentage of graduates who scored in the top quintile of all test takers on the state principal certification exam on their first attempt
Prep Program: > 20% of Graduates Scored in Bottom Quintile	Percentage of graduates who scored in the bottom quintile of all test takers exceeded 20%; programs meeting this criterion were coded as 1, all other programs were coded as 0
Prep Program: > 30% of Graduates Scored in Top Quintile	Percentage of graduates who scored in the top quintile of all test takers exceeded 30%; programs meeting this criterion were coded as 1, all other programs was coded as 0

(continued)

Table 6. (continued)

Variable	Description
Prep Prog: High-Performing Pass Rate	Principal preparation program performed statistically significantly greater than other programs on the state certification exam; programs meeting this criterion were coded as 1, all other programs was coded as 0
Prep Prog: Avg. Total Production Per Year	Total graduates from 1994 to 2003 divided by 10
UCEA	Preparation program is affiliated with the University Council for Educational Administration; coded as 1, others coded 0
Carnegie Classification: Research/Doctoral	Carnegie classification of undergraduate program of college or university housing the principal preparation program is research or doctoral; coded as 1, others as 0
Carnegie Classification: Regional	Carnegie classification of undergraduate program of college or university housing the principal preparation program is master's university or college; these are regional institutions; coded as 1, others as 0

Table 7. Means and Standard Deviations for Variables Employed in Regression 2

Variable	*M*	*SD*
% Eco Disadv Students (Yr. 1)	59.53	28.49
Change: % Eco Disadv Students	2.49	7.04
% Black Students (Yr. 1)	13.29	18.15
Change: % Black Students	0.13	4.04
% Mobile Students (Yr. 1)	19.75	20.37
Change: % Mobile Students	2.18	6.03
% Bilingual Education Students (Yr. 1)	18.98	7.22
Change: % Bilingual Education Students	0.50	4.60
Avg. TAKS z scores in reading and math (Yr. 4)	−0.046	0.910

(continued)

Table 7. (continued)

Variable	*M*	*SD*
School located metro area	0.596	0.491
Prin: Female	0.784	0.412
Prin: White	0.679	0.467
Prin: Education Experience	15.41	6.57
Principal Tenure: Three Years	0.190	0.392
% Teacher FTEs Not Fully Certified (Yr. 1)	7.72	10.15
Cohort 2004	0.325	0.469
Cohort 2005	0.361	0.481
Carnegie Classification: Research/Doctoral	0.290	0.453

N = 806.

Overall, the final model explained 53% of the variance in the change. Not surprisingly, the majority of the variance was explained by the percentage of core course teacher FTEs not fully certified in Year 1. A shown in Table 8, three of the eight school characteristics are statistically significantly associated with the change in the percentage of core course teacher FTEs not fully certified. Specifically, both the percentages of Black and mobile students as well as the change in the percentage of mobile students are statistically significantly and positively associated with the change in the percentage of core course teacher FTEs not fully certified. In other words, these variables are associated with increases—or at least smaller decreases—in the percentage of core course teacher FTEs not fully certified. Unexpectedly, neither the average *z* scores of the TAKS reading and mathematics scores nor the changes in the average *z* scores are statistically significantly related to the change in the percentage of core course teacher FTEs not fully certified. However, if a *p* value of .10 were employed as the decision point for statistical significance, both variables would be statistically significant and negatively related to the percentage of core course teacher FTEs not fully certified. It certainly makes sense that higher achieving schools are able to attract teachers with better qualifications and reduce the overall percentage of teacher FTEs not fully certified.

