Teacher Resources and Student Achievement in High-Need Schools

RESEARCH REPORT

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Research Report
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Executive Summary

With the growing federal, state, and local policy emphasis on teacher quality and student achievement, the Southwest Educational Development Laboratory (SEDL) investigated teacher resources and their relationship to student achievement in Arkansas, Louisiana, and Texas. The purpose of this study was to provide policymakers with information about the relationship between teacher salary, experience, and education, and the relationship between these teacher resources and student achievement, particularly in high-need schools. SEDL used state databases in Arkansas, Louisiana, and Texas to examine the extent to which districts paid teachers based on years of experience and degree level, and whether teacher resources, defined as salary, education, and experience, were distributed differently across schools depending upon their level of need. SEDL also investigated whether within and across the three study states paying teachers based on experience and education contributed to student achievement test scores, specifically on elementary and middle school reading and math tests. SEDL answered three research questions.

1. To what extent do teacher experience and education relate to teacher salary?
    - Teacher experience and education are the primary factors that contribute to teacher salary levels.
    - Variations in teacher salaries exist in schools that are located in rural settings, are populated by high-poverty and a high percentage of minority students, and have low student achievement.
    - An overall pattern in the data revealed salary increases along a typical "step and ladder" structure for education and experience

2. Do teacher salary, experience, and education vary for different categories of high-need schools and between high-need and non-high-need schools?
    - Schools that are low performing, have high concentrations of student poverty and minority students, and are located in rural settings, tend to have less-qualified teachers.
    - The rural location of schools was more "high-need," by definition, than the urban location in the three states studied.
    - The strongest finding across states revealed that schools in rural locations, in conditions of high poverty and low achievement in math, were staffed with the lowest paid teachers, with lower percentages of graduate education, especially compared to urban schools.
3. What effects do teacher salary, experience, and education have on student achievement, particularly in high-need schools?
    - The findings linking teacher education and experience to student achievement are minimal, leaving little to be said about the influence of teacher resources on student achievement in reading and math.
    - Of the teacher resources, teacher salary was related to student achievement in math and reading in Texas, and to student achievement in reading in Arkansas.
    - Teacher education beyond the undergraduate degree had no relationship to student achievement in reading and was found to be negatively associated with math scores only in Texas.
    - Findings for teaching experience were likewise inconsistent.

- There were few significant findings related to high-need schools; teacher education beyond the undergraduate degree was negatively associated with fourth-grade math scores in rural and high-poverty schools and the findings for teaching experience were inconsistent.

Conclusions and Recommendations

In the policy efforts to improve and appropriately compensate teacher quality, special attention needs to be paid to those qualities that positively influence student achievement, especially in high-need schools. The current study did not find conclusive support for the importance of teacher experience, advanced degrees, or teacher salary on student achievement in math or reading. These findings may reveal a problem with current conceptualizations of teacher quality, especially in terms of compensation systems, given the limited effects of teacher resources on student achievement.

Because the statistical link between teacher experience and education and student achievement is tenuous at best, policymakers and education researchers need to find alternate measures of teacher quality that are associated with improved student achievement to provide direction for teacher compensation reform. SEDL's research on this and previous studies indicates that state policymakers would assist future inquiries about teacher compensation by improving state databases. In particular, SEDL recommends that state databases provide documentation of additional teacher compensation data elements, such as individual benefits, incentives, and bonuses, at the individual teacher level, and provide more accurate teacher experience data.

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Introduction

Current state and federal education priorities have increased policymakers' and researchers' attention to the question of whether paying teachers according to their experience and education, as is typically done, is related to student performance. A long-standing body of research on teacher experience and education has not shown any conclusive effects on student achievement, bringing to question whether existing salary structures should be left in place. On the other hand, research indicates that high salaries attract a higher quality teacher pool and also confirms that teacher salary levels influence individuals' decisions to enter and stay in teaching roles (Figlio, 1997, 2002). Despite these findings, teacher compensation is still often viewed as a policy strategy that could be used to improve student achievement, especially in high-need schools that have difficulty recruiting and retaining teachers.

With the growing state and local policy emphasis on teacher quality and student achievement, the Southwest Educational Development Laboratory (SEDL) investigated teacher resources and their relationship to student achievement in Arkansas, Louisiana, and Texas. The purpose of this study was to provide information to policymakers about the relationship between teacher salary, experience, and education, and the relationship between these teacher resources and student achievement, particularly in high-need schools. SEDL used state databases in Arkansas, Louisiana, and Texas to examine the extent to which districts paid teachers based on years of experience and degree level, and whether teacher resources, defined as salary, education, and experience, were distributed differently across schools depending upon their level of need. SEDL also investigated whether within and across the three study states there was any connection between

paying teachers based on experience and education and student achievement test scores, specifically on elementary and middle school reading and math tests.

The connection between teacher salary, teacher characteristics, and student achievement is a high-priority policy issue. Previous research in this area is limited, especially studies that confirm the extent to which teacher experience and education predict teacher salary, discriminate high-need schools on the basis of the distribution of teacher resources, and examine the relationship between teacher resources and student achievement in high-need schools.

Problem Statement

This study is the third policy research study SEDL has conducted in the area of education resource allocation. Resource allocation refers to the ways in which fiscal and non-fiscal resources are divided among competing needs and expended for education purposes. State policy imperatives and the fact that teacher salaries account for over half of instructional costs statewide drive the need for more research to disentangle the relationship between teacher salary, experience, education, and student achievement.

