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The Effect of Teacher Quality on Student Achievement in Urban Schools: A Multilevel Analysis

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The Effect of Teacher Quality on Student Achievement in Urban Schools: A Multilevel Analysis

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The No Child Left Behind Act recognizes the importance of quality teachers in improving student achievement in that it mandates that all students have to be taught by "a highly qualified teacher". The increasing demand for highly qualified teachers has led to a shortage of qualified teachers. A closer look at urban areas reveals that the problem is more severe in those localities than the national average. In order to address the teacher shortage problem in urban areas, more than 40 states initiated an alternative certification route for candidates who hold a bachelor's degree (Darling-Hammond, 2000; Heilig, Cole, & Springel, 2011), although teachers' certification or licensing status play an important role in differentiating teacher quality.

The purpose of this study was to examine how high quality teachers are distributed across a large, urban district in Texas according to student's characteristics, school characteristics and student achievement. In addition, more importantly, this study explored how teacher's quality influences student achievement and, more specifically, on achievement of students with limited English proficiency (LEP). Due to the differences of characteristics in student characteristics and a school system, elementary schools and middle schools were separated in the analyses.

Southeast Independent School District (SISD), which is a major urban district in Texas with large shares of minority and low-income students, was chosen. Student data utilized in this analysis came from the Public Education Information Management System (PEIMS), which is data collection and reporting system produced by the Texas Education Agency (TEA) for the public schools of Texas. SISD provided individual level teacher's data, students' data, and a matching file so that teacher's and their students' data could be linked. All data that SISD provided are protected by using masked identification. To address the research questions, the study involved three statistical approaches – descriptive analysis, Analysis of variance (ANOVA) and three-level hierarchical linear models (HLM).

Results from ANOVA indicated unequal distribution of high quality teachers across an urban school district. Economically disadvantaged students, minority students, and students with limited English proficiency were more likely to be allocated to alternatively certified teachers. It implies that students with economically and socially disadvantaged backgrounds lose a chance to have fully-certified or highly qualified teachers. The test scores of students who had fully-certified teachers were higher than the test scores of under-certified teachers' or alternatively-certified teachers' students. Campus accountability ratings were also significantly lower for schools that had more Teach for America (TFA) teachers than schools that had more fully-certified teachers.

There were also clear distinctions among teacher's qualifications, student characteristics, and school conditions between elementary schools and middle schools. There were more alternative certified teachers and less fully-certified teachers in middle schools. Middle schools served a higher percentage of students that are economically disadvantaged, at-risk of dropping out, were LEP, and Hispanic. The average campus accountability rating was also lower in middle schools than elementary schools. Overall,

school conditions in middle schools were more inferior than in elementary schools among urban schools in Texas.

In order to explain the effect of teacher quality besides student's characteristics on student performance, a multilevel analysis was necessary to explain each variance of students, teachers, and schools. Through multilevel analyses (or three-level hierarchical linear modeling (HLM)), I confirmed that student background or ability was the strongest predictor of student achievement as many previous studies have found. However, HLM results also showed that teacher's and school's effects on student achievement were not negligible based on their proportions of variances. It implied that student achievement could be differentiated by teacher's quality or school's characteristics.

Among variables regarding teacher qualifications, the fully-certified teacher variable was a solely significant and positive factor of student achievement in middle schools. That is, students who had fully-certified teachers were more likely to achieve higher test scores than those who had under-certified and alternatively certified teachers after controlling all variables. However, in elementary schools that had 95 percent of fully-certified teachers did not show the significant differences of student achievement by teacher's qualifications. The years of teaching experience and teacher educational attainment was not significant factors to explain student performance.

Among school-level predictors, campus accountability ranking was a positively significant factor to predict student achievement in both elementary schools and middle schools. The percentage of economically disadvantaged students in campus was negatively associated with student achievement in middle schools.

Since the study focused on reading achievement, the effect of teacher's quality on the achievement of LEP students was particularly concerning. To address research questions, an interaction effect between teacher certification status and the achievement

of LEP students was added on the multilevel model. Results from the analysis showed that after accounting all variables LEP students who had fully-certified teachers achieved 0.1 scores higher on the TAKS reading test in the middle schools. Considering that LEP students typically achieved lower than their peers, the results implied that fully-certified teachers mitigate the effect of LEP on TAKS reading. The finding showed a positive effect of fully-certified teachers for students in need and corresponded with previous studies that high quality teachers played a more important role for socially and economically disadvantaged students.

To sum up, this study found that teacher quality is a significant factor to predict student achievement, yet highly qualified teachers are unequally distributed across an urban school district. Socially and economically disadvantaged students were less likely to be taught by fully-certified teachers and were more likely to be taught by alternatively certified teachers. Furthermore, their achievement was significantly lower than their peers who were taught by highly qualified teachers. These aspects were more noticeable in middle schools.

Key words: Teacher quality, teacher qualifications, student achievement, multilevel analysis

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Chapter 1: Introduction

Since the enactment of the No Child Left Behind Act of 2001 (NCLB), the educational accountability movement has been sweeping the American education system with the objective of holding all public schools accountable for their students' academic achievement. With a growing emphasis on students' academic performance, a corresponding increase in attention is being given to the importance and need for high quality teachers, because an effective teacher is the most influential factor on student achievement in school level (Darling-Hammond, 2000; Darling-Hammond & Baratz-Snowden, 2005; Hanushek & Rivkin, 2004; Hanushek & Rivkin, 2010; Rivkin, Hanushek, & Kain, 2005). Well-prepared high quality teachers are important for all students, but especially for students who are in high-need schools with a large portion of economically disadvantaged and low-performing students (Darling-Hammond & Berry, 2006).

Indeed, NCLB recognizes the importance of quality teachers in improving student achievement in that it mandates that all students have to be taught by "a highly qualified teacher" (NCLB, 2001; The Secretary of Education, 2005). Moreover, the Obama Administration has invested $4.35 billion to reward the accomplishments of effective teachers under the Race to the Top program to improve teacher and principal effectiveness (U.S. Department of Education, 2011). As a concern regarding a high quality teacher increases, related questions, such as the definition, their distribution and the effect of teacher quality on student achievement, have been raised.

UNEQUAL DISTRIBUTION OF HIGH QUALITY TEACHERS

A school's ability to retain high quality teachers significantly influences the level of student achievement in the school (Hanushek, Kain, O'Brien, & Rivkin, 2005). The

persistent shortage of high-quality teachers, needless to say, has been a major obstacle that threatens the quality of education and student achievement. The shortage of fully certified teachers in mathematics, science, and special education has been a chronic problem in the United States (Boe, Cook, & Sunderland, 2006). Moreover, the increasing demand for qualified teachers under NCLB has led to a shortage of qualified teachers nationwide. School staffing problems have been not only due to a shortage in the number of teachers, but also to an insufficient supply of highly qualified teachers (Ingersoll, 2001). Approximately one-third of retiring teachers have left school for non-retirement reasons such as poor working conditions, job dissatisfaction, insufficient compensation, and so on (Ingersoll, 2002). According to Ingersoll (Ingersoll, 2002), the supply of teachers has adequately met the demand, but the shortage problem exists "under the working conditions offered in the specific locations – in the cities (p. 6)."

In the United States, an uneven distribution of high quality teachers has existed. A closer look at urban areas reveals that the problem has been more severe in those localities than the national average. The best-qualified teachers typically have been recruited by better-funded districts, offered higher salaries and afforded better working conditions, which are mostly located in suburban areas. Therefore, urban schools have had a more difficult time recruiting and retaining quality teachers compared to affluent suburban schools with predominantly White students (Borman & Dowling, 2008; Boyd, Lankford, Loeb, Ronfeldt, & Wyckoff, 2010; Hanushek, Kain, & Rivkin, 2004). Indeed, prior studies showed that poor students and minority students in urban schools are most likely to be assigned low-quality teachers (Clotfelter, Ladd, & Vigdor, 2007; Darling-Hammond, 2002; Hanushek & Rivkin, 2007). This unequal distribution of qualified teachers exacerbates the disparity in the opportunities students have to learn from highly qualified teachers between poor urban schools and wealthy suburban schools which

retain a higher percentage of quality teachers (Boyd et al., 2009; Jacob, 2007). This negatively affects the students' academic performance in urban schools that predominantly serve students of color and students in poverty and leads to the school to being a low-ranked accountability campus. As a result, there have been large achievement gaps on standardized tests between students in urban schools and their suburban counterparts (Diamond & Spillane, 2004; Jacob, 2007; Lankford, Loeb, & Wyckoff, 2002; New Leaders for New Schools, 2008).

A bigger problem has been that the lower performance level of urban schools can compel high quality teachers to leave urban districts under the test-based accountability system (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Feng, Figlio, & Sass, 2010; Jacob, 2007; Nichols & Berliner, 2007). Feng et al. (2010) found that teachers were more or less likely to move by school accountability grades in Florida. More effective teachers tend to move to higher achieving schools, while less effective teachers stay in lower-performing schools. Many researchers are concerned that the test-based accountability system has placed additional pressure on teachers, leading to higher teacher turnover in low-performing schools (Feng, et al., 2010; Lee, 2008; Nichols & Berliner, 2007). Thus, low-performing schools have had difficulty attracting highly qualified teachers and finding quality teachers to staff low-performing schools has been a persistent challenge to schools and districts (Boyd, et al., 2009; Boyd, Lankford, Loeb, & Wyckoff, 2008; Burns, 2001; Eller, Doerfler, & Meier, 2000; Hanushek, et al., 2004; Watson, 2001). Specifically, according to Lee (2008), in states that adopted more rigorous test-based accountability systems that emphasizes rewards and sanctions based on student test scores, teachers who graduated from highly competitive colleges and who teach mathematics and science were more likely to leave low-performing schools than other teachers. Considering that high transition rates are strongly correlated with low student

achievement, maintaining stability in high quality teachers' retention rates is an essential factor for improving student achievement in low-performing schools. Overall, the problem has been not only a looming teacher shortage, but rather a shortage of quality teachers in the schools and communities where they are needed the most (Hanushek, et al., 2004; Ingersoll, 2002, 2003).

STATEMENT OF THE PROBLEM

Similar to other states, Texas has faced a growing shortage of qualified teachers, especially within urban school districts (Eller, et al., 2000; Herbert & Ramsay, 2004; The State Board for Educator Certification [SBEC], n.d.-b; U.S. Department of Education, 2010). In 2004, it was reported that nearly 37,000 Texas teachers retire each year or leave schools for other careers (Texas Comptroller of Public Accounts, 2004). Coupled with the states' rapid population growth and subsequent increase in student enrollment, the severity of Texas' teacher shortage is magnified in recent decades (Burns, 2001; Eller et al., 2000; Fuller, 2002). In addition, as mentioned above, since NCLB requires highly qualified teachers in all core subjects, the shortage of highly qualified teachers has been relatively more severe than before implementing NCLB (Herbert & Ramsay, 2004).

Texas has put forth an enormous effort to deal with chronic teacher shortages in core subject areas[1] such as Mathematics, Science, and Special Education (Texas Education Agency, 2011b). In order to increase teacher supply, a growing number of teachers who were accredited through Alternative Certification Programs (ACP) were employed in public schools in Texas (The State Board for Educator Certification [SBEC], n.d.-a). More than 12,000 teachers from ACPs were employed to public schools in Texas

1 TEA announced that the five subject areas that have teacher shortages include: Bilingual Education, Mathematics, Science, Spanish as a Foreign Language, and Special Education for the 2011-2012 school year (Texas Education Agency, 2011b).

in 2009, while only 8,000 ACP teachers were employed in 2005 (SBEC, n.d.–b). For example, for the 2010-2011 school year, among all the states in the nation, Texas had the largest number of Teach for America (TFA) corps, which is one of the most popular alternative teacher preparation programs, with 650 new teachers out of the approximately 4,500 incoming TFA teachers nationwide (Gastrock, 2010, May 24). Rider 84 of the General Appropriations Act of the 81st Texas Legislature supported to expand the number of TFA teachers in Texas, and appropriated $4 million to the program for each fiscal year, beginning in the 2009-2010 school year (Ware et al., 2011). The total number of TFA corps in Texas has been growing since its inception in 1991 and now exceeds 1,000 in Texas schools (Ware, et al., 2011).

As a result, teachers trained from ACPs have occupied a large portion of the teacher population in Texas. While the expansion of ACPs has been considered as the most effective solution to address teacher shortage issues in highest need schools (Raymond, Fletcher, & Luque, 2001), the relatively short preparation time required of ACP teachers has presented a question as to whether the preparation is adequate to properly qualify teachers. ACPs have provided alternatives to the traditional four-year university-based programs for teacher certification, targeting individuals who already hold a bachelor's degree. Education service centers, school districts and other entities offer training, from short summer programs to one- or two-year post-baccalaureate programs (Darling-Hammond, Chung, & Frelow, 2002).Many of those programs can be completed in one year until that time trainees have a paid teaching position in a public school classroom (SBEC, n.d.-b).

Whereas a large number of ACP teachers have been committed to public schools, there is no information as to whether they fill the insufficient number of teaching workforce in high- needs schools and whether they contribute to improving student

achievement in Texas public schools. Moreover, ACP teachers' staying power in the teaching profession is questionable. Previous studies have shown that teachers certified by alternative programs are more likely to leave the teaching profession than those traditionally trained at a university. For instance, the attrition rate of TFA teachers is approximately eighty percent or more by their fourth year of teaching in Houston, Texas (Heilig, et al., 2011; Raymond, et al., 2001). As mentioned earlier, the teacher shortage problem needs to be understood as a problem of shortages of qualified teachers as they are related to specific locations and working conditions. In spite of the importance of retaining high quality teachers on improving student performance, little attention has been given to the effect of teacher quality on student achievement especially within urban context in Texas.

PURPOSE OF THIS STUDY

While teacher quality, teacher shortage, and student achievement are concerns at the national and state level, this study is limited to a particular focus on teacher quality in a large urban school district located in Southeast Texas. According to the NCLB Act highly qualified teachers refers to teachers who hold at least a bachelor's degree, are fully certified to teach, and have demonstrated competency in their core academic subject areas (NCLB Act, 2001). Besides teacher qualifications defining NCLB, this study assumed that teacher preparation programs, such as formal university-based education programs or alternative preparation programs, influence high quality teachers. The definitions will be examined further in the later section in this chapter. This study also explored differences in elementary schools and middle schools due to its distinctive characteristics.

To understand the distribution of high quality teachers and the impact of teacher quality on student achievement, I posed the following research questions:

1. How are high quality teachers distributed across a large, urban district according to student's characteristics, school characteristics and student achievement in elementary schools and middle schools?
2. How does teacher's quality influence student achievement in urban elementary schools and middle schools?
3. How does teacher's quality influence the achievement of students with limited English proficiency in urban elementary schools and middle schools?

SIGNIFICANCE OF THE STUDY

Despite the growth in research concerning teacher quality or teacher effectiveness, there is a lack of research specific to the distribution and the effect of high quality teachers in urban districts in Texas. In addition to the contextual constraints as outlined previously, the state of Texas has recently experienced a serious budget crisis and consequent reduction in education funds. Many school districts in Texas have been forced to reduce the number of teachers due to budget constraints (Weber, 2011, September 29), thus the issue of retaining high quality teachers has been more pertinent than ever, especially in areas that have traditionally dealt with teacher shortages, such as disadvantaged urban districts. Studying the specificities of the Texas case will add important knowledge that may help other states and urban school districts struggling with similar issues.

In spite of the importance, some limitations of past research include a lack of a primary focus on the distribution of high quality teachers and effect of teacher quality on student achievement. In addition, previous research on teacher quality or effectiveness

only analyzed data in a simple linear fashion using outdated data from the 1990s (Burns, 2001; Herbert & Ramsay, 2004), so that they did not reflect the recent trend of the impact of student performance within the test-based accountability system in an urban context in Texas. This study adopted a multilevel model instead of a simple linear model so that the errors could be minimized.

Additionally, previous studies on teacher quality have paid little attention to the comparative analysis between elementary schools and middle schools regardless of its distinctive characteristics by school levels. Thus, this study provided comparative analysis how the distribution of high quality teachers and the effect of teacher quality on student performance is different between elementary schools and middle schools regarding.

Because of the large impact and emphasis on student achievement under the test-based accountability system in the NCLB era, investigating the effect of high quality teachers and the consequences of student achievement is extremely important. Moreover, little attention has been given to studying the distribution of student demographic characteristics, campus characteristics and student achievement by teacher's qualifications in urban schools in Texas. This study not only informed research and debate on this issue statewide, but also created a model that can be replicated by researchers to further study. This research also informed the policy debate and deliberation in this regard by providing data-rich information specific to Texas. The intention of this research was to contribute to the efforts of school administrators, policymakers, and researchers as they work to develop better education policy and support students and teachers in high-needs schools.

ASSUMPTIONS AND LIMITATIONS

The assumptions of this study include:

1. The chosen urban district reflects typical urban districts' characteristics in Texas.
2. The variables and data utilized in this study were measured consistently and accurately across all of the campuses in a given district.

This study was limited by the following:

This study had the general limitations of using value-added measures. First, although standardized tests are imperfect measures of student learning, they are the objective measurable learning indicator to date. Thus, this study also utilized gains in students' standardized test scores as a measure of teacher quality just as other value-added model do.

Only one urban district was selected for this study. Even though the district was a representative location intended to show a typical urban districts' characteristics in Texas, the data may have had a potential bias because of the districts' own uniqueness. However, the large volume of student and teacher data allowed me to generalize the results to overcome the limitation.

Texas Public Education Information Management System (PEIMS) records provided by the Texas Education Agency (TEA) were the primary source of data in this study. Thus, only variables available through the PEIMS data sets were utilized and controlled for this study. This study did not include data from private school systems in Texas. In addition, although previous research showed that internal factors, such as teacher job satisfaction, school climate, and level of job autonomy, predict teacher turnover intention (Cha, 2008; Song, Martens, McCharen, & Ausburn, 2010), these factors were not included in the study. There was also no information regarding family

structure, spouse's salary, and living location, which are possible influential elements of teacher turnover decision. These factors, thus, were excluded in the quantitative analytical model based on the limited data available.

DEFINITION OF KEY TERMS

This section defines key terms that directly relate to the research questions in this study. These terms will be used throughout the research.

Teacher qualifications are basic elements to be a teacher and include education, degree earned, licensing, and certification area. These are measurable characteristics that are typically considered when hiring teachers. Teacher quality is more complex concept than teacher qualifications, because it is difficult to observe and measure it including teacher's level of commitment to teaching, teachers' sense of efficacy, the quality of teaching, and so on (Lewis et al., 1999; Skaalvik & Skaalvik, 2010).

Certified teachers indicate teachers who have earned credentials from the government, a higher education institutions or a private source. However, there are many kinds of certifications, such as standard, professional, out-of-state certificates, provisional, temporary, probationary, temporary, and so on. Therefore, this study classified certified teachers into three categories of fully-certified, under-certified, and alternatively certified.

Fully-certified teachers include teachers who hold professional, standard, and out of state certifications. Under-certified teachers are defined as teachers who are probationary, temporary, emergency certified, and nonrenewal permitted. Alternatively certified teachers are defined teachers from alternative certification programs such as Teach for America (TFA).

Highly qualified teachers refers to teachers who hold at least a bachelor's degree, are fully certified to teach, and have demonstrated competency in their core academic subject areas according to the NCLB Act (NCLB Act, 2001). However, this study differentiated "highly qualified teachers" from "high quality teachers." Besides teacher qualifications defining NCLB, this study utilized teacher's experience of teaching, education level, and a type of preparation programs in order to define high quality teachers.

SUMMARY

In conclusion, this chapter provided an introduction and overview of the current research project regarding the importance of teacher quality and the shortage of high quality teachers in urban schools. In the next chapter, prior research that investigated contributing factors of teacher quality and teacher turnover in an urban setting is summarized. Then, the debate concerning the extent teacher quality has been influenced by student achievement is explored along with the question of why high quality teachers leave urban schools. In chapter 3, the research design for this study is explained, including three statistical approaches to address the research questions. Chapter 4 reports study results for SISD. Finally, Chapter 5 summarizes findings and discusses their implications for policy, theory, and research.