Only one of the individual characteristics of principals is statistically significantly related to the change in the percentage of core course teacher FTEs not fully certified after controlling for other factors. Specifically, female principals are positively associated with the change in the percentage of core course teacher FTEs not fully certified. None of the other principal characteristics are statistically significantly associated with the change in the percentage

Table 8. Ordinary Least Squared Regression Results for Regression 2

	Unstandardized Coefficients		Standardized Coefficients		
Variable	*B*	*SE*	β	*t*	*p* value
(Constant)	2.660	1.602		1.660	.097
% Eco Disadv Students (Yr. 1)	−0.032	0.020	−.093	−1.576	.115
Change: % Eco Disadv Students	−0.009	0.039	−.007	−0.232	.817
% Black Students (Yr. 1)	0.090	0.018	.174	5.099	.000
Change: % Black Students	0.068	0.068	.029	1.009	.313
% Mobile Students (Yr. 1)	0.071	0.019	.145	3.713	.000
Change: % Mobile Students	0.117	0.047	.073	2.503	.013
% Bilingual Education Students (Yr. 1)	−0.027	0.047	−.021	−0.585	.559
Change: % Bilingual Education Students	0.035	0.061	.017	0.575	.565
Avg. TAKS z scores in rdg and math (Yr. 1)	−0.927	0.522	−.088	−1.775	.076
Change in average TAKS z scores	−1.117	0.575	−.056	−1.943	.052
School located metro area	−0.301	0.569	−.016	−0.529	.597
Prin: Female	1.191	0.606	.051	1.967	.050
Prin: White	0.226	0.605	.011	0.374	.709
Prin: Education Experience	−0.020	0.038	−.014	−0.530	.596
Principal Tenure: Three Years	0.350	0.613	.014	0.572	.568
% Teacher FTEs Not Fully Certified (Yr. 1)	−0.774	0.029	−.791	−27.103	.000
Cohort 2004	−0.581	0.617	−.029	−0.942	.347
Cohort 2005	0.299	0.601	.015	0.498	.619
Carnegie Classification: Research/Doctoral	−1.831	0.583	−.086	−3.141	.002

N = 806. Dependent variable: change in the percentage of core course teacher full-time equivalents not fully certified.

of core course teacher FTEs not fully certified, regardless of whether or not the characteristic is included in the final model.

This study focuses on the characteristics of principal preparation programs; thus, the most pertinent finding is that schools with principals whose principal preparation program was housed at colleges or universities designated as research or doctoral institutions according to the 1994 Carnegie classification system were statistically significantly and negatively associated with the change in the percentage of core course teacher FTEs not fully certified. In other words, as compared to principals from preparation programs housed in colleges and universities with other Carnegie classifications, principals from those programs designated as research or doctoral institutions are associated with a greater decrease in the percentage of core course teacher FTEs not fully certified. The only other principal preparation program characteristic associated with the overall qualifications of the team of teachers at a campus is whether the preparation program was housed at a college or university with a Carnegie classification of master's university or college. Specifically, principals from preparation programs located at these regional colleges and universities were positively associated with the percentage of core course teacher FTEs not fully certified. Thus, principals from such programs were more likely to increase the percentage of underqualified teachers, thus reducing the overall qualifications of the team of teachers on their campus. These two Carnegie classification groupings included 95% of all the principals in the study; thus, the two findings are actually signaling the same effect.

Discussion

Our research builds on the growing understanding of the relationship between principal preparation programs and behaviors of building principals from those programs. Unlike other research, however, this study examines the relationship between principal preparation programs and student achievement by preparing principals to build well-qualified teams of teachers.

First, the results of this study suggest that the overall qualifications of teachers on a campus are statistically significantly associated with gains in student achievement. Indeed, as the qualifications of the teachers on a campus increase, so too does the student achievement on the campus. This finding is consistent with a growing body of research that concludes teacher quality is the most important school-factor related to student achievement. Moreover, this finding suggests a way principal preparation programs can more directly influence student achievement—namely, preparing principals to recruit, select, and retain well-qualified teachers to increase the overall qualifications of the team of teachers on campus.

More interesting are the results for the second half of the study. These results suggest that principals prepared by programs housed at research and doctoral institutions are more effective than principals prepared by programs housed at regional institutions in improving the overall qualifications of the team of teachers on a campus. Importantly, this result holds after controlling for a host of school characteristics, school location, principal tenure, and principal characteristics variables. We, in fact, controlled for several important principal characteristics that could explain the result for the Carnegie classification of the institution housing the preparation program.