Current state and federal education priorities have prompted policymakers and researchers to question whether paying teachers according to their experience and education corresponds to their effectiveness in the classroom. Several related areas of concern are relevant to this study. First, paying teachers based primarily on years of education and experience may not correspond to the attributes of teacher effectiveness for which they should be compensated in the current climate of school improvement efforts (Odden and Kelly, 2002). Teacher experience and education, the basis for the single salary schedule, may not affect student performance in a conclusively positive direction,

bringing to question whether existing salary structures effectively support student achievement (Podgursky, 2004; Rice, 2003). There are attributes other than experience and education that better measure teachers' effectiveness in the classroom, such as subject-specific credentials, and the selectivity/prestige of the higher education institution the teacher attended (Rice, 2003).

Second, the current system limits administrators' flexibility to pay teachers differently, especially in order to attract high-quality teachers to less desirable high-need schools (Podgursky, 2004, Prince, 2002). Research supports that high salaries attract a higher quality teacher pool (Figlio, 1997, 2002). Recent research also confirms that teacher salary levels influence individuals' decisions to enter and stay in teaching roles, especially in high-need schools (Goldhaber & Player, 2003; Milanowski, 2003).

Third, urban and rural schools, often characterized by high student poverty, high percentages of minority students, and low student achievement, have difficulty attracting high quality teachers in their efforts to improve student performance (Lankford et al., 2002; Johnson & Strange, 2005). As a result, the cycle of inadequately qualified teachers, teaching high-need populations, and struggling with low student achievement, persists in these schools. This pattern of teacher resources (i.e., lower salary, education, and experience) in schools characterized by high need must be addressed, especially in light of the state and national emphasis on raising student achievement across all subgroups of students.

Purpose of the Study

The purpose of this study was to provide information to policymakers about the relationship between teacher salary, experience, and education, and the relationship

between these teacher resources and student achievement, particularly in high-need schools. SEDL used state databases in Arkansas, Louisiana, and Texas to examine the extent to which districts paid teachers based on years of experience and degree level, and whether teacher resources, defined as salary, education, and experience, were distributed differently across schools depending upon their level of need. SEDL also investigated whether within and across the three study states there was any relationship between the funds expended on teachers' salaries, or their education and experience, and student achievement test scores, specifically on elementary and middle school reading and math tests.

The findings from this study come at a time when many states are considering policy initiatives such as whether to increase teacher salary and whether to provide incentives aimed at staffing and improving achievement, especially in high-need schools. SEDL expects that this work will increase policymakers' knowledge base regarding the links between teacher salary, teacher characteristics like education and experience, and student achievement.

Research Questions

In order to provide information to policymakers on issues salient to teacher salary, teacher characteristics, and student achievement, SEDL pursued answers to the following research questions:

1. To what extent do teacher experience and education relate to teacher salary?
2. Do teacher salary, experience, and education vary for different categories of high-need schools and between high-need and non-high-need schools?

3. What effects do teacher salary, experience, and education have on student achievement, particularly in high-need schools?

Conceptualizing Teacher Resources and Student Achievement

For this study SEDL conceptualized teacher resources as the salary paid to teachers and the education and teaching experience of those teachers. SEDL identified school-level student achievement in math and reading as the outcome of interest. Several critical considerations were assumed in the conceptualization of this study.

- Teacher salaries were set at the district level. Although each of the three study states had a statewide minimum salary schedule, districts within each state often create their own schedules that supercede the state minimum and may vary widely across districts (Ballou & Podgursky, 2002; Lankford et al., 2002).
- Teacher experience and education were traditional determinants of teacher pay and were the two characteristics considered in setting district salary schedules.
- A wide range of factors affected the variation in salaries paid to teachers across districts. These included per pupil expenditures, district locale, district wealth, and district size.
- Geographic locale played a significant role in determining a pattern of variation in teacher resources, in addition to student poverty and minority, and low student achievement.
- A similarly wide range of factors influenced student achievement beyond teacher resources. Such factors included student demographic characteristics (poverty, minority status), school characteristics (rural or urban location, prior year

achievement, school size), and district characteristics (instructional expenditures per pupil, average median household income, parent education).

Literature Review

Previous research on teacher salary, teacher characteristics, and high-need schools provided important considerations for this study. While laying some groundwork for the current study, past research on teacher salary and teacher characteristics has not clarified any one position in ongoing policy debates about teacher pay. For example, teacher compensation is in the forefront of current policy discussions, yet researchers have not found strong links between teacher salaries and student achievement (Hanushek et al., 1999). Teacher characteristics such as the first several years of teaching experience, however, have been shown to affect student achievement to different degrees, depending on the environment (Croninger, Rice, & Rathbun, 2003).

SEDL considered three major areas of existing research to provide a context for this study: the use of teacher experience and education as the basis for determining teacher salary; teacher resource patterns that afflict high-need schools; and the relationship between teacher salary, teacher characteristics, and student achievement.

Teacher Experience and Education in the Allocation of Salaries

In hiring teachers, district administrators place candidates within salary ranges based on their experience and education. Districts allocate resources for instruction according to the amounts available to them through their state funding distributions. All three states in the current study allocate state education funds using minimum foundation programs, which set the "formula" for a foundation level of revenue per pupil that would insure a minimum level of education quality. Of the three states in the current study, Louisiana and Texas use a base funding amount as well as weighted factors that are applied to each student's educational needs (e.g., special education); Arkansas is similar

but uses a modified version in which the foundation amount varies by school rather than one common base amount for all schools (Griffith, 2005; Odden & Picus, 2004).