Chapter 2: Literature Review and Conceptual Framework

In this chapter, I review theoretical and empirical studies that inform the present study. This study is designed to explain what factors influence a teacher's decision to stay or leave the school among high quality teachers. I review influential factors of high quality teachers and of teacher turnover, respectively. This chapter has four major sections: (1) the issues of teacher quality, (2) a review of the contributing factors of high quality teachers, (3) theories related to teacher quality, and (4) a conceptual framework. The first two sections explain in greater detail previous empirical studies and variables related to teacher quality. This review of the literature intertwined with theories on teacher quality in the third section, then, serves as a conceptual framework that guides the research questions and drives the methodology for this study.

The first section includes the issues of definitions of high quality teachers and measuring teacher quality. The second section provides a review of the contributing factors of high quality teachers. Determinants of teacher effectiveness are associated with student achievement and teacher characteristics. Teacher characteristics involve teacher's demographic background, teachers' certification status, preparation programs, years of education, and years of teaching experience. Working conditions include community type, teacher salary and compensation, school accountability rankings, the percentage of socially and economically disadvantaged students in campus, and so on. A review of the literature shows that in addition to student, teacher, and district characteristics, current high-stakes accountability systems is one of the most important variables for increasing the turnover rate of high quality teachers in low-performing schools.

The third section in this chapter includes a review of theories related to teacher quality and teacher turnover. The human capital theory, the professional capital theory,

Chapman's teacher attrition model, and Billingsley's teacher career decision's model provide theoretical foundations for this study. Lastly, the fourth section includes a conceptual framework based on previous empirical studies and theories of teacher quality.

DEFINING HIGH QUALITY TEACHERS

While the importance of securing a high quality teacher in schools is undisputed, there has not been agreement on defining high quality teachers, because teacher quality is difficult to observe and much of the impact is indirect (Darling-Hammond & Berry, 2006; Hanushek & Rivkin, 2006). One explanation for the lack of a simple definition of what makes a high quality teacher is that teacher quality is determined by a complex relationship among many factors, including the quality of teacher preparation programs and teacher's certification status (Ballou & Podgursky, 2000; Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005; Laczko-Kerr & Berliner, 2002; Ware, et al., 2011), teacher's education and experiences (Hanushek & Rivkin, 2006), teacher's level of commitment to teaching and teachers' self-efficacy (Skaalvik & Skaalvik, 2010), assigned students' prior and present achievement levels and a school's working conditions (Hanushek & Rivkin, 2007; Newton, Darling-Hammond, Haertel, & Thomas, 2010; Rivkin, et al., 2005). This complexity explains why the term of "highly qualified teacher" defined by NCLB does not convey the same meaning as "high quality teacher".

NCLB defines highly qualified teacher as a teacher who holds at least a bachelor's degree, has obtained full State certification (including certification obtained through alternative routes) or passed the State teacher licensing examination, and has demonstrated competency in the core academic subjects he or she teaches (NCLB, 2001). However, the definition does not clearly characterize highly qualified teacher, but

ambiguously lists some fundamental requirements to be a teacher. This ambiguity became an issue in the *Renee v. Duncan* (2010) in California. The plaintiffs claimed that intern teachers in training and teachers who are certified in alternative-route programs are considered "highly qualified" under NCLB. The court ruled that they cannot be labeled "highly qualified" and California needs to re-write legislation labeling these teachers as "highly qualified." However, this question of whether the fulfillment of these qualifications directly translates to high quality or effective teaching still remains in other states.

MEASURING TEACHER QUALITY

Measuring teacher quality has been a second controversial issue. While many states have adopted a teacher evaluation policy and attempted to measure teacher quality or teacher effectiveness, due to the multitude of factors involved in determining teacher quality, measuring teacher quality is also difficult and complicated. Some researchers criticize the trend that teacher quality is measured only by quantitative methods and insist the necessity of qualitative research to better understand teacher quality in a particular context (Kennedy, 2008). While qualitative research helps to clarify and supplement quantitative findings, it also has limitations in that the data do not represent a large population and cause a validity concern, because it usually focuses on a particular context with a smaller sample size than that of quantitative research.

In empirical studies, teacher quality is typically measured by quantifying student performance on standardized tests (Buddin, 2010; Newton, et al., 2010). However, some scholars have questioned the validity of using only students' test scores to measure teacher quality, because student achievement is influenced by a host of factors such as students' demographic and socioeconomic characteristics, parental education and

language background, community environment, and other elements (Darling-Hammond, 2000; Loeb, Knapp, & Elfers, 2008). Therefore, more sophisticated forms of measurement tools are required to disentangle teacher effects from those of other uncontrolled factors associated with assigned student's characteristics and environmental factors (Newton, et al., 2010).

To solve this measurement controversy, one method that has proven to be viable is value-added modeling (VAM), which isolates teacher and school effects from students' characteristics and gauges teacher quality based on year-to-year gains that teachers produce in terms of student test scores (Hanushek & Rivkin, 2010; McCaffrey, Lockwood, Koretz, Louis, & Hamilton, 2004; Newton, et al., 2010). Considering that student learning is conceptualized in the current policy climate as gains made on standardized tests, along with the fact that teachers accumulate experience over the course of a career (Darling-Hammond, 2000), the VAM is considered a more precise method for measuring teacher quality because it reflects students' and teachers' changes in effectiveness over time (Buddin, 2010; McCaffrey, et al., 2004). Along with the development of this model, more states have moved toward value-added methods in teacher evaluations with observations (Sawchuk, 2011, January).

The VAM certainly has some limitations in that measurable variables are only used to estimate teacher quality in spite of its several unquantifiable elements, and many other factors determine student academic achievement (Hanushek & Rivkin, 2010; McCaffrey, et al., 2004; Newton, et al., 2010). Additionally, the consistency of teacher effectiveness rankings over time is inconclusive (Sass, 2008). Despite the ongoing debates about VAM, many studies adopt it to estimate teacher quality because it is the most reliable version of measurement for teacher quality currently available (Buddin, 2010; McCaffrey, et al., 2004; Newton, et al., 2010).

In order to estimate teacher quality or teacher effectiveness using the VAM, using variables are limited to quantifiable factors, while there are many unquantifiable predictors to explain teacher quality (Darling-Hammond, 2000; Hanushek & Rivkin, 2010; Laczko-Kerr & Berliner, 2002). Student test scores usually serve as an outcome variable of teacher effectiveness or teacher quality (Hanushek & Rivkin, 2010; Newton, et al., 2010). Measurable teacher factors, including teacher's demographic characteristics, teacher preparation program, certification, teaching experiences, and obtained degrees, are used to explain teacher quality in the model, and variables related to school context are also contained in the model to control contextual effects (Hanushek & Rivkin, 2010; Newton, et al., 2010).

More specifically, among teacher factors, certification or licensing status is a basic component of teacher qualifications that combines aspects of subject matter knowledge and pedagogical knowledge or teaching skills. There are different requirements for teacher certification across the states, but a standard certificate generally means that "a teacher has been prepared in a state-approved teacher education program at the undergraduate or graduate level and has completed either a major or a minor in the field(s) to be taught" (Darling-Hammond, 2000, p. 7). However, more than 30 states still allow the hiring of teachers who do not hold a standard certification or teachers with no license (Darling-Hammond, 2000). In addition, in order to address the teacher shortage problem, more than 40 states initiated an alternative certification route for candidates who hold a bachelor's degree (Darling-Hammond, 2000; Heilig, et al., 2011). The certification or licensing status play important role in differentiating between highly-qualified and under-qualified teachers.

Teacher preparation programs are also used to predict teacher quality, while mixed results exist regarding the impact of teacher preparation program on teacher

quality and student achievement. Some empirical studies show that teacher preparation and certification among teacher credentials strongly correlates with student achievement in reading and mathematics, both before and after controlling for student poverty and language status (Darling-Hammond, 2000; Darling-Hammond, et al., 2005). In addition, the analysis found that certified teachers are more effective than uncertified or alternatively certified teachers, even some candidates have strong liberal arts backgrounds, such as those participating in the Teach for America (TFA) corps. On the other hand, Buddin (2010) found that teachers with full teaching credentials are no more effective in improving student achievement than teachers without credentials.

Teaching experience and educational background constitute components of teacher quality, but they do not always have a significant impact on teacher effectiveness. While many previous findings have established that inexperienced teachers with less than three years in the teaching profession are less effective than more experienced teachers (Gordon, Kane, & Staiger, 2006; Rivkin, et al., 2005), the benefit of experience levels off after about five years and has a very weak effect on teacher effectiveness (Buddin, 2010; Darling-Hammond, 2000). In the same manner, previous findings confirm that the effectiveness of teachers who hold advanced degrees such as a master's and doctoral degree are not different from those teachers who hold a bachelor's degree. The various contributing factors of teacher quality will be explored in greater detail in the literature review in the next chapter.

FACTORS RELATED TO TEACHER QUALITY

Many studies have examined factors related to teacher quality (Clotfelter, et al., 2007; Darling-Hammond, 2002; Hanushek & Rivkin, 2006; Harris & Sass, 2011; Lewis, et al., 1999). Teacher quality is not simply defined or measured by one or two factors.

Rather, multiple factors contribute to teacher quality, such as teacher's individual characteristics and qualifications, assigned students' demographic characteristics and achievement, school environment, and so on (Darling-Hammond, 2000; Lewis, et al., 1999; Skaalvik & Skaalvik, 2010).

Student Achievement and Characteristics

Teachers are often characterized as high quality or highly effective teachers when their students make above average progress in student achievement (Buddin, 2010; Darling-Hammond, 2000; Gordon, et al., 2006; U.S. Department of Education, 2011). Student achievement, thus, is one of the important predictors of teacher quality in a value-added model (or growth model), which is using for measuring teacher effectiveness based on standardized test scores.

Teacher effectiveness is also highly associated with students' demographic characteristics and family background, which is the strongest variable to explain student achievement (Buddin, 2010). Newton et al. (2010) found a high correlation between teacher effectiveness ranking and student's characteristics and concluded that "teachers who were teaching greater proportions of more advantaged students may have been advantaged in their effectiveness rankings, or that more effective teachers were generally teaching more advantaged students"(p. 11). In other words, a possibility exists that teachers who teach non-white and low-income students are more likely to rank lower in effectiveness due to their students' lower achievement levels and poor prior learning status (Buddin, 2010; Newton, et al., 2010).

However, considering the fact that under-qualified teachers who are inexperienced, out-of-field, or uncertified teachers are more likely to teach low-income and minority students, it is hard to conclude that teachers' lower effectiveness is caused

only by student's achievement (Peske & Haycock, 2006; Varela, 2011). Rather, this analysis implies the possibility of an imbalance in high quality teachers' distribution. In other words, schools with the highest proportions of poor, non-white, and low-scoring students may have the least qualified teachers (Clotfelter, et al., 2007; Lankford, et al., 2002; Peske & Haycock, 2006).

Teacher Characteristics

Teachers' individual characteristics and qualifications significantly contribute to teacher's quality. Although contextual factors explain a large amount of teacher effectiveness, more controllable factors – teacher qualifications and working conditions – significantly constitute teacher quality. Teacher qualifications include credentials, preparation program, teaching experience, and education level. Now, I took a close look at the previous studies of the relationship between teacher qualifications and teacher quality.

Credentials

Obtaining licensure is required for public school teachers. According to Darling-Hammond (2000), "certification or licensing status is a measure of teacher qualifications that combines aspects of knowledge about subject matter and about teaching and learning (p. 7)." State requirements for teaching licenses vary among states, but most require a bachelor's degree, the completion of a teacher education program, supervised teaching experience, and the completion of basic writing and math skills tests (Darling-Hammond, 2000). Policymakers have attempted to improve teacher quality by raising minimum credentials for entering teachers; however, recent research shows mixed results regarding the impact of expanding teacher credentials.

Some researchers, for example, insist that such paper qualifications do not significantly predict effective teachers (Buddin, 2010; Gordon, et al., 2006), while others' empirical research findings show that certified teachers are more effective than those who are not trained for certification, because "fully prepared teachers have a higher level of effectiveness" (Darling-Hammond, et al., 2005, p. 18). Darling-Hammond et al. (2005) assert that effects of certification status were generally much stronger than the effects of teacher experience. Studies that explain the effect of teacher credentials on student achievement also found that African American and Hispanic students and low-income students are excessively likely to be taught by teachers without standard certification, including alternatively certified teachers (Clotfelter, et al., 2007; Darling-Hammond, 2000; Darling-Hammond, et al., 2005; Jepsen & Rivkin, 2002). The uneven distribution of certified and prepared teachers by race and socio-economic status of students suggests that widening achievement gaps between wealthy suburban areas and poor urban areas are related not only to context, but also to assigned teachers' quality.

Preparation programs

Advocates of stronger teacher preparation have emphasized that teachers need to thoroughly acquire teaching skills and pedagogical knowledge through the longer and stronger preparation programs (Darling-Hammond, et al., 2005; Goldhaber & Brewer, 2000). However, as previously mentioned, NCLB supports expanding alternative certification programs (ACPs) to provide a sufficient number of qualified teachers to classrooms (Heilig, et al., 2011). As a result, only 133,000 teachers were certified by alternative means in the 17 years before NCLB, compared with 359,000 in the seven years since NCLB was adopted (Heilig, et al., 2011). Currently, 48 states and the District of Columbia offer alternatives to teacher certification via approximately 600

programs. Consequently, each year approximately 35,000 individuals are entering teaching through alternative teacher certification routes (NCEI, n.d.).

For proponents of ACPs, specific subject matter content knowledge is considered to be more important to teaching than coursework related to education (Raymond, et al., 2001). Ware et al. (2011) purported that the subject content knowledge of ACP teachers more positively affects student achievement than pedagogical knowledge of other teachers. In addition, advocates insist that expanding alternative program is a cost-effective way to deal with teacher shortages because of the relatively short time period needed for teacher training.

On the other hand, opponents of ACPs point out that, considering that teachers trained in ACPs have a high attrition rate, it is not a cost-effective way to train teachers in a long-term perspective, but a temporary measure for addressing the teacher shortage. ACP opponents also express concern that there are no standards for assessing the quality of ACPs due to large variability among programs (Laczko-Kerr & Berliner, 2002).

Among several ACPs, Teach for America (TFA) is the most widely-known alternative teacher certification route (Heilig & Jez, 2010; Ware, et al., 2011). TFA is a national nonprofit organization that aims to eliminate disparities in educational outcomes by recruiting graduates from elite colleges who mostly do not have a background in teacher education to teach in low-income urban and rural public schools for a two-year commitment (Heilig, et al., 2011; Ware, et al., 2011). However, contrary to the increasing number of TFA corps, there are persistent questions in the public discourse as to whether TFA teachers accomplish the organization's primary intention: to increase the supply of qualified teachers and to improve student achievment in high-need schools.

In fact, the relatively short time period of teacher training programs brings up the question as to whether the training is sufficient to effectively prepare quality teachers

(Darling-Hammond, et al., 2005). More specifically, the question is whether TFA teachers or ACP teachers improve student achievement relative to traditionally prepared teachers. While traditional university-based prepartion programs provide four-years curricular requiring teaching practice, TFA provides only five weeks of summer training before new recruits begin teaching (Clotfelter, Glennie, Ladd, & Vigdor, 2008; Heilig, et al., 2011). TFA's five-week training is much shorter even when compared to other ACPs, which mostly require a year to complete the course (SBEC, n.d.-b). Moreover, most TFA corps members do not have teaching or pedagogical background (i.g. only 3 percent of 2009-10 TFA corps members) and consider teaching as only a temporary duty (i.g. only 17 percent had even considered a career in education before applying to the program) (Ware, et al., 2011, p. 3). Even though TFA corps, in general, have a strong liberal arts background from top-notch universities, since they are not fully prepared as educators and have lower level of commitment, their teaching quality remains questionable.

Years of teaching experience

Most empirical research confirms that teachers' years of experience is an important predictor in identifying teacher effectiveness, although the effect size varies among studies (Buddin, 2010; Clotfelter, et al., 2007; Darling-Hammond, 2000; Hanushek & Rivkin, 2004; Harris & Sass, 2011). Harris and Sass (2011) found that elementary and middle school teacher productivity in promoting student achievement increases with experience and they continue to grow productivity from experience for the first five years.

It is well known that a large number of beginning teachers leave the profession within the first few years, while more experienced teachers are more likely to remain (Boe, et al., 2006; Boyd, et al., 2009; Darling-Hammond & Baratz-Snowden, 2005;

Darling-Hammond & Sykes, 2003; Eller, et al., 2000; Hanushek, et al., 2005; Hanushek, et al., 2004). According to Hanushek et al. (2004), novice teachers are almost twice as likely as experienced teachers, who have 11 to 30 years of experience, to exit public schools and are almost four times as likely to switch districts in Texas. Darling-Hammond and Baratz-Snowden (2005) also stated that teacher shortages have been mostly due to the high attrition rates among beginning teachers. The increase in turnover of novice teachers causes significant financial losses because recruiting and training new teachers costs more than retaining them (Eller, Doerfler, & Meier, 2000b).

The idea that novice teachers have a negative effect on student achievement is widely accepted. Indeed, research finds that teachers with 0 to 1 year of experience had a strong negative effect on student achievement, regardless of their certification status (Darling-Hammond, et al., 2005). Buddin (2010) also confirms that students with the most experienced teachers achieved higher test scores than students with a novice teacher who had taught less than three years. These findings imply that teaching experience is one of the important elements to constitute high quality teacher.

Education level

It is generally believed that a teacher with a higher educational degree may be more effective in teaching students. However, most research regarding the relationship between teacher education level and student achievement agrees that higher degrees such as a master's or doctoral degree have little predictive power in identifying teacher quality as measured by student outcomes (Ballou & Podgursky, 2000; Darling-Hammond, 2000; Hanushek & Rivkin, 2004). Godhaber and Brewer (2000) found that a more important indicator of teacher quality is the type of coursework teachers completed, rather than their

degree itself. That is to say, teachers' knowledge of teaching and learning obtained during their education coursework is a more important factor in deciding teacher quality.

Working Conditions in Schools

A school's working conditions, such as student demographic composition, salaries, compensatory pay, and class size, also play an important role in student achievement as well as attracting high quality teachers.

Salaries and incentive pay

Salary is one of the important factors when teachers select school or district, and most teachers prefer to work in district with higher wage as do other professions (Jacob, 2007). It is easily predictable that highly qualified teachers are more likely to choose to teach in wealthy district with higher salary (Hanushek & Rivkin, 2004, 2006; Jacob, 2007). Teachers, however, assigned somewhat less importance to salary as a criteria of professional success and turnover decision than that of other professions (Chapman, 1984). Thus, the impact of salary on teacher quality is not clear; rather, it constitutes an indirect contributing factor of the attractive elements configuring working conditions for hiring and retaining high quality teachers.

Incentives that reward higher performance are a traditional strategy for attracting and retaining capable workers in business. This approach is also applied in the education field to motivate and retain effective teachers in the teaching profession. However, there is an ongoing debate whether merit pay programs are successful in rewarding effective teachers and whether it contributes to improved student achievement (Dee & Keys, 2004). Dee and Keys (2004) presented new empirical evidence based on an analysis of Tennessee's former merit pay program, the Career Ladder Evaluation System and data from Tennessee's Project Student Teacher Achievement Ratio. The authors analyzed the

relationship between teaching experience and their students' math and reading test scores. They ran a regression model with independent variables of teacher experience, graduate degree, teacher's race and ethnicity, class size, their students' gender, race, and the eligibility for free and reduced lunch programs. The results suggested that the incentive system was partially successful in rewarding teachers who promote student achievement (Dee & Keys, 2004). An increase in math scores appeared to have been somewhat concentrated among teachers who were on the lower rungs of the career ladder. In contrast, only teachers who had reached the top of the career ladder led to statistically significant gains in reading achievement. Although the estimated coefficients of the career ladder teachers were mixed, test performance was significantly higher among Whites, females, students not eligible for free lunches and students who studied in small sized classes. Also, regardless of teachers' position on the career ladder, teachers being the same race as their students resulted in the students attaining higher academic achievement. These results imply that the effectiveness of merit pay programs depends on subject, teacher's experience, teacher's and student's race, and class size, not just pay itself. Student outcomes are a mixture of the various elements of school settings, rather than only the impact of incentive programs.