Specifically, we investigated whether the Carnegie research or doctoral classification finding simply signaled that principals from programs housed at research or doctoral institutions were of greater ability as measured by whether an individual passed the principal certification exam on his or her first attempt or scored in the top quintile of all test takers on the principal certification exam. Inclusion of both of these variables, however, did not change the findings for the Carnegie classification of the institution housing the preparation program. In fact, neither variable had a statistically significant relationship with teacher-team qualifications nor affected the effect of the other variables in the model, regardless of whether they were entered into the equation alone or in combination with other variables.

In addition, we investigated whether the Carnegie classification of the institution housing the preparation program was simply a proxy for the percentage of a preparation program's graduates passing the principal certification exam or scoring in ether the bottom quintile or the top quintile of all test takers on the principal certification exam. To do so, we entered into the equation variables that reflected the percentage of a preparation program's graduates who passed the principal certification test on their first attempt, scored in the bottom quintile of all test takers on the principal certification exam, and scored in the top quintile of all test takers on the principal certification exam. We entered these variables individually into the model both with and without the Carnegie classification variable of the institution housing the preparation program. None of the three variables were statistically significant, and none of them affected the coefficients or statistical significance of the Carnegie classification of the institution housing the preparation program.

We also explored the effect of the inclusion of three binary variables related to the performance of graduates from principal preparation programs on the principal certification exam. The first variable indicated whether the principal preparation program had greater than 20% of graduates who scored in the bottom quintile of all test takers on the principal certification exam. The second variable indicated whether a preparation program had greater than 30% of

graduates who scored in the top quintile of all test takers on the principal certification exam. The final variable indicated whether a preparation program had principal preparation scores greater than the average preparation program after controlling for the race/ethnicity, gender, age, and teacher certification exam scores of graduates. Again, we entered these variables into the model individually and both with and without the variable indicating the Carnegie classification of the institution housing the principal preparation program. Again, none of these three variables were statistically significantly related to teacher-team qualifications, nor did any of them affect the coefficients or statistical significance of the variable indicating the Carnegie classification of the institution housing the principal preparation program.

Finally, because Baker and Cooper (2005) found that the Carnegie classification of the *undergraduate* institution of the principal influenced the qualifications of the teachers hired by the principal, we explored whether the Carnegie classification of the institution housing the principal preparation program simply served as a proxy for the Carnegie classification of the undergraduate institution attended by the individual. Although we did not have data on the undergraduate institution attended, we had access to data on the teacher preparation program attended. Of the 806 principals in the final model, almost 76% attended a teacher preparation program with a Carnegie classification. The other principals attended teacher preparation programs out of state, obtained teacher certification prior to 1993, or attended an alternative certification program. We included various Carnegie classifications and groupings of the Carnegie classifications of the teacher preparation programs attended by principals in the model, both with and without the Carnegie classification of institution housing the principal preparation program. Of the various individual Carnegie classifications and groupings of the classifications included in the models, none of them were statistically significant, nor did any affect the statistical significance of the Carnegie classification of the institution housing the principal preparation program. Thus, the results suggest that the individual ability level of the principal as measured by attendance at a more selective teacher preparation program was not a factor underlying the statistically significant relationship between the Carnegie classification of the institution housing the principal preparation program and improvements in teacher-team qualifications.

In sum, the findings suggest that the Carnegie classification of the institution housing the principal preparation program was not simply a proxy for principals' abilities as measured by certification test performance or attendance at more selective teacher preparation programs or a proxy for the abilities of the graduates of programs as measured by performance on the principal

certification exam. Thus, we believe the results suggest some type of programmatic or resource availability effect of the preparation programs housed by research and doctoral institutions. Unfortunately, however, the data do not allow us to directly test this belief. This is an area certainly ripe for further exploration using detailed data on the program content and processes of preparation programs, especially those related to training and experiences around the management of personnel. Our results complement the growing body of evidence demonstrating that principals have an important impact on schools, teachers, and student achievement (Hallinger & Heck, 1998; Heck & Hallinger, 1999; Leithwood & Jantzi, 2000; Prestine & Nelson, 2005; Riehl, 2000; Waters et al., 2003).