Teacher salary levels have traditionally been based on teachers' years of experience and degree-level (Odden & Kelley, 2002). According to a national survey, 96.3% of public school districts in the United States use a single salary schedule in which years of experience and education level, referred to as steps and ladders, are the primary determinants of pay level (National Center for Education Statistics, 2002). This way of determining teacher salary was initiated in the 1920s to improve the equity of teacher pay and continues to be supported by teachers' unions and associations (Podgursky, 2004; Prince, 2002). Paying teachers based on their experience and education not only addresses important pay equity concerns, it also encourages teacher longevity and advanced education in the profession and provides a simple and universal standard for paying teachers (Odden and Kelly, 2002; Prince, 2002).

Teacher salaries are typically set at the district level and tend not to vary widely within district (Lankford et al., 2002). In the case of a large district, pay scales for a large number of elementary to secondary teachers, across all types of courses taught, may be defined by a single district salary schedule. The single district-level structure does not allow administrators the flexibility to vary salary levels as needed (e.g., to pay more for recruitment purposes) across many schools, which describes one of its problems. A number of limitations associated with single salary schedules have been noted in the literature: districts cannot ameliorate critical teacher shortages in special education, science, and math with the restricted bargaining power imposed by single salary schedules; salary schedules based upon education and experience restrict administrators'

ability to reward effective teachers; and schedules fixed at the district level, in medium to large districts, influence pay across a large number of schools with differing environments and needs.

In practice, resources allocated to instructional expenditures, which are not uniform across districts, influence the single salary schedule. Additionally, there is wide variety in the salary structures school districts employ, the levels of pay associated with steps and ladders, and the number of changes districts may implement in their salary schedules over time (Podgursky, 2004). Although the structure of the single salary schedule standardizes an approach, it appears that actual teacher pay levels are influenced significantly by a number of other local demographic factors.

While the historical development of the single salary schedule can be seen as one that rectified pay equity problems and brought a professional structure to the allocation of teacher pay, the current need to improve schools draws new attention to the way teachers are paid (Odden & Kelley, 2002). Researchers need to analyze the wide variation in teacher salaries across districts to estimate whether student and school demographic characteristics may be influencing teacher pay. In effect, there is a dearth of research that directly estimates the degree to which education and experience contribute to the prediction of salary. A better understanding of the factors driving teacher salary levels may assist decisions about compensation reform, especially if demographic characteristics of districts contribute to salary patterns. The entrenched patterns suppressing teacher salaries in districts that need to improve their teacher quality must be untangled.

Teacher Resources and High-Need Schools

Research literature supports policy initiatives aimed at raising teacher salaries and creating recruitment incentives for high-need areas. In this study, high-need schools are specifically defined to include those that are urban, rural, high minority, high student poverty, and low performing. Recent studies have found that schools with characteristics such as these have fewer teacher resources, including fewer teachers with graduate degrees; more inexperienced teachers; fewer state-certified teachers; and lower teacher salaries (Betts et al., 2000; Collins, 1999; Goldhaber & Brewer, 2000; Lankford et al., 2002; Roza et al., 2003).

Patterns of teacher resource variation have been identified in schools characterized by urban location, high student poverty, high student minority populations, and low student achievement. For example, urban, high-poverty, non-White, and low-performing schools are less likely to have teachers with graduate degrees and advanced teaching experience compared to suburban, low-poverty, low-minority schools (Lankford et al., 2002). Similarly, school-level data have indicated that high student poverty, especially in large cities and small urban areas, was associated with lower teacher quality, measured as the percentage of teachers with teaching licenses and certification in the subject they teach (Tuerk, 2005).

The pattern of teacher resources in urban, high-poverty, high-minority schools suggests the need for targeted recruitment efforts. While this need seems evident, urban teacher recruitment presents unique challenges. One line of research reveals that school geographic location and teacher hometown are salient to where teachers decide to take their first teaching job. Given the large number of job openings in urban districts

compared to other locales, urban schools must attract a large teacher pool by offering an attractive package, including salaries, working conditions, or student population characteristics to compete with nonurban schools for the best available teachers (Boyd et al., 2005).

Why Rural Matters 2005 (Johnson & Strange, 2005) reports urgent ongoing problems in rural schools, especially in those located in southern states. Large minority student populations and high student poverty threaten to trap rural schools in persistent patterns of low teacher resources. For example, the need to recruit bilingual teachers to the large population of English language learners in rural areas exacerbates a more general teacher recruitment need (Johnson & Strange, 2005). Most states are struggling to staff their schools with highly qualified teachers, not to mention those specialized in bilingual and special education. Rural schools must therefore compete with all other schools for these specially trained teachers, without the necessary bargaining power. The highest rates of poverty and the associated lowest property values put rural schools in the worst negotiating position. Rural schools in the South, including Arkansas, Louisiana, and Texas, must manage the entrenched demographic profiles of high poverty, low levels of adult education attainment, and high percentages of high-need students in their efforts to improve student achievement (Johnson & Strange, 2005).

Studies show that rural schools have particular difficulty with recruiting and retaining teachers who are highly qualified. Rural schools tend to have fewer resources due to state funding formulas that base teacher salary levels on housing costs and school size, both of which tend to be low in rural areas (Collins, 1999). Reeves (2003) found that attracting teachers to rural areas would require salary levels higher than those offered in

suburban or urban areas, when in reality, the average rural salary may be as much as $250 to $10,400 less than other teacher average annual salaries. Further, rural teachers with master's degrees and 20 years of experience earn 17.2% less than teachers in other settings with comparable education and experience (Jimerson, 2003). These fiscal disparities reveal a pattern of lower teacher pay in rural areas.