Student-Teacher Ratio

The movement toward smaller class sizes has been a longstanding trend in the United States, because many believe smaller classes improve student achievement and teacher quality (Betts & Shkolnik, 1999; Jepsen & Rivkin, 2002). In spite of this trend, research results are mixed concerning the effect of class-size reduction on student performance. Betts and Shkolnik (1999) reported a positive impact of smaller classes on student achievement. According to Betts and Shkolnik (1999), although teachers in the

study did not invest extra time developing new teaching methods, smaller class size was effective in increasing student performance because it enabled teachers to increase the individual attention they gave students.

Jepsen and Rivkin (2002) also showed that smaller classes positively impact third-grade math and reading scores, particularly for lower-income students. However, at the same time, their findings showed that class-size reduction led to deterioration in average teacher quality, because reducing class sizes required additional classes which required hiring additional teachers. Most of the newly hired teachers were not fully certified and inexperienced. Jepsen and Rivkin (2002) found that, ironically, when class size is reduced, schools and districts with large concentrations of economically disadvantaged students may experience an overall decline of teacher quality (Imazeki, 2003; Jepsen & Rivkin, 2002). In other words, the benefit of smaller classes can be offset by lower teacher quality in schools with a large proportion of economically disadvantaged student.

High-stakes Accountability Policy

Many researchers have focused on the impact of the policy environment's change into high-stakes accountability system on teacher quality and turnover decision since the NCLB has strongly emphasized improving student achievement based on test scores. Boyd et al. (2008) asserted that the gap between qualifications of New York City teachers in high-poverty schools and those of teachers in low-poverty schools narrowed as a result of halting the hiring of uncertified teachers under NCLB. They pointed out that the results may have been partially affected by an influx of teachers from two prominent programs: the Teaching Fellows program and TFA, which aim to put highly qualified teachers into high-poverty classrooms (Boyd, et al., 2008).

On the other hand, other studies suggested that the high-stakes accountability system is one of the reasons for the high teacher turnover rate (Boyd et al., 2008; Feng et al., 2010; Lee, 2008; Nichols & Berliner, 2007). Lee (2008) accounted for the correlation between teacher turnover rate and accountability policy using an accountability index developed by Carnoy and Loeb (2002). He found that, under a strong accountability policy that emphasized monetary rewards and sanctions based on students' test results, teachers were more likely to leave their jobs (Lee, 2008). In addition, teachers who graduated from highly competitive colleges were more likely to leave than other teachers in a strong accountability system (Lee, 2008). Specifically, math and science teachers working in a state that has a strong accountability policy are more likely to leave than teachers in other states with moderate levels of accountability (Lee, 2008). Feng et al. (2010) also found similar results that "teacher job change increased by 2.8 percentage points in schools that received lower grades under the new accountability regime, whereas schools that did not experience a change in their grade as a result of the change in the accountability system had only one percentage point increase in teacher mobility" (p.12). These results imply that the high-stakes accountability system influences some teachers, especially competent high quality teachers, to abandon their teaching jobs.

GAPS AND FUTURE CONTRIBUTIONS

Studies constantly show teachers' unequal distribution that teachers who are more qualified, more experienced, and licensed in the subjects are more likely to teach students who are in more affluent schools and with higher academic performance. Previous research cited throughout this literature review section has provided a great deal of insight into the determinants of teacher quality. While studies have been made on contributing factors of teacher effectiveness, there is little attention on teacher

distribution among high quality teachers in high-need urban district. However, considering the importance of retaining high quality teachers or highly effective teachers on student achievement, it is necessary to pay more attention to distribution among high quality teachers.

In Texas particularly, little attention has been given to studying the relationship between teacher distribution and high quality teachers. Many school districts in Texas are being forced to reduce the number of teachers due to budget deficit. It would not be concerned about the attrition of low quality teachers. According to Hanushek and Rivkin (2010), "eliminating 6-10 percent of the worst teachers could have dramatic impacts on student achievement even if these were replaced with just average teachers (p. 7)." Yet, the problem is that fully qualified teachers were replaced with the cheaper workforce. Ironically, at the same time, the number of alternatively certified teachers dramatically has increased in schools in Texas. Therefore, the contradictory phenomenon in supply and demand of teachers in Texas needs to be examined in detail now. This investigation will contribute to forming relevant policy recommendations for placing and retaining high quality teacher and an effort to improve student achievement and lessen the achievement gap in urban schools, Texas.

THEORIES RELATED TO TEACHER QUALITY

Retaining optimal levels of high quality teachers is imperative for school districts for many reasons, including economic considerations, continuity of education, and student achievement. The human capital theory, professional capital theory and Chapman's teacher attrition model provide a theoretical foundation for this imperative by emphasizing the importance of retaining high quality human resources on organizational success. These theories can be applied to explain the overarching goals of the proposed

study: To demonstrate the importance of placing and retaining high-quality teachers for schools' and student's success, and to determine what factors influence teachers' choice to stay in or leave the teaching profession.

Human Capital Theory

The human capital theory assumes that humanity is the most important asset and that investing in and building human capital is essential for an organization's success. Human capital theorists view a human being as a stock of cumulative competency, experience, and knowledge and insist that the attributes embodied in a human produce not only economic benefits but also immeasurable social and cultural value (Schultz, 1963, 1971). According to human capital theory, since human resources can be transformed into highly productive human capital with an effective input of education and training, education is thus a primary human capital investment for individual growth, organizational success, and national development (Becker, 1975; Schultz, 1971).

One of the underlying assumptions of human capital theory is that education helps develop work skills and improves the worker's capacity to be productive (Benson, 1978, as cited in Sweetland, 1996). The value of education—including on-the-job training; study programs for adults; and the formal education system organized into elementary, secondary, and higher levels—is that it transforms not only individual growth but also organizational success and national development (Becker, 1975; Schultz, 1971). While the primary purpose of education is not economic, many studies have focused on the economic effect on quantifiable indicators, such as future earnings of the educated individuals, so as to prove the value of education (Becker, 1975; Sweetland, 1996). For instance, Hanushek (2011) found that effective teachers generate higher future annual incomes of their students. Schultz (1963) also mentioned that "schooling and advances in

knowledge are both major sources of economic growth" (p. 46), emphasizing the economic function of educating human capital.

Applying the theory to teacher effectiveness, expanding teachers' capabilities and increasing their effectiveness as prime human resources are the most essential elements of leading schools and students to success (Becker, 1975; Odden, 2011). From an economic perspective, Hanushek (2011) found the economic benefit of hiring and retaining effective or higher quality teachers in that they generate higher economic value of students' future earnings. He also concluded that eliminating ineffective teachers would result in huge improvement of student achievement in the international level, which is equivalent to approximately $100 trillion value (Hanushek, 2011).

Professional Capital Theory

Beyond the simple cost-benefit analysis of teacher effectiveness, Smylie (1997) asserted that, in schools, the concept of human capital needs to be extended beyond its traditional economic implication to include academic aspects, such as knowledge, skills, dispositions, and social resources of teachers that can be applied to promote children's learning and development. In light of the importance of developing teachers' capabilities, it is necessary to discuss the quality of teacher preparation programs and on-the-job training because different levels of quality among these programs can result in a wide variance in teacher capabilities.

Hargreaves and Fullan (2012) also stresses a long-term investment in developing human capital in order to foster high quality teachers and teaching in their book, Professional capital. They criticize the business capital strategy toward teaching that is currently advocated in the United States as follows:

> When education is organized to get quick returns on business investment, and to increase immediate returns by lowering that investment, it favors a teaching force

> that is young, flexible, temporary, inexpensive to train at the beginning, un-pensioned at the end (except by teacher's own self-investment), and replaceable wherever possible by technology. (p. 2)

From the point of view of business capital theory, teachers from alternative preparation program such as Teach for America (TFA) are considered as very productive and quality human resource because they are assumed to have high level of content knowledge. In this view, alternatively certified TFA recruits are not prepared for a career of teaching in spited of their individual knowledge.

However, there is a question whether we only concern teacher's qualifications as a perspective of business capital. Rather, Hargreaves and Fullan (2012) suggest that teachers need to view as a professional capital that is a new concept about high quality teachers and teaching. In a point of view of a professional capital, they define high quality teachers and teaching as follows:

> A big part of this investment is in high-quality teachers and teaching. In this view, getting good teaching for all learners requires teachers to be highly committed, thoroughly prepared, continuously developed, properly paid, well networked with each other to maximized their own improvement, and able to make effective judgments using all their capabilities and experience. (p. 3)

Teachers as important human capital provide the foundation and lifeblood of any educational institution. To effectively build human capital, it is also critical that the existing high-quality teachers be well managed. Odden (2011) insisted that "the strategic management of human capital" in schools includes recruiting a qualified teaching workforce, developing teachers' capabilities and competency through professional-development programs and student-teaching experiences, and retaining the high-quality and educated teachers to promote optimal organizational performance. Odden (2011) also emphasized the importance of the strategic management of human capital in public education, particularly in high-need schools with a high concentration of students from

impoverished and minority backgrounds. Pil and Leana (2009) called it "teacher human capital" that cumulated in particular context of teaching so that have more powerful effect on student achievement than would general human capital.

Although teachers can play a more significant role in the success of high-need schools that are suffering from a restricted educational budget, indeed, teachers have a higher likelihood of leaving inferior schools because of substandard working conditions, thus students suffer the consequences. This situation in the context of human capital theory provides a theoretical foundation to address a hypothesis for this research in regards to the concentration of high-quality teachers and for studying the recruiting, developing, and retaining them in high-need schools.

Chapman (1984) suggested a model of the influences on teacher retention that is grounded in social learning theory and Krumboltz's social learning theory of career decision making. Social learning theory explains psychological functioning as an outcome of the interaction of personal characteristics, previous learning experiences, and environmental conditions (Krumboltz, 1979, as cited in Chapman, 1984). Applying the social learning theory to the career decision-making process, Krumboltz (1979) demonstrated that combinations of personal characteristics, environmental conditions, learning experiences, cognitive and emotional responses, and performance skills interact and then produce different career decisions. After studying with three groups of college graduates with teaching certificates, Chapman (1984) concluded that teacher retention/attrition is also an outcome of teachers' social learning processes as follows:

> The model suggests that to understand teachers' decision to persist in or leave teaching, it is necessary to take into account (a) the personal characteristics of the teachers, (b) the nature of teaching training and early teaching experiences, (c) the degree to which the teacher is socially and professionally integrated into the teaching, (d) the satisfaction teachers derive from their careers, and (e) the

> external environmental influences impinging on the teachers' career (Chapman, 1984, p. 646).

Based on the results, Chapman (1986) asserted that explaining teachers' retention decisions as outcomes of the current teacher job market, salary, or school environment underestimates the influence of other factors on teacher retention. Rather, he concluded that teacher's characteristics, initial career commitment, the quality of teacher training, and early teaching experiences are stronger determinants in accounting for teacher mobility. Among them, Chapman (1984) particularly emphasized the effect of teacher preparation programs as follows:

> Teacher preparation programs can have a meaningful impact, through effort to reinforce and encourage commitment to teaching or to encourage those who are unsure about teaching to seek other career alternatives. (p. 655)

His finding implies that new teachers' experiences while training in their teacher preparation programs are vitally important to teachers' career decisions because they may affect the teachers' initial commitments and first teaching experiences and then this experience influences teachers' turnover decision.

Billingsley's conceptual model of the influences of teachers' career decisions suggested in 1993 shares similar major elements with Chapman's model. Billingsley (1993) also insisted that the interaction of three major factors-- teacher personal factors, employment factors, and external factors—affects teachers' career decision. In his model, teacher personal factors indicate teacher's age, gender, race, and other personal factors including personal finances and perceived other opportunities. In the follow-up research of this model, Cross and Billingsley (1994) concluded that teachers who had higher level of degree, less teaching experiences, and belonged to a minority group were tend to leave teaching profession. The employment factors are assorted into several job-related factors, such as teachers' professional qualifications, working conditions, work rewards, and

commitment, which were mostly included in Chapman's model. More specifically, they also found that teacher professional qualifications including teacher's educational preparation and certification, academic knowledge and skills, prior work experiences, and initial commitment were strongly linked to teachers' career decision (Cross & Billingsley, 1994), as Chapman suggested.

CONCEPTUAL FRAMEWORK

This study investigated the distribution of high quality teachers and the effect of high quality teachers on student's achievement in a large, urban district in Texas. In order to address the research questions, a conceptual framework for this study was based on the theories and empirical studies regarding teacher quality, teacher effectiveness, and teacher turnover, which were reviewed through the previous sections. After reviewing previous studies related in teacher quality, I combined the influencing factors of teacher quality in one conceptual model (See Figure 2.1).

The human capital theory and professional capital theory provides a foundational underlying assumption in this study that teachers are the most important asset and human resource in schools. More importantly, this study assumes that high quality teachers as the high quality professional capital would play an essential role in leading school and student to success, and generate considerable positive social, cultural, and economic values within a school to move a school into success.

Chapman's teacher attrition model (1983) served as the basic structure of a conceptual framework for this study. The three major clusters of factors affecting both teacher effectiveness and teacher turnover—(1) teacher's personal characteristics, (2) teacher's qualifications, and (3) work environment including student demographics and school's working conditions--were derived from Chapman's teacher attrition model,

Billingsley's teachers' career decision model, and previous empirical studies. Teacher effectiveness, which can be a proxy of teacher quality, measured by student achievement based on student's academic growth. The interaction of three major clusters of influencing factors and teacher effectiveness together explained teachers' turnover decision in this model. Teachers' initial commitment, first teaching experience, job satisfaction, and labor market condition would indirectly influence teachers' turnover decision, but the specific variables were not included in the analytic model due to the limited data available.

Considering the impact of teacher qualifications including teacher preparation programs on the teachers' initial commitments and first teaching experiences in Chapman's and Billingsley's studies, I hypothesized that the different curriculums of teacher training programs would produce different qualities of teachers who have a different level of commitment to teaching profession and a different experiences in teaching practice. I assumed that the quality of teacher training programs, thus, would result in a different level of teacher quality. For example, teachers trained at alternative teacher certification programs might have different experiences in student teaching practice compared to traditionally educated teachers and different results in student achievement.

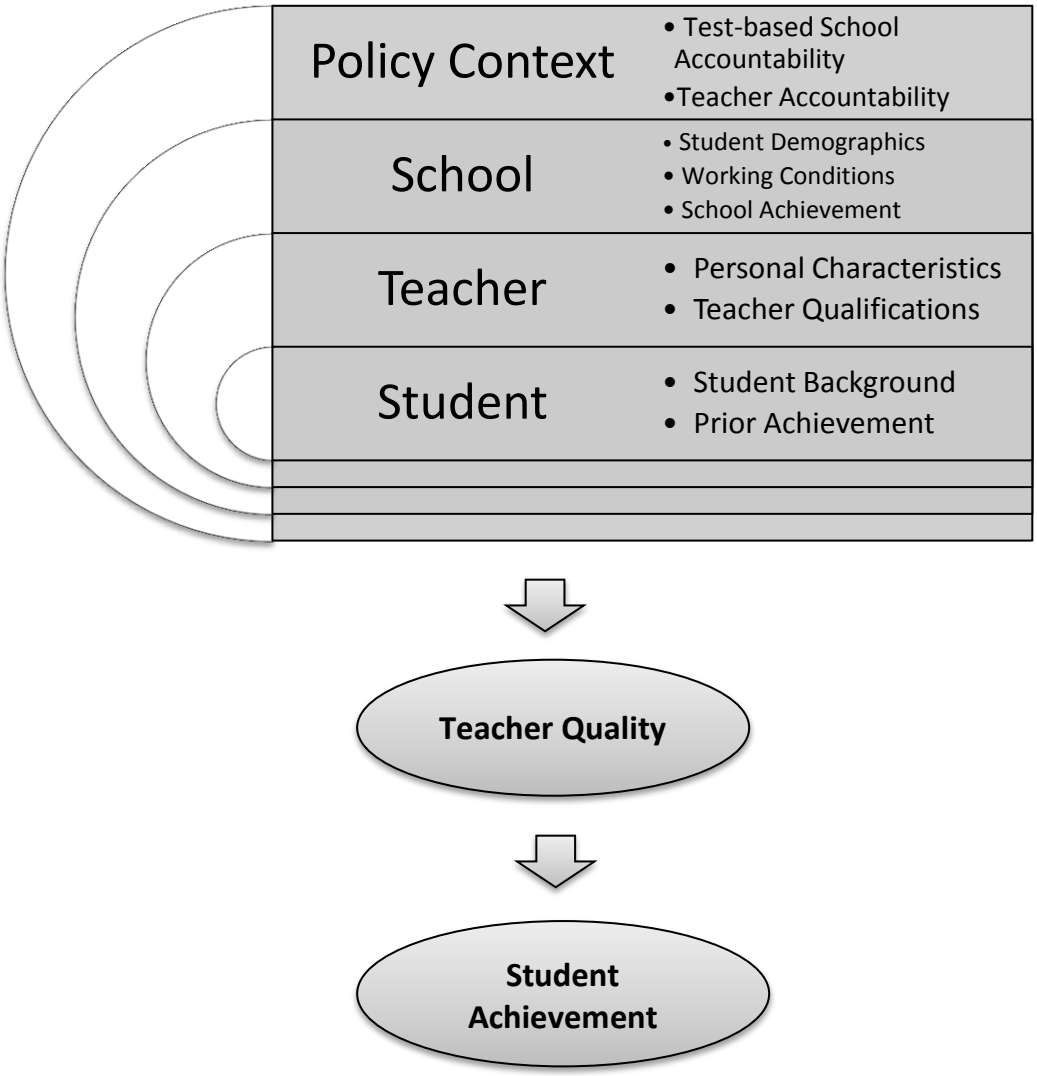
In the curriculum of many alternative teacher certification programs, student teaching practice is not a mandatory, while traditional university-based teacher training programs require classroom observation and student teaching practicum throughout the whole program. The lack of teaching practice experiences in alternative teacher preparation programs may produce a lower level of commitment to teaching and greater difficulty for new teachers in first year of teaching than for teachers trained at the university programs. Although Chapman did not include the influence of student teaching

practice experience on teacher quality and teachers' turnover decision in his model, it is certainly relevant for the future research due to its potential importance.

The framework I employ in this study assumes that this policy climate as an external environment would influence teachers' career decisions. For example, teachers are more attracted to high-performing schools by the prospects of teaching in better working conditions than they would experience in low-performing schools. In addition, high-performing schools tend to be located in wealthier districts, thus, they have better financial resources and are more willing to hire high-quality teachers. The opposite is true for low-performing schools in that they do not have the financial means for recruiting and retaining high-quality teachers.

Overall, a hypothesis in this study was that the application of a test-based accountability policy in an urban school context will neither attract high-quality teachers nor make them stay in lower-performing schools, because the policy demands increasing test scores in a short time period and makes teachers work harder in urban schools, where there is typically lower performance and smaller education budgets. I also assume that this situation will result in the deterioration of urban schools' educational resources and negatively affect student achievement in them, and this may form a vicious circle by discouraging high-quality teachers from working in low-performing schools. Based on this discussion, the overarching goal of this proposed study is to explore links between student achievement, teacher quality, and their turnover decisions. Both the human capital theory and Chapman's teacher attrition model support the underlying assumptions in this study.

Figure 2.1. Conceptual Framework[2]



[2] Chapman's teacher attrition model (1983) served as the basic structure of a conceptual framework for this study. The three major clusters of factors affecting both teacher effectiveness and teacher turnover—(1) teacher's personal characteristics, (2) teacher's qualifications, and (3) work environment including student demographics and school's working conditions--were derived from Chapman's teacher attrition model, Billingsley's teachers' career decision model, and previous empirical studies.