Conclusions and Implications

Through this study we sought to develop a better understanding of the role that principal preparation programs play in influencing student achievement by preparing principals to strengthen the overall qualifications of the team of teachers at a campus. Although we were unable to directly test whether certain program content or experiences were related to principals' abilities to increase student achievement through improving teacher qualifications, we were able to find an association between principals who attended principal preparation programs housed at research and doctoral institutions and improvements in the qualifications of the team of teachers. This finding lends support to the growing body of research documenting relationships between preparation program features and graduates' learning and intermediate career outcomes (Darling-Hammond, 2005; Orr, 2011). Although we believe the results suggest some possible programmatic or resource-availability effect at the preparation program level that influences principals' abilities to improve overall teacher-team qualifications, we simply do not have the data to make a definitive conclusion about this at this time. All we can state is that there is an association, but we cannot clearly determine what is causing the association.

The analyses presented in this article are preliminary in nature, and much more work needs to be undertaken to fully understand the relationship between teacher-team quality and student achievement and the relationship among principal preparation programs, principal characteristics, school characteristics, and teacher-team quality. More specifically, we believe far more research should focus on the link between leadership preparation and practice in an effort to better understand the features of leadership preparation that most powerfully support quality leadership practice. Although a strong research

focus on quality preparation was absent for many years in our field, the growing body of research is increasing understanding of the relationship between preparation and practice (Leithwood, Jantzi, Coffin, & Wilson, 1996), the kinds of program attributes that are associated with quality preparation (Darling-Hammond et al., 2005; Young, 2008; Young et al., 2007; Young & Grogan, 2008), the impact that institutional capacity and mission may have on preparation quality (Baker et al., 2007), and the impact that different types of graduate institutions have on a principal career advancement and effectiveness (Orr, 2011).

We also believe that far more attention should be focused on the attributes and capacities of school leaders to create and sustain teams of high-quality teachers capable of driving high levels of student achievement. As noted, our measures of principal quality and principal preparation quality in this study are limited. Over time, efforts must be made to develop more robust indicators of principal quality and preparation quality that better capture an indication of actual leadership behaviors of the principals and measures of the knowledge and skills taught in principal preparation programs. Regardless of their limitations, our analyses do serve as indicators of the pathways that future research should investigate.

These findings are crucial for policy debates about whether graduate leadership preparation matters. The results show that where leaders are prepared makes a difference in their impact on teacher qualifications and student achievement. This builds on the work of Baker and Cooper (2005) and Brewer (1993) suggesting not only that principals' educational background and ability are important in their selection of teachers but also that the quality of these leaders, as indicated by their undergraduate institution, may be a key indicator of the quality of the team of teachers who they hire and develop. Our research indicates that a leader's graduate education may play a similar role in signaling the quality of an educational leader and ability to build a high-quality teaching team.

Future investigations with the Texas micro data will explore in much greater detail how the school-level composition of teacher-team changes under stable versus less stable principal leadership and under the leadership of principals with varied educational and experiential backgrounds. Future analyses also will attempt to construct alternative measures of school aggregate performance and will propose alternative measures of teacher-team composition and principal quality. This study provides a possible methodology for replication and further consideration of how to investigate these relationships. Future research, on the Texas micro data and data from other states, is needed, however, to confirm and extend these findings.

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The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

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Note

1. Baker, Orr, and Young (2007) also pointed out that the classification system's hierarchical method for categorizing the "comprehensiveness" and research emphasis of postsecondary institutions reflects differences in institutional program diversity and resources. Although comprehensiveness and research capacity do not provide a pure measure of quality, they do indicate what an organization is potentially capable of achieving, particularly with regard to graduate education.

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