Another factor contributing to deficits in particular geographic locations is the tendency for teachers to move to more attractive schools or districts, which are also typically ones with higher student achievement scores. Research studies verify a systematic pattern in which teachers move from low-achieving to high-achieving schools once their seniority allows them to, revealing how low performance becomes a condition of high-need schools (Boyd et al., 2005; Prince, 2002). One of the largest contributors to teacher mobility in Texas is low student achievement, an example of the circular nature of a "teacher quality gap," most prevalent in high-poverty and high-minority schools (Hanushek et al., 1999; Haycock, 2004).

Teacher Resources and Student Achievement

The literature on teacher resources and student achievement can be categorized into four areas of research: teacher salary, teacher experience, teacher education, and teacher certification. The importance of teacher experience and education in salary determination highlights the need to understand whether these two teacher characteristics contribute to teacher effectiveness and improved student achievement. A wide range of teacher attributes—from experience and education level to alternative and traditional certification—have been investigated for their contributions to student performance. So

far, these studies have revealed a complex and incomplete picture of what characterizes effective teachers.

Teacher salary. A body of research conducted primarily in the last two decades has corroborated seminal findings (Coleman et al., 1966) regarding the influence of school and teacher resources, namely that they are not consistently or positively related to student achievement. Research has generally been unable to establish a strong link between teacher salaries and student achievement. In extensive summaries of research done on school expenditures and achievement, Hanushek (1986, 1997) found little support for the effects of teacher salaries or per pupil expenditures on student outcomes. One set of findings reported a weak but significant positive relationship between salaries of experienced teachers and achievement on math and reading scores of elementary school students (Hanushek et al., 1999).

Research studies linking spending on teacher salaries to student achievement have been hampered by several conceptual and methodological limitations. For example, salaries are traditionally based on teacher characteristics that are also typically included in the conceptualization and measurement of highly qualified teachers (experience, education level, certification). In order to isolate the effect of salary on student outcomes, researchers must include teacher salary as well as account for teacher experience and education and other factors that affect student achievement levels. Given the sparse amount of research on teacher salary and student achievement, the current study considered the findings and suggestions in the literature to date and included a number of teacher, school, and district context features in its investigation of teacher salary and its contribution of student achievement.

Teacher experience. A number of conflicting findings have emerged from the literature on teacher experience. Hanushek (1997) reviewed several hundred studies using teacher experience in production function models common to economic research, which examine the relationship between educational inputs and their contribution to educational outputs. The review revealed that teacher experience was not an important indicator of teacher quality, and therefore an unlikely contributor to student achievement. Hanushek's review has been criticized for its lack of clarity regarding the intent of the studies, the specific measures of teacher experience used, and the extent of other variables included in the studies. Another source of inconsistency in the empirical findings on teacher experience is the potential nonlinearity of effects. In other words, early years of teaching (i.e., up to 7 years) may be associated with a gradual increase in student outcomes, middle years of 8 to 14 correspond to a weak negative effect, and then a positive effect on student achievement among teachers with 15 or more years, as found in Murnane and Phillips' study (1981).

Several other researchers have constructed studies and found a relationship between teacher experience and student achievement. Ferguson and Ladd (1996) used Alabama data to examine the association between teacher experience of five or more years and student achievement in the third, fourth, eighth, and ninth grades. Findings revealed that teacher experience between beginning and up to 5 years had a statistically significant positive effect on math and reading achievement, whereas teachers' experience of 5 or more years was associated with no significant influence on reading and math scores. Another examination of teacher experience found a positive relationship between elementary student scores and teachers' experience of at least 2 years but no

effects for additional years beyond (Grissmer, et al., 2000). A recent study reported a positive relationship between teacher experience and student achievement in elementary mathematics within the first 3 to 7 years of teaching, but no significant connection beyond that experience range (Milanowski & Kimball, 2005). These findings suggest that teacher experience should be analyzed with attention to its possible nonlinear effect on student achievement.

Teacher education. Historically, studies have not been conclusive about whether teachers' education beyond the undergraduate degree influences student achievement (Rice, 2003). One study has shown significant, positive relationships between teachers holding graduate degrees and student achievement. Across a range of grades, a positive relationship between holding advanced degrees and student achievement was found for student math scores but not for reading scores for a sample of third, fourth, eighth, and ninth graders in Alabama (Ferguson & Ladd, 1996).

Other studies have found contradictory relationships between teacher education and student achievement. One study found a negative relationship between teacher education and elementary student achievement on math scores, but found a positive relationship between holding advanced degrees and reading scores (Rowan, et al., 2002). Overall, the empirical findings on the importance of advanced degrees to student achievement remains inconclusive, but the findings in past research and the policy issues related to teacher compensation suggest the need to investigate its effect further.

Teacher certification. Teacher certification is another characteristic that may help explain the relationship between teacher pay, experience, education, and student achievement. The teacher certification process provides states with an important

mechanism to address the quality of their teacher force. Most states impose a number of requirements on the certification process, including graduation from an accredited teacher education program, teaching under supervision, recommendation from the graduating institution, and a passing grade on one or more certification tests. Intuitively, one would expect the certification requirements of most states to enhance student achievement. The empirical research, however, provides limited information on the influence of certification on students' achievement (Hanushek, et al., 1999).