Chapter 3: Method

This chapter presents the research methods and analytical procedures of the current study that were used to investigate the distribution of high quality teachers and the effect of teacher quality on student achievement. The first section includes the research questions and hypotheses. The second section describes the data sources and sample population for this study. The next section contains the research design and analytical procedures. The last section introduces variables for descriptive analysis and multilevel analysis.

While concern about teacher quality has been growing, little is known about the distribution of high quality teachers by student and school characteristics and the effect of high quality teachers on student achievement. Therefore, in order to demonstrate teachers' distribution across a large urban district, I classified students' demographic characteristics, school characteristics and schools' performance level by teachers' qualifications. Through this process, I demonstrated the overall view of teacher distribution by student characteristics and school factors across an urban district. The limitations of this study are also included in this chapter.

RESEARCH QUESTIONS AND HYPOTHESES

This study attempted to answer the following questions:

1. How are high quality teachers distributed across a large, urban district according to student's characteristics, school characteristics and student achievement in elementary schools and middle schools?
2. How does teacher's quality influence student achievement in urban elementary schools and middle schools?

3. How does teacher's quality influence the achievement of students with limited English proficiency in urban elementary schools and middle schools?

In order to address the research questions, a conceptual framework for this study was based on the theories and empirical studies regarding teacher quality, teacher effectiveness, and teacher turnover. The human capital theory provided a foundational underlying assumption in this study that teachers are the most important asset and human resource in schools. More importantly, this study assumed that high quality teachers as the high quality human capital would play an essential role in leading student to success. The hypotheses for the research questions 1 are as follows:

1. Socially and economically disadvantaged students are more likely to be assigned to under- or alternatively-certified teachers.
2. Students who are classified as at-risk students and limited English proficiency are more likely to be assigned to under- or alternatively-certified teachers.
3. Students who had under- or alternatively-certified teachers achieved lower than students who had highly qualified teachers.
4. Low performing schools have more under-qualified teachers.
5. There are significant differences between elementary schools and middle schools in regard to the proportion of highly qualified and under qualified teachers.
6. There are significant differences between elementary schools and middle schools in regard to the effect of teacher quality on student achievement.

The hypotheses for the research questions 2 are as follows:

7. Teacher characteristics, such as preparation programs, years of experience, and degree level, are associated with student achievement in the classroom.

8. High quality teachers are more likely to positively affect student achievement than under- or alternatively- certified teachers in urban schools.

The hypothesis for the research questions 3 is as follows:

9. High quality teachers are more likely to positively affect the reading achievement of students with limited English proficiency than under- or alternatively certified teachers in urban schools.

This chapter describes the study's research design with respect to the research questions, data sources, samples, analytic procedures, and limitations.

DATA SOURCES

In order to determine the effect of teacher quality on students' achievement in an urban district, Southeast Independent School District (SISD), which is a major urban district in Texas, was chosen[3]. SISD is a pseudonym used to mask the district's identity. SISD is the largest public school system in Texas. SISD has large shares of minority and low-income students—approximately 62 percent of students are Hispanic and 27 percent are African American; 80 percent of students are eligible for free and reduced lunch program; 31 percent of students have limited English proficiency (LEP); and 63 percent of students are at-risk in an academic year 2009-2010.

The objective of the study was to conduct quantitative research on teachers who work in public schools located in Texas. Teachers who are in elementary schools and middle schools were selected as a sample for the analysis. Elementary schools and middle schools are separated in analyses due to its distinctive characteristics. For instance, in elementary schools one teacher typically teaches every subject to students in the same classroom, while there are subject teachers in each subject in middle schools. Thus,

[3] Texas Education Agency defines major urban districts as counties with populations of 650,000+ and over 35% economically disadvantaged.

statistically, the linkage between teachers and their students is easier and more precise than matching data from middle schools. The data linking teachers to their students are necessary and important for the multilevel model. Indeed, the district data on students and teachers are available to researcher in forms that permit the matching of students over time, and in many cases, the matching of students to their specific teachers. In order to matching teachers and their students' data in middle schools, I only selected one subject of reading.

The data utilized in this analysis was derived from the Public Education Information Management System (PEIMS), which is the data collection and reporting system produced by the Texas Education Agency (TEA) for the public schools of Texas. Through PEIMS, the TEA annually collects a broad range of information on more than 1,200 districts (including charters), encompassing more than 7,800 schools, 289,000 educators, and more than 4.5 million students (TEA, 2008). It includes extensive information on students, staffing, and school budget/finances, and serves as the fundamental database for many statewide reports on public education, such as the Academic Excellence Indicator System (AEIS). The AEIS reports provide a variety of performance information, such as Texas Assessment of Knowledge and Skills (TAKS), student attendance, dropout rate, advanced courses, as well as school completion information and extensive profile information about students, staff, finances, and programs.

The data included reading achievement scores which were taken from the Texas Assessment of Knowledge and Skills (TAKS), the state accountability system's high-stakes test for grade 3 to 11. The TAKS is an end-of-year and criterion-referenced assessment. Statewide standardized testing in Texas began earlier than any other states from 1990. TAKS is the 4th version of the statewide test from 2003 to 2012 after Texas

Assessment of Basic Skills (TABS), Texas Educational Assessment of Minimum Skills (TEAMS), and Texas Assessment of Academic Skills (TAAS). As indicated by the changing title, the test has shifted from emphasizing basic skills towards high-stakes tests. TAKS was replaced to the State of Texas Assessments of Academic Readiness (STAAR) since 2012. The testing subjects are mathematics, reading, writing, social studies, and science and they differ from student's grade. There are Spanish and English versions of the test, however in this study only TAKS scores of English version were included in order to control the differences between the two language versions[4].

In addition to PEIMS and AEIS data, teachers' data and a linkage file of student and teacher were provided by SISD. In order to protect individual students' and teachers' identifications, SISD provided data with masked identifications for teacher's data. I displayed how to match teachers' data and students' data in the Appendix A. Moreover, SISD approved to use the data after thoroughly reviewing a research proposal of this study. The whole process to receive the data was scrupulously examined and secured by both SISD and the University of Texas at Austin.

The district's data was collected from PEIMS and student achievement was measured by the TAKS scores for reading and English Language Arts. The basic TAKS score on any test is the raw score, which is simply the number of questions correct. Unlike raw scores, scale scores can be interpreted across different sets of test questions and allow direct comparisons of student performance between specific sets of test questions from different test administrations (Student Assessment Division, 2011). A scale score is a conversion of the raw score onto a scale that is common to all test forms for that assessment. The scale score takes into account the difficulty level of the specific

[4] For English language learners (ELL), both Spanish and English versions of TAKS have been operating from 1997.

set of questions on which it is based. It quantifies a student's performance relative to the passing standards or proficiency levels (Student Assessment Division, 2011).

However, there was a limitation about score scales in that TAKS utilizes a horizontal scale scoring system. A horizontal scale enables to compare scores within the same grade, but it was impossible to compare longitudinal data overtime. In the multilevel model, the prior year's TAKS reading test scores was typically included for examining student progress over time. Vertical scale scores allow for directly comparing year-to-year test scores across different tests, subjects or grades, because the scale score quantifies a students' performance relative to the passing standards or proficiency levels for tests (Texas Education Agency, 2011a). The Texas assessment system used a horizontal scale until 2009, which allows direct comparisons of test scores across different test administered but not across grades (TEA, 2011).

Vertical scale scores were developed in 2009 for TAKS English reading and mathematics tests in grades 3-8, so they are only available since 2010 (TEA, 2011). Due to the short implementation period of vertical scale scores, this study could not utilize the vertical scaled scores. Thus, in order to compare two consecutive year's student TAKS scores across grades, student's test scores were standardized into Z-score to have a mean of zero and a standard deviation of one in each grade to compare test scores across grades and simplify interpretations.

DEPENDENT AND INDEPENDENT VARIABLES

In this study, data of 40,239 students and 969 teachers from approximately 200 campuses in SISD were collected for analysis. Approximately 16,500 students and 623 teachers were selected from 166 elementary schools, and 346 teachers and 24,000 students were selected from 43 middle schools in Southeast ISD. Two consecutive TAKS

reading scores were used for 4 to 8 graders. Due to the substantial differences of characteristics between elementary and middle schools, the sample was divided into two by school levels and the analysis also was conducted separately.

Variables used in the three-level model were descriptively summarized in Table 3.1. The variables in Level 1 are TAKS Reading achievement score from 2008~09 to 2009~10 school year and students' demographic and background data. Level 2 includes the variables about teacher's qualifications and Level 3 contains school-level variables.

Outcome variable

The outcome variable for each multilevel model is student achievement measured by the Texas Assessment of Knowledge and Skills (TAKS) reading scores for the 2009-2010 school year (See Table 3.1). TAKS scores were also available for math, however, this study focuses only on the impact of teacher quality on student reading achievement. The previous year's TAKS reading scores were used as an independent variable to control for students' prior achievement. Therefore, two consecutive years' TAKS scores for reading from 2008-2009 to 2009-2010 are included in the model. As mentioned earlier, the horizontally scaled test scores were standardized into Z scores to have a mean of zero and a standard deviation of one.

Independent variables

A series of independent variables were used in the multilevel model. Based on the nested nature of the data, variables were selected at each level. Student background variables were used in level 1 and variables of teacher qualifications were included in level 2. Level 3 included variables of school characteristics.

Student prior achievement.

Student prior achievement is included as one of student's background variables. Student's knowledge or ability is considered an important background factors, because some researchers assumed that student's prior ability is an outcome of student background. So, some previous research did not include any other student's individual characteristics except student's prior achievement. In this study, it is measured via the TAKS reading scores in the previous year, 2008-2009 school year.

Student demographic background

Student demographic background variables include student gender, race/ethnicity, economically disadvantaged status, limited English proficiency (LEP) status, students at-risk of dropping-out of school and students in gifted/talented program. The gender composition was relatively even (females 52% and males 48%) in the sample. For analytic purpose, females were coded as one and males were coded as zero. Dummy variables were also created for the racial group. The most common racial group was Hispanic (51%) and all remaining racial categories (White, Black, Asia, and Native American) were coded as zero.

As one of the student background variables, students with limited English proficient are included. Students were identified as limited English proficiency (LEP) by the Language Proficiency Assessment Committee (LPAC) according to criteria established in the Texas Administrative Code. Not all pupils identified as LEP receive bilingual or English as a second language instruction, although most do. A variable of economically disadvantaged students was also included in the model. The proxy of economically disadvantaged students that they were eligible for a free or reduced-price lunch or other public assistance divided by the total number of students. At-risk students are students who are not experiencing success in school and are potential dropouts. They

are usually low academic achievers and disproportionate numbers of them are males and minorities from low socioeconomic status families (TEA, n.d).

Many previous research included students in a special education program as a covariate variables to estimate student achievement in their analysis models, however, they were excluded in this analysis. This is because these students took an alternative version of TAKS (TAKS-ALT) and the assessment is based on alternate academic achievement standards. Overall, student demographic background factors, such as gender, a racial and ethnic group, the level of poverty, status of at-risk of dropping out, students in gifted/talented program and limited English proficiency were used in the model to control the effect of student background to examine student achievement.

Teacher qualifications

The variables of teacher qualifications, such as teacher's certified status, education level, and years of teaching experience, were used to estimate teacher quality in level 2. In accordance to their type of certification, teachers were coded into fully-certified, under-certified, and alternatively certified. A variable of alternatively certified included teachers from Teach for America (TFA) which is a representative institution of alternative teacher preparation programs. Since TFA teachers leave campuses after 2-years commitment, collecting enough data more than two years was technically not possible. Thus, as shown in the later chapter, TFA teacher's teaching experience were from zero to two years. A variable, years of teaching experience, is obtained by determining each teacher's years of experience. This measure refers to the total number of years of professional experience for the individual in any district (TEA, n.d.). Teachers' education level is divided into no degree, a bachelor's, a master's, and a doctorate degree.

Table 3. 1: List of Variables Included in the Multilevel Model

Variables	Scale
Dependent variable	
TAKS ZRead10	TAKS reading scores in 2009-2010 school year were transformed to Z scores.
Student-level variables	
TAKS ZRead10	TAKS reading scores in 2008-2009 school year were transformed to Z scores. Variable indicating student's prior achievement.
Female student	Indicator variable for student's gender (0: Male, 1: Female)
Economically disadvantaged	Indicator variable for students who are eligible for free or reduced lunch. Proxy of economically disadvantaged students. (0: Non, 1: Economically disadvantaged)
At-risk	Indicator variable for students who is designated at- risk of dropping out of school. (0: Non, 1: At-risk)
Limited English Proficiency	Indicator variable for students who have a limited ability to read, speak, write, or understand English can be limited English proficient (LEP). (0: Non, 1: LEP)
Gifted/Talented	Indicator variable for students who is participating in a state-approved Gifted/Talented program. (0: Non, 1: Gifted/Tal)
Hispanic	Indicator variable for Hispanic (0: Non, 1: Hispanic)
African American	Indicator variable for African American (0: Non, 1: African American)
Teacher-level variables	
Fully-certified	Indicator variable for teachers who are certified. (0: Under-certified, 1: Fully-certified)
Experience of teaching	Years of experience in teaching
TFA	Indicator variable for Teach for America (0: Non-TFA, 1: TFA)
Holding degree	Indicator variable for teacher's level of education (0: Bachelor, 1:Master, 2: Doctoral)
School-level variables	
Campus Accountability Rating	Campus Accountability Rating (1: Academically Unacceptable, 2:Acceptable 3: Recognized, 4: Exemplary)
School funds	Expenditure by function-total operating per pupil all funds
Teacher-Student Ratio	Teacher-Student Ratio in campus
% Disadvantaged	Percentage of economically disadvantaged students in campus

ANALYTIC PROCEDURES

In order to address the research questions, the study involved three statistical approaches – descriptive analysis, one-way analysis of variance (ANOVA) and a three-level hierarchical linear model (HLM). First, descriptive statistics presented the distribution of types of teachers classified by teachers' characteristics and qualifications, and by school characteristics, such as student demographic and socioeconomic characteristics, language background, and student achievement. A set of descriptive analyses indicated how teacher qualifications are associated with what features of students. Second, ANOVA was conducted to understand the extent to which teacher certification group affect each student's demographic factor and student achievement. Third, a multilevel statistical analysis was conducted to estimate the effect of teacher's qualification on students' TAKS reading scores while controlling student-level, teacher-level, and school-level factors that influence students' academic performance. In order to investigate how students', teachers', and school's factors affect student's achievement and explain the variation at each level, I built up the model by adding variables one level at a time.

Multilevel Models

The nature of data collected from TEA and Southeast Independent School District (SISD) is a nested structure with three layers of individual students, teachers, and schools. In other words, individual students are nested in teachers, and students and teachers are nested in schools. This hierarchical data structure allowed me to conduct a multilevel analysis so that I can examine multilevel factors' effects of students, teachers and schools on students' achievement. In addition, statistically, if a single-level multiple regression is used for multilevel structured data, variability of the nested data within

schools will be lost and statistical power is decreased (Stevens, 2009). The nested multilevel data provided an optimal structure to build a multilevel model in this study.

In order to estimate the effect of teacher's qualification, a three-level model was adopted to measure students' standardized test score gains after accounting for students' prior achievement levels, other background characteristics, teacher's qualifications and school conditions. Many previous studies have developed a multilevel model such as a value-added model (VAM) or student growth model to measure and evaluate teacher effectiveness for student academic progress (Buddin, 2010; Hanushek & Rivkin, 2010; McCaffrey, et al., 2004; Newton, et al., 2010; Raudenbush & Bryk, 2002), because the hierarchical liner models (HLM) can remove the effects of factors not under the control of school and teachers, such as prior achievement and socioeconomic background.

Despite its statistical advantages of hierarchical value-added model, some studies raise fundamental and complex statistical issues (Hanushek & Rivkin, 2010; McCaffrey, et al., 2004; Newton, et al., 2010). First, they caution about the assumptions of VAM that students learning can be measured solely by standardized test scores, although student learning is comprised of students' social, emotional, behavioral and intellectual growth (Diamond & Spillane, 2004; Johnson & Johnson, 2006). Second, there is a lack of a statewide data system including vertically scaled scores designed to support the longitudinal analysis (McCaffrey, et al., 2004; Newton, et al., 2010). This is the main reason why many states has not been adopted VAM in spite of the advantages of VAM for teacher evaluation. Third, even though VAM has developed to the way for effectively controlling contextual effects, completely isolating contextual factors from student achievement is not possible due to the high correlation between student test scores, prior learning condition, and family background. Lastly, instability of teacher ranking in VAM across time is another challenge (Sass, 2008). Since teacher effectiveness is vulnerable to

working conditions, school resources, and assigned students' characteristics, the consistency of teacher effectiveness rankings over time is inconclusive (Sass, 2008). In spite of the ongoing debates about VAM, this study adapted multilevel HLM to measure teacher's effect on student achievement because it is the most reliable version of measurement for teacher effectiveness currently available (Buddin, 2010; McCaffrey, et al., 2004; Newton, et al., 2010).

Prior to running a multilevel model, I ran a series of ordinary least square (OLS) regressions with student controls and school fixed effects to predict pupils' TAKS scores after taking into consideration the prior year's achievement in the same subject area. These OLS analyses will generate four residual (observed minus predicted) scores for each student. Then, I tested a three-level mixed-effects model to take into account the ways in which students are nested within classrooms and teachers are nested within schools.

A multilevel analysis is employed to determine both student-level and teacher-level factors that influence students' academic performance. Student's progress was estimated by adding previous year's achievement variables in the model. First, the fully unconditional model as the simplest model without any independent variables is used to obtain useful preliminary information about the amount of variance explained at each level and reliabilities (Raudenbush & Bryk, 2002). The fully unconditional model, at level 1, the outcome of Y_{ity} for case i within level-2 unit j and level-3 unit k, is represented as:

Level 1: Student-level model

$$Y_{ijk} = \pi_{0jk} + + \varepsilon_{ijk}, \qquad \varepsilon_{ijk} \sim N(0, \sigma^2)$$

Level 2: Teacher-level model

$$\pi_{0jk} = \beta_{00k} + r_{0jk}, \qquad r_{0jk} \sim N(0, \tau_\pi)$$

Level 3: Campus-level model

$$\beta_{00k} = \gamma_{000} + + u_{00k}, \qquad u_{00k} \sim N(0, \tau_\beta)$$

The model I used is summarized by Equation 1:

$$Y_{ijk} = \gamma_{000} + \varepsilon_{ijk} + r_{0jk} + u_{00k}, \quad (1)$$

where Y_{ijk} is the standardized test score (TAKS) of reading measure of student *i* that is observed with teacher *j* in school *k* in the targeted subject area. This simple three-level model partitions the total variability in the outcome Y_{ijk} into its three components: (level 1) among students within teachers, σ^2; (level 2) among teachers within schools, τ_π; and (level 3) among schools, τ_β. It also allowed me to estimate the proportions of variance in outcome at each of the three levels (Raudenbush & Bryk, 2002).