Two recent studies highlight the effect of standard teacher certification status on student achievement in elementary and middle schools. Croninger, Rice, and Rathbun (2003) analyzed national data drawn from the Early Childhood Longitudinal Study (ECLS) using a production function model and concluded that certification status, degree type, and years of experience are positively related to student learning, and that teacher certification matters most in reading for children with low socioeconomic status (Croninger, et al., 2003). A second study conducted using Texas data focused on the effect of holding a state teaching certificate on middle school student math achievement gains over a 2-year period (Alexander, 2004). Using a value-added model, results revealed that, on average, students with certified teachers had higher gains in math than those with noncertified teachers. The findings held after controlling for student and school demographics, teaching experience, and prior student achievement. These recent studies suggest that teacher certification needs further investigation to evaluate its contribution to student achievement.

In Summary

There is still a need for research that provides clarification on the relationship between teacher resources and student achievement. High-need schools tend to have fewer resources to expend toward attracting high quality teachers to their schools, while research suggests recruitment efforts might require a salary higher than that offered in more attractive school contexts. To understand more about the patterns and influence of teacher resources, SEDL investigated how teacher salary, education, and experience corresponded to student achievement in high-need schools.

This study was designed to better inform state policy through the explicit use of extant state data. It contributed to the knowledge base by showing how these growing state databases could be used to enhance state policy efforts to improve student achievement. SEDL tested the roles that education and experience played in the prediction of salary, the distribution of teacher resources along indicators of high needs, and the contributions of teacher resources to student achievement, particularly in high-need schools. To the best of SEDL's knowledge, never before has a multistate database of this size and scope been applied to the examination of these questions.

Methodology

SEDL's ultimate goal was to provide state and local policy audiences with information about the relationship between teacher salaries, teacher characteristics, and student achievement in Arkansas, Louisiana, and Texas schools, especially those designated as high need. SEDL used a subsample of the state data collected and analyzed in a previous study (Pan, et al., 2004). [1]

Quantitative data analyses were conducted separately within each state, and to the extent possible, cross-state comparisons of results were made. To answer the first question, "To what extent do teacher experience and education relate to teacher salary?", SEDL used teacher-level and district-level data assembled from databases collected from the three study states and federal sources. The same teacher-level data used to answer the first question was aggregated to the school level, and along with other school- and district-level context variables, were used to answer the last two research questions, "Do teacher salary, experience, and education vary for different categories of high-need schools and between high-need and non-high-need schools?" and "What effects do teacher salary, experience, and education have on student achievement, particularly in high-need schools?"

Definition of Variables

For the purposes of this study, the following definitions of variables were used:

- Context: District- and school-level measures of school locale,[2] student minority enrollment, student poverty enrollment, per-pupil expenditures, student-teacher

[1] The study was conducted in three of the five states in SEDL's region because New Mexico was undergoing staffing changes at the time of the requests for participation, which interfered with a timely transfer of the data, and Oklahoma did not agree to participate in the study.

[2] Locale refers to Common Core Data (CCD) geographic designations of urban, suburban, and rural.

ratio; district-level measures of teacher to administrator ratio, district household income, and parent education

- High minority: High minority school, meaning those with higher than 50% non-White student enrollment
- High-need schools: Those characterized by rural or urban geographic designations, high-minority and high-poverty student enrollment, and low student achievement
- High-poverty schools: Those with over 50% student enrollment participating in the free and reduced-priced lunch (FRPL) program
- Teacher salaries: State measure of base pay for teachers in instructional roles
- Teacher experience: Total number of years in the teaching profession
- Teacher education: Whether teacher holds a master's level or higher education status
- Student achievement: Scores on state criterion-referenced reading and math tests for the grades tested in each state within their elementary and middle/junior high schools levels

Regression Models Estimating Teacher Salary: Investigating Research Question 1

Sample Selection

All regular, independent school districts in each of the three study states were included in the study sample. This study did not include state- or federally-operated local education agencies, nor did it include other nontraditional agencies such as charter districts in its sample. The schools that were included for analysis were those with fourth-

and/or eighth-grade state criterion-referenced student achievement test results in reading and math during the 2002–03 school year in Arkansas and Louisiana and 2001–02 in Texas,[3] Teachers drawn from the final school sample, who fell into the selection criteria described below, composed the teacher-level data set.

Teachers in the study sample included classroom instructors who held at least a 75% full-time equivalent (FTE) position, taught at only one school, and worked only in an instructional role. All teachers in the study sample were reported as teaching core classes, defined as courses that are part of a core academic curriculum as established by the state education agency in each study state. Teachers in the sample also were teaching in the schools with fourth- or eighth-grade student achievement test results during the 2002–03 school year (2001–02 in Texas). Teachers listed with special status (e.g., sabbatical leave, retirement rehire) were excluded from the sample.

Data Sources

SEDL used a subsample of teacher salaries and characteristics, and district-level context data assembled and analyzed in the previous study of data usability and quality (Pan et al., 2004). Data were collected from state departments of education databases, and other state (e.g. state teacher licensing agencies) and federal sources (e.g., 2000 Census and Common Core Data). SEDL found that the variables were generally stable across years, and that the most recently available year of data (i.e., 2002–2003) at the time of collection contained the most refined measures of the variables of interest. Variables were chosen primarily on the basis of two considerations: findings on the quality of each

[3] Texas results reflect 2001–2002 data due to the fact that the criterion-referenced test in that state changed in 2002–03 and we were unable to control for prior year student achievement in regression models due to non-comparability of results from 2001–02 to 2002–03.

state's data for the purposes of this type of research (Pan et al., 2004) and information deemed important for policymaker needs in each state.

Individual-level data on teacher salary, years of experience in the teacher profession, highest degree level attained, and certification status were collected from the state departments of education in each of the three study states. These data represented active teachers during the 2002–03 school year (2001–02 in Texas).