The conditional models allowed estimation of variability associated with the three levels—students, teachers, and schools. Adding explanatory variables at each level enable accounting for the variability. Student background characteristics, teacher's qualifications, and school's characteristics were used as explanatory variables at each level respectively. The model specifications are as follows:

Level 1: Student-level model

$$Y_{ijk} = \pi_{0jk} + \pi_{1jk}(X_1)_{jk} + \ldots + \pi_{pj}(X_p)_j + \varepsilon_{ijk}, \qquad \varepsilon_{ijk} \sim N(0, \sigma^2)$$

Level 2: Teacher-level model

$$\pi_{pjk} = \beta_{00k} + \beta_{01k}(X_1)_{jk} + \ldots + \beta_{pqk}(X_q)_{jk} + r_{pjk}, \qquad r_{0jk} \sim N(0, \tau_\pi)$$

Level 3: Campus-level model

$$\beta_{pqk} = \gamma_{000} + \gamma_{01k}(X_1)_k + \ldots + \gamma_{pk}(X_q)_k + u_{pqk}, \qquad u_{00k} \sim N(0, \tau_\beta)$$

The model I used is summarized by Equation 2:

$$Y_{ijk} = \gamma_{000} + \Sigma\pi_{pj}(X_p)_j + \Sigma\beta_{pqk}(X_q)_{jk} + \Sigma\gamma_{pk}(X_q)_k + \varepsilon_{ity} + r_{pjk} + u_{pqk} \qquad (2)$$

where Y_{ijy} is the standardized test score (TAKS) measure of student *i* that is observed with teacher *j* in school *k* in the targeted subject area; Previous Achievement is the standardized test score (TAKS) measure of student *i* that is observed with teacher *t* in the previous year; a vector of the student characteristics for student *i* with teacher *t* in school *k* is included at level-1; ε_{ijk} is the random effect associated with student *i*. At level-2, taken as a vector, the *r*'s are assumed to have a multivariate normal distribution with a mean vector of 0 and a covariance matrix T_π, with maximum dimension (K+1)×(K+1). At level-3, the *u*'s are also assumed to have a multivariate normal distribution with a mean vector of 0 and a covariance matrix T_β.

Explanatory variables of student characteristics at level 1 include previous achievement, gender, free or reduced price lunch status(economically disadvantaged), race/ethnicity(Hispanic dummy variable), Limited English Proficiency (LEP), At-risk of dropping out, and gifted and talented program participants. At level 2, the explanatory variables of teacher qualifications are included such as certified status, years of teaching experience, education level (bachelor, master, and doctoral), and a teacher from alternative certified program such as Teach for America. At level 3, the explanatory variables of campus characteristics are included such as campus accountability ranking and percentage of economically disadvantaged students in campus as a proxy of poverty. This study analyzed the effect of teacher's qualification on student achievement after controlling student and school characteristics using the multilevel model.

LIMITATIONS

Limitations of this study are as follows. First, the district's data was collected from PEIMS and student achievement was measured by the TAKS scores for Reading. In order to examine student progress over time, this study used only two consecutive years' data, because TAKS utilizes a horizontal scale scoring system. Vertical scale scores allow for directly comparing year-to-year test scores across different tests or subjects, because the scale score quantifies a students' performance relative to the passing standards or proficiency levels for tests (Texas Education Agency, 2011a). The Texas assessment system used a horizontal scale until 2009, which allows direct comparisons of test scores across different test administered but not across grades (TEA, 2011). Vertical scale scores were developed in 2009 for TAKS English reading and mathematics tests in grades 3 –8, so they are only available since 2010 (TEA, 2011). Due to the short implementation period of vertical scale scores, this study utilized only two consecutive years' TAKS scores for academic year 2009-2010 and 2010-2011.

Second, this study did not include immeasurable student, teacher, and school factors in despite of its importance. As I mentioned above, teacher quality is hard to define and is composed of both measurable and unmeasurable factors. For example, the time of teacher training could be measured but, the quality of teacher training could not be measured. Teacher's effort to be a high quality teacher is hard to quantify. In the same context, teacher's working conditions are also not easily measurable because there are many unobservable influential factors such as a school culture, the organizational climate of school, an effect of principal's leadership, relationship between administrators and teachers, teacher's morale, and so on. Thus, this research considered only quantifiable aspects of teacher qualifications and working conditions including teacher's certified status, education level, their teaching experiences, student racial composition in campus,

level of poverty, school's accountability ranking, instructional expenditure, etc. Therefore, invisible factors in each individual student, teacher, and school were ignored in this study. This limitation would be overcome in future research.

Chapter 4: Results

This chapter presents the main findings of the study on the effects of teacher qualifications on student achievement in Texas urban schools. In order to answer the research questions, I analyzed data with three steps of statistical analyses and I present the results in three sections: descriptive statistics, analysis of variance (ANOVA), and a three-level hierarchical linear regression analysis (HLM). to understand the extent to which teacher qualifications affect each student's demographic factor and student achievement. Third, I display multilevel model's results that estimate teacher effectiveness by teacher qualifications based on student achievement. Finally, I discuss the relationship between teacher effectiveness, teacher qualification, and student achievement.

STUDENT'S, TEACHER'S, AND SCHOOL'S CHARACTERISTICS BY TEACHER'S CERTIFIED STATUS

A descriptive analysis was conducted to obtain an understanding of students' demographic background, teacher's characteristics, and school's characteristics in this study. The data set for this study included 40,239 students and 969 teachers from 207 campuses in the Southeast Independent School District (SISD). Due to the substantial differences of characteristics between elementary and middle schools, the sample was divided into two school levels. For elementary schools, 16,594 students, 623 teachers, and 166 schools were included, and for middle schools, 23,645 students, 346 teachers, and 43 schools were included in the analysis.

Students' test scores were converted into a Z score with a mean of zero and standard deviation of one by grade level. The converting process into standardized scores was necessary because a vertical score system that makes test scores compatible regardless of grade level has been used since a vertical score system was being adopted in

Texas Education Agency from 2012. Yet, this study includes data from 2009-10 and 2010-11 school year. So, in order to compare data from 2009-10 to data from 2010-11 school year, transforming test scores into standardized scores was necessary.

Descriptive results of elementary schools were presented in Table 4.1. I separated the results into elementary schools and middle schools to compare the differences in characteristics among students, teachers and schools. The proportion of males and females were even in both elementary schools and middle schools. Compared with elementary school students, in middle schools, a higher percentage of students were economically disadvantaged, at-risk of dropping out, limited English proficient, and Hispanic. There are also more students in gifted and talented programs in elementary schools.

In teacher's qualifications years of teaching experience and level of education, showed similar averages in both school levels. For example, average years of teaching were 10.95 for elementary school teachers and 10.26 for middle school teachers. Most teachers hold bachelor's degree in both school levels. However, there was a noticeable difference in the certified status. 95% of elementary school teachers were fully-certified, while 90% of teachers were fully-certified in middle school. Also, only 3% of teachers were from Teach for America (TFA) in elementary schools, while 9% of teachers were from TFA in middle schools. These differences in teachers' certification status showed that teachers were less qualified in middle schools than teachers in elementary schools.

Table 4.1. Descriptive Statistics of Variables by School Levels

School levels	Variables	N	Mean	SD	Minimum	Maximum
Elementary	Students					
	TAKS ZRead09	15034	0.00	1.00	-3.42	2.31
	TAKS ZRead10	15034	0.00	1.00	-5.93	2.53
	Female	15034	0.51	0.50	0.00	1.00
	Economically disadvantaged	15034	0.77	0.42	0.00	1.00
	At-Risk	15034	0.36	0.48	0.00	1.00
	LEP	15034	0.13	0.34	0.00	1.00
	Gifted/Talented	15034	0.24	0.43	0.00	1.00
	Hispanic	15034	0.54	0.50	0.00	1.00
	African American	15034	0.30	0.46	0.00	1.00
	Teachers					
	Education level	565	0.34	0.50	0.00	2.00
	Experience of teaching	565	10.95	9.33	0.00	42.00
	Fully-certified	565	0.95	0.22	0.00	1.00
	TFA	565	0.03	0.18	0.00	1.00
	Schools					
	Accountability Rating	166	2.00	0.76	0.00	3.00
	School fund	166	7127.46	1138.18	272.00	9666.00
	S-T ratio	166	15.87	0.52	14.62	16.89
	% Econ_dis students	166	85.39	21.48	1.90	100.00
Middle	Students					
	TAKS ZRead09	23645	0.00	1.00	-5.82	2.81
	TAKS ZRead10	23645	0.00	1.00	-5.60	2.53
	Female	23645	0.51	0.50	0.00	1.00
	Economically disadvantaged	23645	0.79	0.41	0.00	1.00
	At-Risk	23645	0.48	0.50	0.00	1.00
	LEP	23645	0.17	0.37	0.00	1.00
	Gifted/Talented	23645	0.21	0.41	0.00	1.00
	Hispanic	23645	0.62	0.48	0.00	1.00
	African American	23645	0.25	0.43	0.00	1.00

Table 4.1 (continued)

Teachers					
Education level	346	0.38	0.54	0.00	2.00
Experience of teaching	346	10.26	9.60	0.00	42.00
Fully-certified	346	0.90	0.31	0.00	1.00
TFA	346	0.09	0.29	0.00	1.00
Schools					
Accountability Rating	43	1.42	0.73	0.00	3.00
School fund	43	8792.33	3802.20	559.00	27399.00
S-T ratio	43	14.66	0.66	11.20	15.56
% Econ_dis students	43	83.18	18.55	33.10	97.20

School conditions, such as campus accountability rating, amount of campus operating funds, student-teacher ratio, and percentage of economically disadvantaged students, were also slightly different. The average campus accountability rating was higher in elementary schools. The average amount of the campus operating funds was higher in middle schools. As a result, the descriptive statistics display the distinctions between student characteristics, teacher qualifications, and school conditions between elementary schools and middle schools.

MEANINGFUL DIFFERENCES BETWEEN STUDENT'S ACADEMIC AND DEMOGRAPHIC CHARACTERISTICS BY TEACHER'S QUALIFICATIONS

In order to highlight the differences of assigned students' demographics, teachers' characteristics, and schools' characteristics by teacher's qualifications, I classified teacher qualifications into three statuses: fully-certified, under-certified, and alternatively certified. As I mentioned earlier in the first chapter, the categories are operationally defined in this study. Fully-certified teachers include teachers who hold professional, standard, and out of state certifications. Under-certified teachers are defined as teachers who are emergency uncertified, temporary and emergency certified, probationary, and

nonrenewal permitted. Alternatively certified teachers are defined as teachers from alternative certification programs such as Teach for America (TFA). TFA was selected among several alternative teacher training institutions because it is well known as one of the most popular and effective programs. Teachers' experience of teaching was selected from zero to eight years.

In order to analyze the three groups' variances, I conducted the analysis of variances (ANOVA) and I analyzed elementary schools' data and middle schools' data separately so as to examine the differences according to school levels. The results from ANOVA showed that students' demographic background, teachers' characteristics, schools' characteristics, and students' test scores differed by teacher's qualifications. As can be seen in Table 4.2, there were substantial differences in achievement in each category for the teacher qualifications in elementary schools. First, TAKS test scores which were converted into Z-scores also showed differences by teacher's qualifications. TAKS reading scores were significantly higher for students who had a fully certified teacher than those of students of alternatively certified teachers, $F(2, 16594) = 13.21$, $p<.001$. In the standardized test scores with mean of zero, students who had fully-certified teachers were .02 and this was higher than test scores of under-certified teachers' and TFA teachers' students (-.04 and -.19, respectively).

Students' gender was evenly assigned, but the portion of economically disadvantaged students and of students with Limited English Proficiency (LEP) was significantly different by teacher qualifications. Post hoc analyses using the Tukey post hoc criterion for significance indicated that TFA teachers were more likely to have a greater number of economically disadvantaged students, $F(2, 16594) = 42.21$, $p<.001$, and LEP students than fully and under-certified teachers were, $F(2, 16594) = 10.21$, $p<.001$. Also, teachers from TFA had significantly more Hispanic students than fully-

and under-certified teachers, $F(2, 16594) = 163.63$, $p<.001$. Meanwhile, under-certified teachers had significantly more African American students than fully-certified teachers or TFA teachers. The results presented that under- or alternatively- certified teachers were more likely to teach minority students.

This finding suggested that TFA corps members were intentionally placed in high-need schools. Actually, TFA organization places TFA recruits to highly disadvantaged and low-performing schools, as part of their mission. From a different standpoint, another possible reason is that campuses that had alternatively certified teachers for years might score lower student achievement grades due to the low quality of teaching. Overall, the disparity of student's characteristics by teacher's qualification might lead to different consequences in regards to student achievement. These results also showed that students' demographic backgrounds should be controlled for to compare apples to apples for understanding teacher effectiveness by qualifications in the following hierarchical multilevel analysis.

Teacher's characteristics were also meaningfully different by their qualifications. In elementary schools, male teachers were outnumbered among fully-certified teachers than under-certified or alternatively certified teachers, $F(2, 16594) = 6.24$, $p<.01$. Interestingly, the proportion of male and female teachers was reversed in the middle schools' data in the next section. There were more male teachers among alternatively certified teachers in middle schools.

Fully-certified teachers are more experienced than other groups of teachers, $F(2, 16594) = 888.18$, $p<.001$. Teaching years of under-certified or alternatively certified teachers leaned toward zero to two years, whereas years of teaching experience of fully-certified teachers ranged from zero to forty-two years. The difference was anticipated because teachers from TFA were supposed to teach for only two years, and their teaching

experience is usually less than two years. Due to the huge differences of teaching years among teacher groups, the years of teaching was controlled in the multilevel analysis of the following section so that the effect of teaching experiences could account to estimate teacher's effect on student achievement.

In the level of education, fully-certified teachers were more likely to hold a master's and doctoral degree than under-certified and TFA teachers, $F(2, 16594) = 160.47$, $p<.001$. This is also a predicted result because TFA corps members are hired right after they graduate university. Therefore, in order to compare teacher effectiveness by teacher qualifications, teachers' teaching experience and education level was also controlled in the multilevel analysis.

Teachers' working environments represented by campuses' student demographic backgrounds and student academic achievements were compared by teachers' qualifications. Campus accountability ratings in 2011 were significantly higher for schools of fully-certified teachers than those of under-certified and TFA teachers' schools, $F(2,16594) = 27.33$, $p<.001$. Percentages of economically disadvantaged students and LEP students in campuses were significantly higher for TFA teachers than fully- and under-certified teachers' campuses, along with results, $F(2, 16594) = 93.95$, $p<.001$ and $F(2, 16594) = 272.22$, $p<.001$.

In middle schools, the differences within these groups of assigned students and campus' characteristics depending on the teacher's qualification were bigger than those of elementary schools. As can be seen in Table 4.4, students' academic achievement was significantly different between different teacher qualifications. TAKS reading achievement of students who had fully-certified teachers was significantly higher than those of students who had under-certified teachers or alternatively certified TFA teachers, $F(2, 23907) = 152.77$, $p<.001$.

Table 4.2. One-way ANOVA Results by Teacher's Qualifications in Elementary Schools

	Teacher's Qualifications			F	Post-Hoc
	(1)Fully certified	(2)Under-certified	(3)TFA		
Students					
TAKS ZRead	.02 (1.00)	-.04 (1.01)	-.19 (.94)	13.21**	1>3
Student_female	.51 (.50)	.51 (.50)	.49 (.50)	0.502	-
Economically disadvantaged	.77 (.40)	.79 (.40)	.92 (.27)	42.21***	3>1, 3>2
At-Risk	.36 (.48)	.39 (.48)	.41 (.49)	3.54*	3>1
Limited English Proficient	.14 (.35)	.14 (.33)	.20 (.38)	10.21*	3>1, 3>2
Gifted/Talented	.24 (.40)	.28 (.44)	.21 (.41)	4.13*	2>1
Hispanic	.54 (.50)	.41 (.49)	.87 (.34)	163.63***	3>1>2
African American	.30 (.46)	.41 (.50)	.08 (.30)	95.83***	2>1>3
Teacher					
Teacher_female	.87 (.35)	.91 (.30)	. 91 (.31)	6.24***	1>2, 1>3
Experience of teaching	12.19 (9.62)	.26 (.54)	.87 (1.62)	888.19***	1>3>2
Education level	.36 (.52)	.19 (.40)	.03 (.17)	160.48***	1>2>3
School					
2011 Campus Accountability Rating	2.09 (.78)	1.91 (.63)	1.94 (.55)	27.33***	1>2, 1>3
% of Economically disadvantaged in campus	79.13 (26.80)	83.69 (21.00)	93.01 (7.50)	93.95***	3>2>1
% of LEP	36.21 (20.89)	36.19 (24.49)	55.64 (12.98)	272.22***	3>1, 3>2

Note. p^{*} <.05, p^{**} <.01, p^{***} <.001. Standard deviations appear in parentheses below means. Means with differing subscripts within rows are significantly different at p <.05 based on Tukey's post hoc paired comparisons.

Student's gender was not meaningfully different depending on teachers' qualifications, but teachers from TFA had significantly more economically disadvantaged students, students with Limited English Proficiency (LEP), and students who are at-risk of dropping out of school compared to groups of fully and under-certified teachers ($F(2, 23907) = 121.81$, $p<.001$, $F(2, 23907) = 99.81$, $p<.001$ and $F(2, 23907) = 127.34$, $p<.001$). TFA teachers also had more Hispanic students than other groups of teachers $F(2, 23907) = 92.04$, $p<.001$. These results were similar to those of elementary schools; however the disparity within each demographic factor for the teacher qualifications was greater in middle schools. These results imply that TFA teachers in middle schools work with more high-needs students in inferior working environments when compared to fully certified, under-certified, and TFA teachers in elementary schools.

Teacher characteristics were also meaningfully different depending on teacher qualifications. In middle schools, the percentage of male teachers was significantly greater among TFA teachers than fully and under-certified teachers, $F(2, 23907) =182.00$, $p<.001$. Similar to elementary schools' results, teachers' teaching experience was much higher for a group of fully-certified teachers than the other two groups', $F(2, 23907) =2282.58$, $p<.001$. Teachers' level of education was also higher for fully and under-certified teachers than TFA teachers who typically hold only a bachelor's degree, $F(2, 23907) =375.55$, $p<.001$. As I mentioned above, this is because most TFA corps members are assigned right after having attained a bachelor's degree.

Campuses' student demographic backgrounds and student academic achievements were also compared by teachers' qualifications. Campuses' academic achievement is represented by accountability ratings. Campus accountability ratings in 2011 were significantly lower for schools of teachers from TFA than those of fully certified and under-certified teachers, $F(2, 23907) = 182.33$, $p<.001$. As for the results in elementary

schools, the percentages of economically disadvantaged students and LEP students in campuses were significantly higher for TFA teachers than fully or under-certified teachers' campuses, $F(2, 23907) = 459.65$, $p<.001$ and $F(2, 23907) = 602.60$, $p<.001$. Overall, there is a greater disparity within each demographic factor by teacher qualifications assessed in middle schools.

Through a set of one-way ANOVA tests, I found that students, teachers, and campuses' demographic characteristics showed significant differences depending on teacher qualifications. Teachers who are trained at a four-year college program or are fully-certified are teaching under the better school conditions in terms of their students' achievement and backgrounds. On the contrary, socially and economically disadvantaged students were more likely to have under-certified or alternatively certified teachers who were trained from a short-term program, such as TFA's five weeks of summer training. There is also an implication for further analysis. Since the differences of each demographic factor make meaningful variances in teacher's effectiveness based on their students' achievement, the factors should be controlled to estimate teacher effectiveness in further multilevel analysis. Then, I could examine teacher effect after accounting for all other factors that influence teacher effectiveness.

Table 4.3.One-way ANOVA Results by Teacher's Qualifications in Middle Schools

	Teacher's Qualifications				
	(1)Fully certified	(2)Under-certified	(3)TFA	F	Post-Hoc
Students					
TAKS Reading Z score	.037 (1.00)	-.083 (1.01)	-.36 (.90)	152.77**	1>3, 2>3
Student_female	.51 (.50)	.53 (.50)	.49 (.50)	2.26	-
Economically disadvantaged	.78 (.41)	.78 (.43)	.92 (.27)	121.81***	3>1, 3>2
At-Risk	.47 (.50)	.49 (.50)	.65 (.48)	127.34***	3>1, 3>2
Limited English Proficient	.16 (.36)	.12 (.33)	.28 (.45)	99.81***	3>1, 3>2
Gifted/Talented	.22 (.40)	.18 (.41)	.10 (.30)	94.76**	1>3, 2>3
Hispanic	.62 (.49)	.65 (.48)	.76 (.43)	92.04***	3>1, 3>2
African American	.25 (.43)	.19 (.40)	.22 (.42)	12.38***	1>2, 1>3
Teacher					
Teacher_female	.84 (.38)	.84 (.38)	.68 (.47)	182.00***	1>3, 2>3
Experience of teaching	11.41 (2.07)	.69 (1.56)	.34 (.57)	2283.58***	1>2, 1>3
Education level	.41 (.52)	.34 (.60)	.07 (.50)	375.55***	1>3, 2>3
School					
2011 Campus Accountability Rating	1.55 (.65)	1.50 (.62)	1.27 (.52)	182.33***	1>2>3
% of Economically disadvantaged in campus	78.04 (24.80)	75.00 (23.59)	91.94 (7.58)	459.65***	3>1>2
% of LEP	18.90 (11.78)	16.15 (9.43)	27.91 (10.88)	602.60***	3>1>2

Note. p^{*} <.05, p^{**} <.01, p^{***} <.001. Standard deviations appear in parentheses below means. Means with differing subscripts within rows are significantly different at p <.05 based on Tukey's post hoc paired comparisons.