Teacher salary information was collected according to varying methods across the three study states. In all of the states, a measure for base pay was available for teachers at the individual level. Base pay does not include special incentives or extra service pay, such as compensation for coaching athletics and other roles in extracurricular activities. Individual teacher salaries were standardized by annualizing the total base salary figure to represent a full-time, standard teaching contract of 182 days for Louisiana and 187 days for Texas, with 7 work hours per day in each state.[4] While other fiscal characteristics of pay such as benefits would have been important to include, data measuring health, retirement, or other benefits at the individual teacher level were either imprecise or unavailable. For this reason SEDL used the actual, state-audited, base pay to measure teacher salary.

District characteristics were collected from state and federal sources. State departments of education provided the following characteristics: district size (total enrollment); district free and reduced-price lunch enrollment; district non-White student enrollment; and district per-pupil instructional expenditures. Data on district geographic designation were collected from the National Center for Education Statistics' Common

[4] Arkansas teacher salaries were assumed to be annualized; SEDL was unable to determine whether the base-pay data were standardized because teacher FTE data were unavailable for the year of data collected.

Core of Data. Data on average median household income were collected from the U.S. Census Bureau.

Data Analysis

Large datasets were constructed for each individual state by merging all assembled data. SEDL retained individual-level teacher data for teacher-level variables used to answer the first research question. Base salary figures, district wealth (measured as average median household income), and district per-pupil expenditures were transformed to natural logs, a common approach to normalizing skewed data (Tabachnick & Fidell, 1996). Dummy variables for urban, suburban, and rural district locale were used. District size and its squared transformation, which was used to normalize average daily attendance (ADA), were both entered into the regression as the measures used for district size, in order to support statistical assumptions (i.e., normality of distribution). Teacher experience was entered as a continuous variable and also entered as a squared term to address the potential nonlinearity of its distribution as it related to salary. Teacher education, measured as teachers with graduate-level education, was entered as a dummy variable, as was traditional certification. District-level context and student demographic variables were used, computed as percentages for the whole district.

Teacher salary was estimated using an ordinary least squares (OLS), stepwise multiple regression technique. The stepwise method was used in order to determine at which point and to what degree (i.e., explained variance) each predictor contributed to the explanation of teacher salary. The following is an example of the full model regression notation:

$$Y_{\text{natural log of teacher salary}} = X_{\text{teacher-level education}} + X_{\text{teacher-level experience}} + X_{\text{teacher-level certification}} + X_{\text{teacher-level route certification}} + X_{\text{district-level context}} + X_{\text{district-level student demographics}} + e$$

The dependent variable, Y, is the natural log of teacher salary. The independent variables in the model include teacher-level resource variables, district-level context variables, which provided controls for district resources (i.e., instructional expenditures per pupil, locale, size, and the average median income), and student demographic variables (i.e., percentage of minority and poverty). A total of 12 independent variables were used in the OLS regression analysis of teacher salary for each state.[5] Determinations of the adequacy of the regression equation were addressed upon inspection of the data output. Additional post hoc tests were performed, for example, to determine the independence of error term correlations (Durbin-Watson), and the fit of standardized residuals.[6]

Teacher Resource Patterns and Regression Analyses Predicting Student Achievement: Investigating Research Questions 2 and 3

SEDL examined the second research question "Do teacher salary, experience, and education vary for different categories of high-need schools and between high-need and non-high-need schools?" using analysis of variance (ANOVA) models to test mean differences of teacher salary, education, and experience by school level teacher and context variables commonly used to define high need in the literature. For these analyses, low achievement is included as an indicator of high need and used as a predictor of

[5] The regression notation is for a typical hierarchical equation, which specifies the order of entry of variables; in a stepwise regression, order of entry is determined by the amount of variance explained by each variable, therefore the notation used here is used as an example equation.

[6] As a note regarding the analytic approach, SEDL was aware that multilevel analyses would be appropriate to get the most accurate estimates of teacher salary, where teachers are nested in districts, but multilevel data necessary for multilevel modeling were inaccessible.

variation in teacher resources; low achievement is not used as a predictor for the third research question given that the outcome variable is student achievement.

The third research question, "What effects do teacher salary, experience, and education have on student achievement, particularly in high-need schools?" was answered using regression models estimating student achievement. The set of independent predictors included school-level measures of teacher salary, education, and experience, and a number of other school-level controls. The controls were included to address resource distribution factors such as school size, locale, and school level student characteristics.

Sample Selection

The analyses were conducted using the same sample of data described for the analysis of the first research question, and required the aggregation of individual teacher data to the school level in order to use descriptive, correlation, and regression techniques to estimate relationships among the key variables of interest.[7]

Data Sources

State departments of education provided the following characteristics: fourth- and eighth-grade math and reading achievement scores (also third- and seventh-grade scores in Texas) aggregated to the school level; total K–12 school enrollment; free and reduced-price lunch enrollment; and non-White student enrollment. School locale was collected from the Common Core of Data (CCD) and recoded: urban school geographic designation (codes 1 and 2); suburban school geographic designation (codes 3, 4, 5, and

[7] The study design does not allow for random assignment of participants to experimental and control conditions, establishing quasi-experimental matched-comparison control groups, or a regression discontinuity design assessing change over time, and, therefore, has inherent limitations in terms of explaining causal relationships among the key variables of interest in the study.

6); and rural school geographic designation, determined by using CCD locale codes (codes 7 and 8). The district-level variables used in research question one were used for these analyses.

Student achievement data were also collected from the state departments of education in each study state. SEDL learned from its previous studies that Arkansas and Louisiana's criterion-referenced tests could not be compared across grade levels because the scaling methods would not allow it. As a result, SEDL used the achievement score for the same grade but from the previous year of the one under investigation, as a baseline score for prior school-level achievement. These data included grade-level criterion-referenced test results for fourth- and eighth-grade students in math and reading for the 2002–03 school year (2001–02 in Texas). Test score data were collected at the school level in a scale score format. Prior year test results were collected in Arkansas and Louisiana for grades 4 and 8 that reflect the 2001–02 school year. Prior year test results were collected in Texas for grades 3 and 7 that reflect the 2000–01 school year. For each state, quartiles were constructed grouping the mean scores on student achievement across all schools. Student achievement data are further described in Table 1.

Table 1

Description of Student Achievement Test Data

Data	Arkansas	Louisiana	Texas
Test name	**Benchmark**	**LEAP-21** Louisiana Educational Assessment Program for the 21st Century	**TAAS** Texas Assessment of Academic Skills
Type	Criterion-referenced	Criterion-referenced	Criterion-referenced
Score format	Scale	Scale	Scale (Texas Learning Index)
Grades	4, 8	4, 8	3, 4, 7, 8
Years	2001–2002 2002–2003	2001–2002 2002–2003	2000–2001 2001–2002
Subjects	Math Literacy	Mathematics English language arts	Math Reading

Data Analysis

High-need schools were designated according to the following indicators: greater than 50% student minority population, greater than 50% participation in free and reduced-price lunch, rural or urban school locale, and average student achievement scores in math or English in the bottom quartile.

As mentioned previously, individual teacher data was aggregated to the school level, and the following variables were constructed: natural log of mean teacher salary; mean years of teaching experience; squared term of teaching experience; percentage of teachers with a master's degree or above; and percentage of teachers holding standard certification. District-level controls used in research question one were also used for question three; district per-pupil instructional expenditures, average median household income, and parent education. SEDL also used school and student data to construct the

following school-level variables: mean scaled score in English language arts for 2003 (2002 in Texas); mean scaled score in English language arts for 2002 (2001 in Texas); mean scaled score in mathematics for 2003 (2002 in Texas); mean scaled score in mathematics for 2002 (2001 in Texas); quartiles of student achievement scores across all school means; percentage of students on free or reduced-price lunch; percentage minority students; school size; and school locale.

To examine the second research question on patterns of teacher resources, SEDL constructed analysis of variance (ANOVA) models partitioning variance in teacher salaries, experience, and education by school locale, student poverty, student minority, and reading and math achievement. First, to discern whether a systematic pattern of teacher resources would emerge for the three states, SEDL examined the extent to which the patterns in Arkansas, Louisiana, and Texas reflected one another. SEDL modeled combinations of high-need indicators and determined that three-way ANOVA models were promising, interpretable, and provided the right level of profile statistics needed. Variance in teacher salary, teacher experience, and teacher education was partitioned among school locales, levels of student poverty, student minority enrollment, and student achievement quartiles. Second, SEDL examined the findings in terms of teacher resource patterns within each state and for the possibility of constructing an approach to filtering on specific patterns of high-need schools for the next set of analyses examining student achievement.

To conduct the analyses for the third research question, examining the effects of teacher resources and school and district context variables on student achievement, SEDL used a number of the same variables constructed for the previous analyses. SEDL

regressed student achievement on prior year achievement, school level average teacher variables, and controlled for a number of district, school, and student demographic measures. The following is an example of the full model regression notation:

$$Y_{\text{8th-grade math}} = X_{\text{7th-grade math}} + X_{\text{school-level salary}} + X_{\text{school-level education}} + X_{\text{school-level experience}} + X_{\text{school-level certification}} + X_{\text{district-level context}} + X_{\text{school-level context}} + X_{\text{school-level student demographics}} + e$$

The dependent variable, Y, is the average eighth-grade math achievement score for each school. The independent variables, Xs, include seventh-grade math achievement (in Texas, previous year eighth-grade math achievement in Arkansas and Louisiana), teacher-level variables, district-level context variables (i.e., instructional expenditures per pupil, parent education, and the average median income), school-level context variables (i.e., locale and size), and student demographic variables (i.e., percentage minority and poverty). A total of 14 independent variables (which included squared transformations of experience and school size to address normality of distribution) were used in the general form of ordinary least squares (OLS) regression analysis of student achievement.

Descriptive Sample Data

To provide an overall description of the teacher sample and general characteristics of the larger data set, Table 2 displays descriptive data for the study sample by state. A number of descriptive differences between the states were striking. The Texas teacher sample, compared to Arkansas' and Louisiana's, greatly outnumbered the two and was the highest paid on average; however, the percentage of teachers with graduate degrees and standard certification status was the lowest, and the percentage of new teachers

Table 2

Sample Descriptives by State

Teacher data	Arkansas	Louisiana	Texas
Number of teachers	22,186	19,379	150,248
Average teacher salary	36,380	34,695	39,102
Percent of teachers with master's degree or above	33	25	21
Average years of teacher experience	13	13	12
Percent of teachers with 0–2 years experience	17	15	22
Percent of teachers with standard certification	95	95	75
Percent of teachers with alternative certification	5	2	9
Percent of female teachers	87	90	87
Percent of minority teachers	11	27	30
District data			
Average median district income	31,423	31,990	39,693
Average instructional expenditure per pupil	4,835	4,258	3,663
School data			
Number of schools	914	1,033	4,671
Percent of urban schools	19	30	44
Percent of suburban schools	28	36	34
Percent of rural schools	53	34	22
Student demographic data			
Percent of students FRPL	55	68	55
Percent of schools > 50% FRPL	60	77	57
Student race/ethnicity (%)			
White	73	47	43
African American	22	50	13
Asian	.5	1	2
American Indian	.5	1	<1
Hispanic	4	2	41

and of alternatively certified teachers was the highest. While the average median district income was the highest in Texas, the average instructional expenditure per pupil was the lowest compared to the other two states, with Arkansas expending more than the others in the category.