MULTILEVEL ANALYSIS: EFFECTS OF TEACHER'S QUALIFICATIONS ON STUDENT'S READING ACHIEVEMENT

Next, hierarchical multilevel analysis was conducted to estimate the effect of teacher's qualifications on student's reading achievement. As I mentioned in chapter three, the data structure of SISD allowed building a model with three layers of students, teachers, and schools. In order to isolate the effects of teacher's qualifications, other influencing factors on student's achievement were controlled in the model. After the fully unconditional model, the conditional models with explanatory variables were conducted as follows:

Level 1: Student-level model

$Y_{ijk} = \pi_{0jk} + \pi_{1jk}$(Previous Achievement) $+ \pi_{2jk}$(Gender) $+ \pi_{3jk}$(Economically disadvantaged) $+ \pi_{4jk}$(At-risk) $+ \pi_{5jk}$(Limited English Proficiency) $+ \pi_{6jk}$(Gifted/Talented) $+ \pi_{7jk}$(Hispanic) + π_{8jk}(African America) ε_{ijk}, $\varepsilon_{ijk} \sim N(0, \sigma^2)$

Level 2: Teacher-level model

$\pi_{0jk} = \beta_{00k} + \beta_{01k}$(Certified status) + β_{02k}(Experience of teaching) + β_{03k}(Alternatively Certified(TFA)) + β_{04k}(Level of Education) + r_{0jk}, $r_{0jk} \sim N(0, \tau_\pi)$

$\pi_{1ik} = \beta_{10k}$

$\pi_{2ik} = \beta_{20k}$

$\pi_{3ik} = \beta_{30k}$

$\pi_{4ik} = \beta_{40k}$

$\pi_{5ik} = \beta_{50k} + \beta_{51k}$(Certified status)

$\pi_{6ik} = \beta_{60k}$

$\pi_{7ik} = \beta_{70k}$

$\pi_{8ik} = \beta_{80k}$

Level 3: Campus-level model

$\beta_{00k} = \gamma_{000} + \gamma_{001}$ (Campus Accountability Rating) + γ_{002} (Percentage of economically disadvantaged) + γ_{003} (The amount of operating fund) + γ_{004} (Student-Teacher Ratio) + u_{00k}, $u_{00k} \sim N(0, \tau_\beta)$

$\beta_{01k} = \gamma_{010}$

$\beta_{02k} = \gamma_{020}$

$\beta_{03k} = \gamma_{030}$

$\beta_{04k} = \gamma_{040}$

$\beta_{10k} = \gamma_{100}$

$\beta_{20k} = \gamma_{200}$

$\beta_{30k} = \gamma_{300}$

$\beta_{40k} = \gamma_{400}$

$\beta_{50k} = \gamma_{500}$

$\beta_{51k} = \gamma_{510}$

$\beta_{60k} = \gamma_{600}$

$\beta_{70k} = \gamma_{700}$

$\beta_{80k} = \gamma_{800}$

The model I used is summarized by Equation 3:

$Y_{ijk} = \gamma_{000} + \pi_{1jk}$ (Previous Achievement) + π_{2jk} (Gender) + π_{3jk} (Economically disadvantaged) + π_{4jk} (At-risk) + π_{5jk} (Limited English Proficiency) + π_{6jk} (Gifted/Talented) + π_{7jk} (Hispanic) + π_{8jk} (African America) ε_{ijk} + β_{51k} (Limited English Proficiency *Certified status) + β_{01k} (Certified status)$_{jk}$ + β_{02k} (Experience of teaching)$_{jk}$ + β_{03k} (Teach for America)$_{jk}$ + β_{04k} (Level of Education)$_{jk}$ + γ_{001} (Campus Accountability Rating)$_{00k}$ + γ_{002} (Percentage of economically disadvantaged)$_k$ γ_{003} (School fund)$_k$ + γ_{004} (Student-Teacher Ratio)$_k$ + ε_{ijk} + r_{0jk} + u_{00k}, (3)

Data from elementary schools and middle schools were separately analyzed in a two different models due to the distinct characteristics of two different school levels. I firstly presented elementary school's results and then showed middle school's results. Finally, I compared the two results and made conclusions regarding the differences.

Elementary Schools: The Fully Unconditional Model

The fully unconditional model as the simplest model without any independent variables is used to obtain useful preliminary information about the amount of variance explained at each level and reliabilities (Raudenbush & Bryk, 2002). The results of the variance components generated by the fully unconditional three-level model are given in Table 4.5. This simple three-level model partitions the total variability in the outcome Y_{ijk} into its three components: (level 1) among students within teachers, σ^2; (level 2) among teachers within schools, τ_π; and (level 3) among schools, τ_β. It also allowed me to estimate the proportions of variance in outcome at each of the three levels (Raudenbush & Bryk, 2002).

In the fully conditional model, there is only one fixed effect, γ_{000}, which is the average classroom mean of TAKS reading (γ_{000} = -0.07, t = -2.147) (See Table 4.5). At level 1, or student level, the proportion of the variance in TAKS Reading score that exists between students within teachers and within students is given by:

$$\frac{\sigma 2}{\sigma 2 + \tau\pi + \tau\beta} = \frac{0.767}{0.767 + 0.093 + 0.111} = 0.7899$$

At level 2, or teacher level, the proportion of the variance in TAKS Reading score that exists between teachers within schools is given by:

$$\frac{\tau\pi}{\sigma 2 + \tau\pi + \tau\beta} = \frac{0.093}{0.767 + 0.093 + 0.111} = 0.0957$$

At level 3, or school level, the proportion of the variance in TAKS Reading score that exists among schools is given by:

$$\frac{\tau\beta}{\sigma 2 + \tau\pi + \tau\beta} = \frac{0.111}{0.767 + 0.093 + 0.111} = 0.1143$$

The estimations showed that the largest percentage (78.99%) lies between students within teachers at level 1; 9.57% of variation lies between teachers within schools at level 2; and 11.43% of variation lies between schools at level 3. The variation of student-level was the largest and the variation of teacher-level was relatively smaller than that of student- and school-level.

The X^2 values also associated with these variance components indicated significant variation between teachers and among schools. The variation between teachers is statistically significant, X^2=1605.85 with 399 df (p<.001) and the variance between schools is also statistically significant, X^2=712.53 with 165 df (p<.001).

The fully unconditional model also estimated the reliabilities at two levels: teachers (level-1) and schools (level-2). Table 4.4 showed the reliabilities of the coefficients and indicated that the average reliability of the classroom's (or a teacher's) sample mean for use in discrimination among teachers within the same school, π_{0jk} is 0.692 at level 2, and the reliability of the school's sample mean as an estimate of its true mean, β_{00k} is 0.719 at level 3.

Table 4.4. Results from the Unconditional Model in Elementary School

Random coefficient		*Reliability estimate*		
INTRCPT1, π_{0jk} (Level-1)		0.692		
INTRCPT1/INTRCPT2 , β_{00k}	(Level-2)	0.719		
Fixed Effect	*Coefficient*	*se*	*T Ratio*	*P Value*
Average classroom mean, γ_{000}	-0.067	0.03	-2.147	0.033
Random Effect	*Variance Component*	*df*	X^2	*p Value*
Students (level 1), e_{ijk}	0.767			
Teachers (level 2), r_{0ij}	0.093	399	1605.85	.000
Schools (level 3), u_{0jk}	0.111	165	712.53	.000
Variance Decomposition	*(Percentage by Level)*			
Level 1	78.99			
Level 2	9.57			
Level 3	11.43			

Notes: $e_{ijk} = \sigma^2, r_{0ij} = \tau_\pi, \quad u_{ojk} = \tau_\beta$

These results implied that student achievement in reading varies by students' background or ability even when they have the same reading teachers. Also, student's reading achievement differs by individual teacher's quality even within schools and by schools. These results showed that even though students' individual differences are the important factors to explain their achievement, their teacher's and school's effects are not negligible based on their proportions of variances.

Elementary Schools: Conditional Models

In order to investigate how students', teachers', and school's factors affect student's achievement and explain the variation at each level, I built up the model by adding variables one level at a time. The conditional models allowed estimation of variability associated with the three levels—students, teachers, and schools. Adding explanatory variables at each level enable accounting for the variability. Student background characteristics, teacher's qualifications, and school's characteristics were used as explanatory variables at each level respectively. Therefore, I introduced predictors into the level-1 model, level-2 model, and level-3 model step by step at each time. So, when I introduced predictors into the level-1 model, I specified all corresponding π parameters as random at levels 2 and 3 and pose unconditional models at both levels (Raudenbush & Bryk, 2002). Then, predictors were added at level 2 from the previous model in the same manner. The final model included all predictors at all three levels and an interaction effect.

Model 1 included a student's previous year's achievement score and background variables, such as their grade, gender, race and ethnicity, economically disadvantaged status, at-risk of dropping out, LEP, and participants in gifted and talented programs, on level 1. In Model 2, level-2 variables regarding teacher's qualifications, such as teachers who are fully-certified, years of teaching experience, education level, and TFA status, were added on Model 1. This is for estimating the effect of teacher's qualifications on student achievement after controlling for student's background factors. The Model 3 included all level-1, level-2, and level-3 variables at all three levels. The Model 4, final model, added an interaction effect between LEP students and fully-certified teachers on the Model 3.

Table 4.5. Effects of Teacher's Qualifications on Student Achievement (Elementary Schools)

	Model 1		**Model 2**		**Model 3**		**Model 4(Final)**	
	Coefficient (se)	t (*p*)	Coefficient (se)	t (*p*)	Coefficien t (se)	t (*p*)	Coefficient (se)	t (*p*)
Student-level fixed effects								
(Intercept)	0.12 (.02)	4.60*** (.000)	0.10 (.05)	1.91* (.05)	0.12 (.44)	.272 (.78)	0.10 (.43)	0.27 (.83)
Previous year's reading score	0.52 (.01)	69.78*** (.000)	0.52 (.01)	69.69*** (.000)	0.52 (.01)	69.58*** (.000)	0.52 (.01)	69.69*** (.000)
Female	0.06 (.01)	5.13*** (.000)	0.06 (.01)	5.11*** (.000)	0.06 (.01)	5.10*** (.000)	0.06 (.01)	5.08*** (.000)
Economically disadvantaged	-0.09 (.02)	-5.57*** (.000)	-0.10 (.02)	-5.54*** (.000)	-0.09 (.02)	-5.15*** (.000)	-0.09 (.02)	-5.81*** (.000)
At-risk	-0.20 (.02)	-12.45*** (.000)	-0.20 (.02)	-12.45*** (.000)	-0.20 (.02)	-12.34*** (.000)	-0.20 (.02)	-12.35*** (.000)
LEP	-0.04 (.02)	-1.77 (0.08)	-0.04 (.02)	-1.76 (0.08)	-0.03 (.02)	-1.59 (0.11)	-0.15 (.067)	-2.24* (0.02)
Gifted/Tal	0.30 (.02)	17.66*** (.000)	0.30 (.02)	17.66*** (.000)	0.29 (.02)	17.58*** (.000)	0.29 (.02)	17.56*** (.000)
Hispanic	-0.09 (.02)	-4.41*** (.000)	-0.09 (.02)	-4.40*** (.000)	-0.09 (.02)	-4.21*** (.000)	-0.09 (.02)	-4.22*** (.000)
African American	-0.08 (.02)	-3.54 *** (.001)	-0.08 (.02)	-3.54 *** (.001)	-0.07 (.02)	-3.06 ** (.003)	-0.07 (.02)	-3.09 ** (.002)
Teacher-level fixed effects								
Fully-Certified			0.01 (.05)	0.87 (.38)	0.01 (.05)	0.22 (.82)	0.01 (.05)	0.20 (.84)
TFA			-0.03 (.06)	-0.47 (.64)	-0.01 (.05)	-0.37 (.71)	-0.02 (.05)	-0.33 (.74)
Yrs of teaching Experience			0.00 (.00)	0.87 (.38)	0.00 (.00)	0.52 (.60)	0.00 (.00)	0.53 (.60)
Level of Education			-0.00 (.02)	-0.30 (.76)	-0.00 (.02)	-0.18 (.86)	-0.00 (.02)	-0.19 (.85)
School-level fixed effects								
Accountability Ratings					0.15 (.02)	8.45*** (.000)	0.15 (.02)	8.42*** (.000)
% of Econdis					-0.00 (.00)	-.117 (.90)	-0.00 (.00)	-.281 (.90)
Operating Funds					0.002 (.00)	2.18* (.03)	0.002 (.00)	1.70* (.03)
Student-Teacher Ratio					-0.02 (.03)	-.57 (.57)	-0.02 (.03)	-.58 (.56)

Table 4.5 (continued)

Cross-level interaction					
LEP*Fully-Certified Teachers				0.13 (0.07)	1.83 (.06)
Random Effect					
Level 1 and Level 2					
Variation, e_{ijk}	0.463	0.463	0.463	0.463	
Variation, r_{0ij}	0.025	0.025	0.025	0.025	
Chi-square	934.34***	932.24***	932.24***	932.24***	
df	399	399	395	395	
p value	.000	.000	.000	.000	
Level 3					
Variance Comp.	0.021	0.022	0.009	0.009	
Chi-square	418.70***	419.62***	281.40***	281.40***	
df	165	165	161	161	
p value	.000	.000	.000	.000	

Notes. Each model was compared to the immediate previous model (p^{*} <.05, p^{**} <.01, p^{***} <.001)

Table 4.5 presents the estimation of fixed effects for the three levels in each model. In Model 1, the level 1 predictors, such as previous year's test score and student background, was found to have a significant impact on students' TAKS score. All predictors were statistically significant expect LEP status. The largest coefficient, 0.52 of previous year's reading score indicated that student's prior achievement markedly and positively predicted current student's achievement level. It means that students who attained a higher score the previous year were also likely to attain higher scores on the current year's test. Since the prior achievement is a powerful predictor to explain student's achievement, some research about value-added models using student's longitudinal test scores were used only as a variable of student's prior achievement in order to control student background. This is because the researchers assumed that student's prior achievement level was reflecting the effect of student background factors. However, in this study, I just considered student's prior achievement as one of a student's

background predictors, because the effects of other variables were still large after controlling it.

Moreover, other background factors showed statistically significant influence on student achievement. For example, students in gifted and talented programs were likely to obtain 0.3 more points in TAKS. Student's gender showed a significant influence on achievement scores on the TAKS reading test with a coefficient of 0.06. It means that girls were likely to gain 0.06 more points than boys on the TAKS reading test. This was the same result with previous research that showed girls perform better than boys in reading. On the other hand, students who were designated as at risk of dropping out of school, and economically disadvantaged, and Hispanic students showed a significant but negative influence on student achievement. For example, students who were designated at risk of dropping out were likely to score 0.20 points lower and students who were eligible for free and reduced meals were likely to score 0.1 point lower on the TAKS reading test. Additionally, Hispanic students and African American students were likely to score 0.09 and 0.08 points less respectively. Overall, I confirmed that student's previous performance level and student background are still very strong predictors to explain student achievement from Model 1.

In Model 2, teacher-level variables, such as certification status, years of teaching experience, and level of education, were added to Model 1. The Level 1 coefficient had hardly changed after adding level 2 predictors. Teacher-level predictors explained a small amount of the variance of level 2 and their coefficients were also smaller compared to the coefficient of student-level predictors. None of fully-certified teachers and alternatively-certified teachers was statistically significant factors to predict student achievement. The possible reason is that the proportion of fully-certified teachers is 95% in elementary schools.

Model 3 included all three levels of predictors. School-level predictors, such as campus accountability ranking, the amount of operating funds for the campus, student-teacher ratio, and percentage of economically disadvantaged students, were added to Model 2. After adding school-level variables, the overall values of level-1 and level-2 coefficients were slightly decreased, but the significance and directions was not changed. Among school-level predictors, campus accountability ranking was a highly significant factor to predict student achievement. Based on the school's performance, the schools receive one of four possible rankings: Exemplary (the highest possible ranking), Recognized, Academically Acceptable, and Academically Unacceptable (the lowest possible ranking). The results showed that as the ranking increased one step, student's test scores were likely to rise 0.15 point. School's operational funds per students also significant; however, in spite of the statistical significance to predict student achievement, the effect size of the coefficient (-0.002) and the standard error of close to zero is too small to conclude that student scores, in reality, are affected by school's operational funds.

In addition to the predictors that showed a direct effect on student performance, Model 4 included an interaction effect between Level 1 and Level 2 predictors so as to explore whether fully-certified teachers influence the reading performance of students with LEP or not. The coefficient of fully-certified teachers on LEP students ($y=0.13$, $t=1.83$) indicated a positive effect of having fully-certified teachers with LEP students, although the level of significance was borderline ($p=0.059$). This result showed that LEP students who had fully-certified teachers achieve higher scores on the TAKS reading test. The other variables' coefficient values were similar with Model 3, but the coefficient of LEP predictor changed to -0.15 ($p<0.05$) from -0.03 ($p=0.44$) after adding an interaction term between fully-certified teachers and LEP students.

Table 4.5 presents the results obtained from each model for estimates of the variance components. After adding predictors in each level, the estimates of variance components decreased in comparison with those in the fully unconditional model. The proportions of variance explained at each level in the final model were calculated as follows:

Proportion of variance explained at level-1:

$$\frac{\widehat{\sigma}2(Unconditional) - \widehat{\sigma}2\ (Model\ 4)}{\widehat{\sigma}2(Unconditional)} = \frac{0.767-0.463}{0.767} = 0.3963$$

Proportion of variance explained at level-2:

$$\frac{\widehat{\tau\pi}(Unconditional) - \widehat{\tau\pi}(Model\ 4)}{\widehat{\tau\pi}(Unconditional)} = \frac{0.093-0.025}{0.093} = 0.7312$$

Proportion of variance explained at level-3:

$$\frac{\widehat{\tau\beta}(Unconditional) - \widehat{\tau\beta}\ (Model\ 4)}{\widehat{\tau\beta}(Unconditional)} = \frac{0.111-0.009}{0.111} = 0.9189$$

The results showed that 40% of the level-1 variance, 73% of the level-2 variance and 92% of the level-3 variance in reading achievement was accounted for by the predictors of student background and previous achievement, teacher's qualifications and school conditions in the final model. It was interesting that the variance explained at level-3 or the between-schools level is approximately 92%. It meant that variables included in the final model mostly explained the difference of student's achievement between schools. The noticeable point was that the school's accountability ranking was one of the most significant factors among school-level variables in the final model.

In addition, the total variance explained was estimated by multiplying variance explained by the final model and variance explained by the fully unconditional model. The total variance explained was calculated as follows:

The total variance explained between-students:

$$0.3963 \text{ (final)} \times 0.7899 \text{ (fully unconditional)} = 0.31$$

The total variance explained within-teachers:

$$0.7312 \text{ (final)} \times 0.0957 \text{ (fully unconditional)} = 0.07$$

The total variance explained between-schools:

$$0.9189 \text{ (final)} \times 0.1143 \text{ (fully unconditional)} = 0.11$$

The total variance explained by the model:

$$0.31 + 0.07 + 0.11 = 0.49$$

Therefore, the proportion of total variance explained by the model is 49%.

Overall, the final model did not emphasize the effect of teacher qualifications on student's performance as hypothesized; however, I found the positive effect of fully-certified teachers on the reading performance of LEP students. Also, the model confirmed the strong effect of student background on their achievement in accordance to previous studies (Darling-Hammond, 2007; Lareau, 2003). It was also noticeable that campus accountability was the strongest predictor to estimate student performance among other school-level factors that are traditionally considered as strong predictors of student achievement, such as percentage of economically disadvantaged students, the amount of operating budget, and student-teacher ratio. The middle school level's analysis in the following section showed a somewhat different and meaningful outcome regarding the effect of teacher's qualification on student performance from these analyses of the elementary school level.

Middle Schools: The Fully Unconditional Model

The results of the variance components generated by the fully unconditional three-level model are given in Table 4.7. This simple three-level model partitions the total variability in the outcome Y_{ijk} into its three components: (level 1) among students within teachers, σ^2; (level 2) among teachers within schools, τ_π; and (level 3) among schools, τ_β. An estimate of the proportions of variance in outcome at each of the three levels was calculated.

In the fully conditional model, there is only one fixed effect, γ_{000}, which is the average classroom mean of TAKS reading (γ_{000} = -0.172, t = -2.581) (See Table 4.7.).

At level 1, or student level, the proportion of the variance in TAKS Reading score that exists between students within teachers and within students is given by:

$$\frac{\sigma 2}{\sigma 2 + \tau\pi + \tau\beta} = \frac{0.674}{0.674 + 0.197 + 0.154} = 0.6575$$

At level 2, or teacher level, the proportion of the variance in TAKS Reading score that exists between teachers within schools is given by:

$$\frac{\tau\pi}{\sigma 2 + \tau\pi + \tau\beta} = \frac{0.197}{0.674 + 0.197 + 0.154} = 0.1921$$

At level 3, or school level, the proportion of the variance in TAKS Reading score that exists among schools is given by:

$$\frac{\tau\beta}{\sigma 2 + \tau\pi + \tau\beta} = \frac{0.154}{0.674 + 0.197 + 0.154} = 0.1502$$

The estimations showed that the largest percentage (65.75%) lies between students within teachers at level 1; the second largest percentage (19.21%) of variation lies between teachers within schools at level 2; and 15.02% of variation lies between schools at level 3. The X^2 values also associated with these variance components indicated significant variation between teachers and among schools. The X^2 values

indicated the variation between teachers was statistically significant, X^2=5951.54 with 303 df (p<.001) and the variance between schools was also statistically significant, X^2=273.57 with 42 df (p<.001). The fully unconditional model also estimated the reliabilities at two levels: teachers (level-1) and schools (level-2). Table 4.6 showed the reliabilities of the coefficients and indicated that the average reliability of the classroom's (or a teacher's) sample mean for use in discrimination among teachers within the same school, π_{0jk} is 0.923 at level 2, and the reliability of the school's sample mean as an estimate of its true mean, β_{00k} is 0.812 at level 3.

Table 4.6. Results from the Unconditional Model in Middle Schools

Random coefficient		*Reliability estimate*		
INTRCPT1, π_{0jk} (Level-1)		0.923		
INTRCPT1/INTRCPT2 , β_{00k}	(Level-2)	0.812		
Fixed Effect	*Coefficient*	*se*	*T Ratio*	*P Value*
Average classroom mean, γ_{000}	-0.172	0.07	-2.581	0.014
Random Effect	*Variance Component*	*df*	X^2	*p Value*
Students (level 1), e_{ijk}	0.674			
Teachers (level 2), r_{0ij}	0.197	303	5951.54	.000
Schools (level 3), u_{0jk}	0.154	42	273.57	.000
Variance Decomposition (Percentage by Level)				
Level 1	65.75			
Level 2	19.12			
Level 3	15.02			

Notes: $e_{ijk} = \sigma^2, r_{0ij} = \tau_\pi, \quad u_{ojk} = \tau_\beta$

These results showed a similar pattern with elementary school's results and implied that middle schools' student reading achievement varies by students' background or ability even when they have the same reading teachers and student's reading achievement differs by individual teacher's quality even within schools and by schools. It meant that even though students' individual differences were important factors to explain their achievement, their teacher's and school's effects are also significant factors based on their proportions of variances.

Middle Schools: Conditional Models

In the same manner as the conditional models of the elementary schools, I also built up the models by adding variables one level at a time so that I could observe the change of variability associated with each model. The same kinds of variables as the elementary school models were used in the middle school models so as to maintain constancy and to compare the results between elementary schools and middle schools. Model 1 included student-level variables, such as a student's previous year's achievement score and background variables, in level 1. In Model 2, teacher-level variables regarding teacher's qualifications, such as teachers who are fully-certified, years of teaching experience, education level, and TFA status, were added in Model 1. Model 3 included all student, teacher, and school variables at all three levels. Model 4, a final model, added an interaction effect of LEP students and fully-certified teachers in Model 3.

The estimation of fixed effects for the three levels in each of the four models are presented in Table 4.7. In the first model (Model 1), all level-1 predictors were statistically significant to estimate students' TAKS reading score except for the variable of Hispanic students. The largest coefficient, 0.5 of previous year's reading score indicated that student's prior achievement positively predicted current student's

achievement as the result of elementary schools. Students who attained a higher reading score the previous year were also likely to gain higher scores on the TAKS reading test.

Other student background factors were also statistically significant to explain student achievement. As expected, students in gifted and talented programs were likely to obtain 0.31 more points, while students who were designated as at risk of dropping out of school, and economically disadvantaged, LEP and Hispanic students showed significant but negative influence on student achievement. At-risk students were likely to score 0.27 points lower and students who were eligible for a free and reduced lunch were likely to score 0.08 point lower on the TAKS reading test. LEP students' scores were also 0.12 points lower than other students. However, the Hispanic variable was not a significant predictor to explain student achievement, while it was a significant variable in the elementary school models. In addition, student gender showed a substantial influence on achievement scores in TAKS reading test with a coefficient of 0.03. It meant that female students were likely to attain 0.03 more points than male students in reading. Overall, I confirmed that student's previous performance and student background were very strong predictors to explain student achievement regardless of students' school level.

In Model 2, teacher-level variables, such as certification status, years of teaching experience, and level of education, were added to Model 1. Although teacher-level variables were added, the level-1 coefficient hardly changed and their coefficients were also smaller compared to the coefficient of student-level predictors. It showed that a small amount of the variance of level 2 was explained after adding teacher-level variables. However, unlike the elementary school's results, the variable of fully-certified teachers displayed a statistically significant impact on student's reading achievement ($y=0.10$, $t=3.31$). That is, students who had fully-certified teachers were more likely to attain 0.1 points than those who had under-certified teachers and TFA teachers. While the

effect of fully-certified teachers was not statistically significant in elementary schools, it is noticeable that the impact was markedly and positively significant in middle school. As I mentioned above in the descriptive statistics section, there were fewer fully-certified teachers and more under-certified and alternatively certified teachers in middle schools when compared to teachers in elementary schools. The disparity in the number of highly qualified teachers in the two school levels would influence the different effect of teachers' qualifications on student performance.

School-level predictors, such as campus accountability ranking, the amount of operating funds for the campus, student-teacher ratio, and percentage of economically disadvantaged students, were added to Model 3. After adding school-level variables, the overall values of level-1 and level-2 coefficients slightly decreased, but the significance and directions were not changed. Among school-level predictors, campus accountability ranking and the percentage of economically disadvantaged students was a significant factor to predict student achievement in middle schools. For instance, when campus accountability ranking increased one step, student's test scores were likely to rise 0.06 point. Whereas campus accountability rating was the only significant factor among school-level variables in elementary schools, the percentage of economically disadvantaged students on a campus was also a statistically significant factor to explain student reading performance. However, in spite of the statistical significance of the percentage of economically disadvantaged students on campus for predicting student achievement, the effect size of the coefficient (-0.002) and the standard error of close to zero is too small to conclude that student scores were significantly lower on campuses that had more economically disadvantaged students.

Table 4.7. Effects of Teacher's Qualifications on Student Achievement (Middle Schools)

	Model 1		Model 2		Model 3		Model 4(Final)	
	Coefficient (se)	t (*p*)	Coefficient (se)	t (*p*)	Coefficient (se)	t (*p*)	Coefficient (se)	t (*p*)
Student-level fixed effects								
(Intercept)	0.22 (.02)	9.79*** (.000)	0.14 (.04)	3.78*** (.156)	0.80 (.35)	2.28* (.028)	0.80 (.35)	2.31* (.026)
Previous year's reading score	0.50 (.01)	84.93*** (.000)	0.50 (.01)	84.96*** (.000)	0.49 (.01)	84.77*** (.000)	0.49 (.01)	84.77*** (.000)
Female	0.03 (.01)	3.10** (.002)	0.03 (.01)	3.15** (.002)	0.03 (.01)	3.17** (.002)	0.03 (.01)	3.02** (.003)
Economically disadvantaged	-0.08 (.01)	-6.00*** (.000)	-0.08 (.01)	-6.00*** (.000)	-0.07 (.01)	-5.49*** (.000)	-0.07 (.01)	-5.51*** (.000)
At-risk	-0.27 (.01)	-23.65*** (.000)	-0.27 (.01)	-23.66*** (.000)	-0.27 (.01)	-23.53*** (.000)	-0.27 (.01)	-23.58*** (.000)
LEP	-0.12 (.01)	-8.32*** (.000)	-0.12 (.01)	-8.38*** (.000)	-0.12 (.01)	-8.40*** (.000)	-0.21 (.04)	-5.49*** (.000)
Gifted/Tal	0.31 (.01)	22.77*** (.000)	0.31 (.01)	22.82*** (.000)	0.31 (.01)	22.47*** (.000)	0.31 (.01)	22.43*** (.000)
Hispanic	-0.12 (.02)	-7.07*** (.000)	-0.11 (.02)	-7.08*** (.000)	-0.11 (.02)	-6.81 (.000)	-0.11 (.02)	-6.83 (.000)
African American	-0.14 (.02)	-8.45*** (.000)	-0.15 (.02)	-8.48*** (.000)	-0.14 (.02)	-8.23*** (.000)	-0.14 (.02)	-8.22*** (.000)
Teacher-level fixed effects								
Fully-Certified			0.10 (.03)	3.31*** (.001)	0.11 (.03)	3.72*** (.000)	0.09 (.03)	3.02** (.003)
TFA			0.01 (.03)	0.348 (.727)	0.03 (.03)	0.98 (.329)	0.04 (.03)	1.10 (.273)
Yrs of teaching Experience			-0.001 (.00)	-1.55 (.12)	-0.001 (.00)	-1.69 (.09)	-0.001 (.00)	-1.69 (.09)
Education level			0.00 (.01)	0.01 (.99)	0.00 (.01)	0.00 (.99)	0.00 (.01)	-0.07 (.95)
School-level fixed effects								
Accountability Ratings					0.06 (.02)	3.44** (.002)	0.06 (.02)	3.49*** (.002)
% of Econdis					-0.002 (.00)	-4.07*** (.000)	-0.002 (.00)	-4.17*** (.000)
Operating Fund					0.001 (.00)	-1.50 (.145)	0.000 (.00)	-1.47 (.150)
Student-Teacher Ratio					-0.04 (.02)	-1.52 (.136)	-0.03 (.02)	-1.54 (.131)

Table 4.7 (continued)

Cross-level interaction					
LEP*Fully-Certified Teachers				0.10 (0.04)	2.43* (.015)
Random Effect					
Level 1 and Level 2					
Variation, e_{ijk}	0.423	0.423	0.423	0.423	
Variation, r_{0ij}	0.01	0.01	0.01	0.01	
Chi-square	804.74***	770.12***	799.39***	789.15***	
df	303	299	299	299	
p value	.000	.000	.000	.000	
Level 3					
Variance Comp.	0.007	0.006	0.001	0.001	
Chi-square	167.30***	166.87***	69.61***	67.30***	
df	42	42	38	38	
p value	.000	.000	.002	.000	

Notes. Each model was compared to the immediate previous model (p^{*} <.05, p^{**} <.01, p^{***} <.001)

Model 4 included an interaction effect between fully-certified teachers and LEP students so as to explore whether fully-certified teachers have an influence on the reading performance of students with LEP. The coefficient of an interaction effect (y=0.1, t=2.43) indicated a significantly positive effect of having fully-certified teachers with LEP students. That is, LEP students who had fully-certified teachers achieved 0.1 points higher scores on the TAKS reading test. The result is meaningful in that the effect of fully-certified teachers on reading achievement was significant to students who had limited language ability. The results implied the importance of fully-certified teachers for students in need. After adding an interaction effect, the other coefficient values were similar with Model 3, but the coefficient of LEP predictor increased to -0.21 (t=5.49) from -0.12 (t=8.40). Considering that LEP students typically achieved lower than their peers, the results implied that fully-certified teachers mitigate the effect of LEP on TAKS reading.

Moreover, the estimates of the variance components from each model are presented in Table 4.7. The proportions of variance explained at each level in the final model were calculated as follows.

Proportion of variance explained at level-1:

$$\frac{\widehat{\sigma}2(Unconditional) - \widehat{\sigma}2\ (Model\ 4)}{\widehat{\sigma}2(Unconditional)} = \frac{0.658-0.423}{0.658} = 0.36$$

Proportion of variance explained at level-2:

$$\frac{\hat{\tau}\pi(Unconditional) - \hat{\tau}\pi(Model\ 4)}{\hat{\tau}\pi(Unconditional)} = \frac{0.191-0.01}{0.191} = 0.95$$

Proportion of variance explained at level-3:

$$\frac{\hat{\tau}\beta(Unconditional) - \hat{\tau}\beta\ (Model\ 4)}{\hat{\tau}\beta(Unconditional)} = \frac{0.150-0.001}{0.150} = 0.99$$

The results showed that 36% of the level-1 variance, 95% of the level-2 variance and 99% of the level-3 variance in reading achievement was accounted for by the predictors of student background and previous achievement, teacher's qualifications and school conditions in the final model.

Lastly, the total variance explained was estimated by multiplying variance explained by the final model and variance explained by the fully unconditional model. The total variance explained was calculated as the follows.

The total variance explained between-students:

0.36 (final) × 0.66 (fully unconditional) = 0.24

The total variance explained within-teachers:

0.95 (final) × 0.19 (fully unconditional) = 0.18

The total variance explained between-schools:

0.99 (final) × 0.15 (fully unconditional) = 0.15

The total variance explained by the model:

$$0.23 + 0.18 + 0.15 = 0.56$$

Therefore, 56% of the proportion of total variance was explained by the model.

SUMMARY OF RESULTS

Results from the descriptive statistics indicated clear distinctions among student characteristics, teacher's qualifications, and school conditions between elementary schools and middle schools. The results revealed that more difficult and disadvantageous conditions exist in middle schools than in elementary schools. Middle schools served a higher percentage of students that were economically disadvantaged, at-risk of dropping out, limited English proficient, and Hispanic. Moreover, there were more alternative certified teachers and less fully-certified teachers in middle schools. The average campus accountability rating was also lower in middle schools. Overall, school conditions in middle schools were worse than in elementary schools.

Student, teacher, and school characteristics were classified by teacher qualifications such as fully-certified, under-certified, and alternatively certified (TFA). This study found that assigned students' characteristics showed meaningful differences by teacher certification status and that alternatively certified teachers were more likely to be assigned to teach students who had an economically and socially disadvantaged background. The TFA organization places recruits in highly disadvantaged and low-performing schools that suffer from teacher shortages. In other words, it means that students with economically and socially disadvantaged backgrounds lose a chance to have fully-certified or highly qualified teachers.

On the level of a teacher's education, fully-certified teachers were more likely to hold a master's and doctoral degree than under-certified and TFA teachers. The test

scores of students who had fully-certified teachers were, on average, higher than the test scores of under-certified teachers' and TFA teachers' students. Campus accountability ratings were significantly lower for schools that had teachers from TFA than those of fully-certified and under-certified teachers.

Chapter 5: Discussion

With a growing emphasis on students' academic performance since the enactment of the No Child Left Behind Act of 2001 (NCLB), a corresponding increase in attention has been given to the importance and need for high quality teachers (Darling-Hammond, 2000; Darling-Hammond & Baratz-Snowden, 2005; Hanushek & Rivkin, 2004; Hanushek & Rivkin, 2010; Rivkin, et al., 2005). NCLB recognizes the importance of quality teachers in improving student achievement in that it mandates that all students have to be taught by "a highly qualified teacher". However, the policy effort to meet the increasing demand for qualified teachers under NCLB has in fact led to a shortage of qualified teachers nationwide. In the United States, as a result, an uneven distribution of high quality teachers has existed and has been exacerbated. A closer look at urban areas reveals that the problem has been more severe in those localities than the national average because highly qualified teachers have been recruited mostly to better-funded districts with better working conditions, which are mostly located in suburban areas. Therefore, urban schools have had a more difficult time recruiting and retaining high quality teachers compared to affluent suburban schools (Borman & Dowling, 2008; Boyd, et al., 2010; Hanushek, et al., 2004).

Similarly, Texas has faced a chronic shortage of qualified teachers (Eller, et al., 2000; Herbert & Ramsay, 2004; The State Board for Educator Certification [SBEC], n.d.-b; U.S. Department of Education, 2010). In an effort to alleviate the teacher shortage, a large number of teachers who were accredited through Alternative Certification Programs (ACP) have been employed in public schools in Texas (The State Board for Educator Certification [SBEC], n.d.-a). As a result, teachers trained from ACPs have occupied a large portion of the teacher population in Texas. For example, for the 2010-2011 school

year, among all the states in the nation, Texas had the largest number of Teach for America (TFA) corps(Gastrock, 2010, May 24).

While the expansion of ACPs has been considered as an effective solution to address teacher shortage issues in highest need schools (Raymond, et al., 2001), the relatively short preparation time required of ACP teachers has presented a question as to whether the preparation is adequate to properly qualify teachers. Many of ACP programs can be completed in a short period from five weeks to one year. While still participating in the program, the trainees have a paid teaching position in a public school classroom (SBEC, n.d.-b). Whereas a large and increasing number of ACP teachers have been committed to public schools, there is no information as to whether they contribute to improving the achievement of their students.

For this reason, the purpose of this study was to examine which students were allocated to highly qualified teachers and which were to alternatively certified and under-qualified teachers in what school conditions. In addition, this study was conducted to examine whether teachers from alternative certification programs effectively teach students in comparison to teachers who were fully-certified from university-based preparation programs in high needs urban area. The study answered the following questions:

1. How are high quality teachers distributed across a large, urban district according to student's characteristics, school characteristics and student achievement in elementary schools and middle schools?
2. How does teacher's quality influence student achievement in urban elementary schools and middle schools?
3. How does teacher's quality influence the achievement of students with limited English proficiency in urban elementary schools and middle schools?

In order to address the research questions, a conceptual framework for this study was based on the theories of human capital and professional capital and empirical studies regarding teacher quality, teacher effectiveness, and teacher turnover. The human capital theory provided a foundational underlying assumption in this study that high quality teachers who are the most important asset and human resource in schools would play an essential role in leading student to success.

Student data utilized in this analysis came from the Public Education Information Management System (PEIMS), which is a data collection and reporting system produced by the Texas Education Agency (TEA) for the public schools of Texas. SISD provided teacher's data so that teacher's and their students' data could be matched. The study involved three statistical approaches – descriptive analysis, Analysis of variance (ANOVA) and three-level hierarchical linear models (HLM) to address research questions. In the remainder of this chapter, I summarize the study's findings and discuss these findings with respect to the unequal distribution of highly qualified teachers and the effect of highly qualified teachers on student achievement. I then discuss the implications of the study for policy, practice, theory, and research in the subsequent sections.

SUMMARY OF FINDINGS

In order to address the first research question, a descriptive statistics and an analysis of variance (ANOVA) was conducted. Results from a descriptive statistics and the ANOVA verified the hypotheses and showed an unequal distribution of high quality teachers across urban schools. In an effort to display the study's major finding, a brief overview of the answer to each research question was provided below:

1. *How are high quality teachers distributed across a large, urban district according to students' characteristics, school characteristics and student achievement in elementary schools and middle schools?*

There were clear distinctions among teacher's qualifications, student characteristics, and school conditions between elementary schools and middle schools. The results revealed that more difficult and disadvantageous conditions exist in middle schools than in elementary schools. Middle schools served a higher percentage of students that were economically disadvantaged, at-risk of dropping out, limited in English proficiency, and Hispanic. Moreover, there were more alternatively certified teachers and less fully-certified teachers in middle schools. The average campus accountability rating was also lower in middle schools.

As suggested in the hypotheses, the characteristics of students were distinct depending on the certification status of teachers they were assigned to. Economically disadvantaged students, minority students, and students with limited English proficiency are more likely to be allocated to alternatively certified teachers in both elementary and middle schools. It means that students with economically and socially disadvantaged backgrounds are deprived of chance to have fully-certified or highly qualified teachers. The disparity might cause a vicious circle in that students from economically and socially disadvantaged backgrounds show poorer performance due to receiving instruction from under-certified and alternatively certified teachers. Indeed, the test scores of students who had fully-certified teachers were significantly higher than the test scores of under-certified teachers' and alternatively certified teachers' students. Campus accountability ratings were significantly lower for schools that employed teachers from alternative certification programs, such as Teach for America, than those of fully-certified teachers.

2. *How does teacher's quality influence student achievement in elementary schools and middle schools?*

In order to explain the effect of teacher quality and school condition besides student's characteristics on student performance, a multilevel analysis was necessary to explain each variance of student, teacher, and school. Through the multilevel analyses, I confirmed that student background or prior ability is the strongest predictor of student achievement, as previous studies have found. The results showed that student achievement significantly differs by students' background or prior ability even when they have the same reading teachers. However, the results also showed that teacher's and school's effects on student achievement are not to be overlooked based on their proportions of variances.

Among the variables regarding teacher qualifications, the fully-certified teacher variable was a solely significant and positive factor in student achievement in middle schools. That is, students who had fully-certified teachers were more likely to achieve higher test scores than those who had under-certified and alternatively certified teachers. In particular, the effect of teacher qualifications on student achievement was stronger for middle school students. Compared to middle schools, in elementary schools teacher qualifications were not statistically meaningful factors to estimate student performance after controlling for student's demographic background variables and school-level variables. I guessed that this is because there are more under- or alternatively certified teachers in middle schools than in elementary schools. The effect of teacher's qualifications was stronger in middle schools.

Among school-level predictors, campus accountability ranking was a significant factor to predict student achievement in both school levels. Student performance was significantly higher in higher ranking campuses, based on the school accountability

ranking. The percentage of economically disadvantaged students on campus was negatively associated with student achievement in middle schools. Overall, students who had high quality teachers on a campus that has fewer economically disadvantaged students were more likely to perform better.

It was also noticeable that campus accountability ranking was the strongest predictor among other school-level factors while traditionally strong predictors of student achievement were such as percentage of economically disadvantaged students, the amount of operating budget, and student-teacher ratio. I assumed that there would be a significant impact of test-based school accountability system.

3. *How does teacher's quality influence the achievement of students with limited English proficiency in urban elementary schools and middle schools?*

Since the study focused on reading achievement, the effect of teacher's quality on the achievement of students with limited English proficiency was particularly concerning. To address research question 3, an interaction effect between teacher certification status and the achievement of students with limited English proficiency was added on the three-level model. Results from the analysis showed that after accounting all variables LEP students who had fully-certified teachers achieved 0.1 scores higher on the TAKS reading test in the middle schools. Considering that LEP students typically achieved lower than their peers, the results implied that fully-certified teachers mitigate the effect of LEP on TAKS reading. The finding showed a positive effect of fully-certified teachers for students in need and corresponded with previous studies that high quality teachers played a more important role for socially and economically disadvantaged students.

In spite of or because of the inferior conditions, the effect of teacher qualifications on student achievement was stronger in middle schools as shown in a three-level analysis. In particular, for students with limited English proficiency, teacher's effect was

significant. That is, LEP students who had fully-certified teachers achieved higher scores on the TAKS reading test. This result implied that teacher quality plays a more important role to improve student achievement for students in need.

The amount of teacher- and school-level variances from a three level model was larger than expected. For example, 9.57 percent of teacher effect and 11.43 percent of school effect existed in elementary school's model. In middle schools, the amount of variances increased to 19.12 percent of teacher effect and 15.02 percent of school effect. The values implied that a multiple regression or a two-level HLM was not enough to find where the variances exist. The amount of student-level variances was 65.75 in middle schools, while it was 78.99 in elementary schools. It implied that student's background variables are more powerful predictor of student achievement in elementary schools; however, the impact decreases in middle schools. Instead, teacher's and school's impact increased in middle schools.

All in all, this study confirmed that teacher quality was a significant predictor to estimate student achievement and highly qualified teachers played a more important role for students in need. Well-prepared high quality teachers were important for all students, but especially for students who are in high-need schools with a large portion of economically disadvantaged and low-performing students. Nonetheless, highly qualified teachers are currently unequally distributed across the urban school district examined in the study. Socially and economically disadvantaged students were less likely to be taught by fully-certified teachers and were more likely to be taught by alternatively certified teachers. Under this circumstance it is not surprising that their achievement was significantly lower than that of their peers who were taught by highly qualified teachers. Therefore, this study stressed the necessity of even distribution of high quality teachers

across urban schools so that all students have high quality teachers with fully certification in accordance to NCLB's slogan.

IMPLICATIONS FOR POLICY AND PRACTICE

The results of this study provide a number of important implications to inform policymakers and practitioners in designing and implementing teacher policies to improve student achievement and teacher quality at the district and school levels in urban public schools.

The study results revealed that middle schools had a higher proportion of students that were economically disadvantaged and at-risk of dropping out. Thus, at the school district level, it is necessary to provide additional support for middle schools. One of the supports is to identify high quality teachers and assign or recruit them to middle schools in need. In particular, this study found the positive interaction between highly qualified teachers and low-achieving LEP students in middle schools. Thus, the school district should make an effort to recruit more highly qualified teachers using incentive pay for individual teachers or group of teachers or other methods in order to better meet the needs of their students. Previous research has shown mixed results as to the effect of incentive pay. However, recent studies that were conducted in Texas schools have found that performance pay was positively related to improvements in student achievement and teacher effectiveness (Barkowski, 2012).

Over the past decade policy makers have increased financial and political support for alternative teacher preparation programs. For example, the Texas Legislature has continued to support the expansion of the number of Teach for America teachers in Texas, and appropriated millions of dollars to the program each year (Ware et al., 2011). One major reason for the widespread political support of alternative certification

programs like Teach for America is that such programs quickly, and relatively cheaply, meet an immediate need to get teachers into classrooms. As the results of the study show, alternatively certified teachers teach more economically disadvantaged students, minority students, and students with limited English proficiency in both elementary and middle schools. Alternative certification programs, however, often require very little pre-service training, and leave teachers ill-prepared to deal with the challenges of working in high-need school environments.

Whereas the effectiveness of TFA and other alternatively certified teachers are still being debated, it has been recognized that the effect of TFA teachers on raising student achievement is smaller than the effect of teachers from regular university-based teacher training programs (Harris & Sass, 2011; Heilig, et al., 2011). Furthermore, this study's findings suggest that there was a positive correlation between teacher's fully-certified status and student achievement. As such, it seems that increasing number of alternative teacher preparation programs may not be the ultimate solution to settle the problem of teacher shortages in high-needs schools. In order to solve the chronic problem of teacher shortages in urban schools, it is essential to invest in cultivating high quality teachers with a long-term view. Increasing support for high quality teacher preparation programs and expanding the pool of fully-certified teachers in the field is necessary. Thus, policy makers should consider allocating more financial and political support to high quality teaching preparation programs, and teacher preparation programs must work to improve recruitment strategies to attract and credential a larger volume of promising students.

In addition to this, policy makers need to pay close attention to the result that schools where fully-certified teachers work had higher school accountability ratings. The results did not indicate that there is a causal relationship between teacher quality and

school accountability rating; however, it demonstrated a significant relationship between them. Current high-stakes accountability policies put high demands on teachers to improve students' standardized test scores in a short period, especially in urban schools, where there is typically lower performance (Boyd, Lankford, Loeb, & Wyckoff, 2005; Diamond & Spillane, 2004; Jacob, 2007). Despite various efforts that may encourage highly qualified teachers to work in high-needs schools, a majority of teachers would still prefer to teach at high-performing and high-ranking schools (Jacob, 2007). Consequently, as mentioned in the previous sections, economically and socially disadvantaged students end up losing their opportunity to have high quality teachers. This perpetuates a vicious cycle by discouraging high-quality teachers from working in low-performing schools. In this manner, the test-based accountability system has increased the inequality between high-performing and low-performing schools (Diamond & Spillane, 2004; McNeil, 2005; Scheurich, Skrla, & Johnson, 2000).

The test-based accountability system that focuses too much on test scores has brought unintended consequences to the public education system and teacher's work (Valli & Buese, 2007; Webb, 2006). One possible alternative is to decrease the value or proportion that students' test scores contribute to the overall calculation of school accountability ratings or teacher evaluations. In Korea, evaluations of schools and teachers have been conducted annually, but students' academic performance has not been included in the evaluations. Instead, a survey of the level of satisfaction from parents, students, and teachers in regards to school management and teaching quality are included. Also, qualitative measures are included, such as multiple class observations from peer teachers, principals, parents, and educational experts and post-observation conference with colleagues and school administrators. Including such factors as interviews with

administrators and portfolios of student work throughout the semester could provide more substantial materials to evaluate schools and teachers.

Lastly, Southeast school district needs to improve and expand teacher level data collection to capture the complexity of high quality teachers, especially, since there is a lot of variance among fully-certified teachers. Generally, school districts have focused on collecting only administrative purposed data and it has provided a great amount of understanding of the current status of schools. However, from a standpoint of teacher quality, the available data are insufficient to provide insight on the complexity of high quality teachers. Thus, school district data needs to include more specific information, such as teacher's level of commitment to teaching and teachers' self-efficacy (Skaalvik & Skaalvik, 2010), race of teachers and race-congruency with students (Egalite, Kisida, & Winters, 2015), teacher's level of satisfaction of school's working conditions (Cha, 2008) and assigned students' prior and present achievement levels (Hanushek & Rivkin, 2007; Newton, et al., 2010; Rivkin, et al., 2005). This complexity would provide better knowledge of high quality teachers beyond the definition of "highly qualified teachers" of NCLB. Regarding students' race, the study results presented the lower performance in standardized test of Hispanic and African American students. A previous study found that there is a positive effect of same-race teachers on student achievement for lower-performing African American students (Egalite, et al., 2015). Current data need to be collected on teacher race in order to better understand the benefit of being assigned to a race-congruent teacher and to address racial competency.

THEORETICAL IMPLICATIONS

In this study, human capital theory and professional capital theory provided a useful theoretical framework. The study's findings indicated that human capital in the

form of well-prepared and fully-certified professional teachers positively affected student achievement and, in particular, achievement of students in need. In contrast, under-prepared teachers had no affirmative impact on student progress. The study findings imply that long-term investment in the preparation of professional teachers is critical for school and student's academic success, particularly in high-need schools with a high concentration of students from impoverished and minority backgrounds.

The expansion and on-going support of alternative certification programs in the United States reflects a business capital strategy that aims to increase immediate returns with lower investment in teaching and teacher quality. From the point of view of business capital theory, teachers from alternative preparation programs, such as Teach for America (TFA) are considered a productive and cost-effective human resource because they are "inexpensive to train at the beginning, un-pensioned at the end and replaceable" (Hargreaves &Fullan, 2012, p. 2). However, as the study findings show, alternatively certified teachers were not as effective of a resource as fully certified teachers in supporting student achievement.

The study results revealed that human capital theory had limitations for explaining the impact of high quality teachers in that well-educated human capital, such as TFA recruits, did not produce positive outcomes for student. This may be because they were not appropriately prepared for a career of teaching in spite of their knowledge and capability. What is needed to more fully understand the urban school context is professional human capital theory, which suggests that it takes a longer period of time with more financial effort to foster high quality teaching professionals (Hargreaves & Fullan, 2012). With a long-term investment, the policy strategy could support more educational equity for all students.

IMPLICATIONS FOR RESEARCH

There are two parts of implications for research in the aspects of methods and the content of the findings. I also suggested future research based on the study limitations. This study conducted a three-level analysis to explore the effect of teacher quality on student's standardized test achievement. Most studies that found influencing factors on student achievement have preferred to adopt a multiple regression or a two-level hierarchical linear model with students' and teachers' data or with students' and schools' data than to use a three-level model with students', teachers', and schools' data due to the difficulties of data collecting and the matching process. However, the amount of teacher- and school-level variances from a three-level model was quite large to ignore. For example, 9.24 percent of teacher effect and 11.8 percent of school effect existed in elementary school's model. In middle schools, the amount of variances of teacher effect increased to 19.12 percent and the amount of variances of school effect amplified to 15.02 percent. The total variances from teacher and school are totally more than 20% in elementary schools and are more than 34% in middle schools.

The amount of variances implied that a multiple regression or a two-level HLM was not enough to find where the variances exist and the total variances are assumed from students' individual differences. Thus, future research should also consider a three-level analysis to estimate the effect of teachers or schools on student achievement or student achievement growth. Otherwise, variances from students would be overly estimated.

In a multilevel model in this study, teacher-level variables showed a smaller effect on student achievement than the effect of student-level or school-level variables after controlling for all other predictors. The main reason was that the impact of students' background characteristics and their prior performance on their achievement were

statistically powerful enough to estimate student achievement. For this reason, some studies used only one variable of students' prior achievement because they presumed that students' prior achievement was reflective of the effect of student background factors. Thus, I recommend using only one variable of students' prior achievement so that teacher effects would be relatively larger than one from this study.

Another reason that the teacher effect was small in the study is that some important teacher-related variables that affect teacher quality might not be included in the model, such as teachers' preparation time for instruction, frequency or time participating in teacher training, a teacher's commitment, a sense of efficacy and so on. Therefore, future research should consider including other teacher variables that explain teacher's internal factors to decide teacher quality.

Accordingly, future research on teacher quality should consider using qualitative data beyond administrative purposed data used in this study. The advantages of administrative purposed data are that they are annually collected by the education agency (e.g. Texas Education Agency in Texas) and enable the comprehension of the objective situation in regard to schools and districts as they provide an overview of the corresponding school district. However, the administrative data are only focused on a measurable index even though immeasurable internal factors are equally important in evaluating teacher quality. The present study provided important insights into the effect of teacher quality on student academic outcomes using administrative purposed data, but there is still a great need for future research in the area of internal factors that affect teacher quality. A qualitative approach using interviews or a survey would be helpful to enlighten teachers' internal factor in future research.

In this study, an operational definition of a high quality teacher was used as a teacher who was a fully-certified teacher. However, a more detailed approach to define

the term of teacher quality is needed in future research. In fact, the definition of teacher quality or teacher effectiveness is difficult to generalize because teacher effectiveness is greatly affected by context rather than absolute indexes, as Newton and her colleagues (2010) pointed out. Therefore, defining the term of 'teacher quality' or 'teacher effectiveness' is needed to garner more attention in future studies.

Furthermore, future research should more closely investigate TFA teachers' effectiveness and turnover trends from a micro perspective. This approach is still needed to enlighten TFA teacher's roles and efforts in schools, such as how committed they are to teaching their students, how cooperative they are with other teachers, and how enthusiastic they are in building a network with other TFA teachers. In future research, the role and effectiveness of TFA teachers at a school organization and classroom should be scrutinized on a micro level from a qualitative perspective.

Finally, this study was conducted with data from an urban school district. The findings of the study could be different if a study focused on wealthy suburban context. Thus, future research should consider a comparative analysis of the impact of teacher quality on student achievement between an urban school district and a suburban school district.

CONCLUSION

Public education in the United States has pursued the ideal that every student should have high quality teachers. However, this study found that high quality teachers were not equally distributed to all students in reality. Especially, I confirmed that most students in high-needs school are losing a chance to have a high quality teacher even though they are more in need of instructional support from a high quality teacher. In light of the results presented above, various implications are suggested for policymakers and

practitioners in designing and implementing teacher policies to improve student achievement in urban public schools.

This study contributes to the existing body of research by exploring the specific impact of teachers from alternative certification programs compared to teachers with other levels of certification on student outcomes using a three-level analysis model. The results provide useful information about the distribution of teachers by their types of certification and the impact of teacher quality on student achievement in Texas, one of the largest employers of alternatively certified teachers. Additionally, unlike other teacher quality research related to alternatively-certified teachers this study focuses on a comparison analysis between elementary schools and middle schools. The comparative results highlight the different contribution of highly qualified teachers between elementary schools and middle schools.

Appendix A: Data Matching Process

Student data (Student's ID)

1 : SID | 9001089950

	SID	Campus	campus10	Grade09	Grade
1	9001089950	47	47	07	08
2	9001099079	47	47	07	08
3	9001103027	77	56	08	08
4	9001105341	47	47	08	08
5	9001105345	47	47	08	08
6	9001108057	75	75	07	08
7	9001114266	59	59	07	08
8	9001118285	60	60	07	08
9	9001120315	47	47	07	08
10	9001120939	338	338	07	08
11	9001121854	82	456	07	08
12	9001122022	59	59	07	08

Teacher data (Teacher ID)

: TID | 1014

	TID	Gen	BirthDate10	Campus10	Department10
1	1014	F	1944-09-02	1	Austin High School
2	1024	F	1947-04-27	2	Bellaire High School
3	1032	F	1965-11-19	229	Roberts Elementary
4	1045	M	1961-08-18	15	Waltrip High School
5	1048	M	1954-04-13	148	Elrod Elementary
6	1049	F	1955-06-18	201	MacGregor Elementary
7	1053	F	1959-05-16	223	Pugh Elementary
8	1065	F	1960-05-21	283	Garcia Elementary
9	1073	M	1965-03-19	114	Braeburn Elementary
10	1075	F	1944-03-08	11	Milby High School
11	1078	F	1958-07-19	276	Shadowbriar Elementary
12	1079	F	1959-08-27	239	Shearn Elementary

Link file (Students' and Teachers' IDs only without information)

	TID	subject	gradeT	CID	SID
576139	[illegible]	Reading	4	130	[illegible]
576140	09338	Reading	4	130	9001500067
576141	09338	Reading	4	130	9001500071
576142	09338	Reading	4	130	9001500073
576143	09338	Reading	4	130	9001500088
576144	09338	Reading	4	130	9001500089
576145	09338	Reading	4	130	9001500090
576146	09338	Reading	4	130	9001500109
576147	09338	Reading	4	130	9001500118
576148	09338	Reading	4	130	9001500195
576149	09338	Reading	4	130	9001500198
576150	09338	Reading	4	130	9001500205

Matched file

: WHITE | 0

	SID	TID	CID	GradeType	Grade10	Read09	Read10	ZRead09	ZRead10	S_female
1	9001332628	1032	229	1	5	667	829	.21	1.28	
2	9001296371	1032	229	1	5	725	763	.80	.55	
3	9001302444	1032	229	1	5	667	643	.21	-.77	
4	9001321112	1032	229	1	5	647	763	.01	.55	
5	9001363014	1032	229	1	5	725	829	.80	1.28	
6	9001366112	1032	229	1	5	691	763	.45	.55	
7	9001366339	1032	229	1	5	853	763	2.08	.55	
8	9001383283	1032	229	1	5	853	904	2.08	2.10	
9	9001383291	1032	229	1	5	725	763	.80	.55	
10	9001383363	1032	229	1	5	591	683	-.55	-.33	
11	9001383387	1032	229	1	5	778	775	1.33	.68	
12	9001383977	1032	229	1	5	853	829	2.08	1.28	
13	9001383979	1032	229	1	5	853	763	2.08	.55	
14	9001384201	1032	229	1	5	631	683	-.15	-.33	

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