Student demographics for the study sample varied widely across the states. The Texas sample had the lowest percentage of White and African American students, and the largest population of Hispanic students; the Louisiana sample was described by almost an equal split between White and African Americans student enrollment; and the Arkansas student sample was predominantly White. The Louisiana sample had the largest percentage of students in poverty, almost 80%, relative to the other two states' standing, which hovered at 60%.

Findings

SEDL analyzed three research questions, which for clarity and ease of presentation are used to organize this section. Significant within state results are reported first and then cross state comparisons are made, when possible, for each set of findings.

Research Question 1: To what extent do teacher experience and education relate to teacher salary?

In order to answer the first research question SEDL estimated the natural log of teacher salary as a function of teacher resources, district-level control variables, and student demographic variables. SEDL found that

- teacher experience was the most robust predictor of teacher salary;
- teachers with advanced degrees earned between 4% and 9%, on average across all three states, more than teachers who held undergraduate degrees, matching the increase for graduate education specified in state salary schedules;
- student poverty had a negative effect on teacher salary across all three states; and
- in all three states, teaching in an urban district was associated with higher salaries compared to those in suburban or rural districts.

Correlations Between Variables of Interest

SEDL began the examination of teacher salary by computing and inspecting correlations between salary and variables of interest for the regression models. Teacher-level data were used for education, experience, and certification variables; district-level data were used for district size, average median income, locale, and student demographics.

Table 3 displays correlations between teacher salary and select teacher, student, and district variables for all three states. There were consistent patterns of correlations across the three states. Teacher base salary was positively related to education level and years of experience. The strongest positive relationship across all independent variables and teacher salary was found between experience and salary. Teacher salary was significantly negatively correlated with alternative certification (with the exception of Arkansas, which was nonsignificant), rural district locale, and student poverty. Contrary to expectation, there was a significant positive correlation between teacher salaries and urban districts, and teacher salary and student minority.

Table 3

Correlations Between Teacher Salary and Select Teacher, Student, and District Variables

	Teacher Salary		
	Arkansas	Louisiana	Texas
Education	.40	.38	.39
Experience	.61	.76	.84
Traditional certification	*ns*	.28	.32
Alternative certification	*ns*	-.16	-.19
District size	.37	.13	.21
Urban district	.28	.11	.14
Rural district	-.28	-.08	-.17
Student poverty	-.16	-.09	-.01
Student minority	.11	.02	.14

Note. All reported correlations significant at the .001 level.

There could be a number of explanations for the significant, positive correlations between teacher salary and district size, including school location, district wealth, and

student population demographics. These factors may also contribute to the significant positive correlation between teacher salaries and urban districts, in contrast to the negative correlation between teacher salaries and rural districts. The majority of expected trends and strengths of association within and across the states were confirmed through correlations between salary and teacher variables and district and student variables of interest, with the exception of the urban and student minority findings.

Regression Models Estimating Teacher Salary

In Arkansas, the analysis regressing teacher salary on all of the variables entered into the equation[8] revealed significant main effects with the exception of standard certification and student minority, the order of which confirms expected relationships between predictors and salary. The most robust predictor was experience (see Table 4). The full model of independent predictors explained 67% of the variance in teacher salary in Arkansas, $F(10, 17{,}333) = 3501.773$, $p < .001$, $R^2 = .67$.

Table 4 contains the basic model results for Arkansas.

[8] As mentioned previously, stepwise regression adds independent variables to the regression on the basis of the amount of variance each variable contributes; the $R^2\Delta$ column in the table reports the change in variance produced for each variable entry. R^2 is the total variance explained by all the variables in the model.

Table 4

Summary of OLS Regression Analysis for Variables Predicting Teacher Salary in Arkansas

Variable	*B*	*SE B*	β	$R^2\Delta$
1. Teacher experience	.021	.000	1.060***	
2. District size	4.179	.000	1.032***	.15
3. District size^2	-1.862	.000	-.755***	.07
4. Teacher education (master's degree and above)	.089	.002	.209***	.04
5. Teacher experience^2	.000	.000	-.502***	.02
6. Student poverty (district)	-.066	.007	-.060***	.004
7. Instructional expenditures per pupil	.030	.004	.037***	.003
8. Locale (urban district)	.039	.003	.086***	.001
9. Locale (suburban district)	.024	.002	.058***	.003
10. Average median household income	.025	.007	.024***	.000

Note. R^2 = .67 for full model. N = 17,344 teachers.

*** $p < .001$.

The teacher variables were expected to predict salary explained significant amounts of variance. The relationship between teacher experience and salary was the first and largest contributor to the explanation of variance in salary. Education entered the model after district size was accounted for. District size and its squared term both contributed to the explained variance; the district size coefficient was positive, and its squared term was negative. In such cases, where both the term and its square contribute, the squared term is considered more valid for interpretation given its detection of a curvilinear slope, even though the linear measure provides some fit (Cohen & Cohen, 1983).

Across the set of independent predictors, the effects of teacher experience, district size, and education contributed the most to the model in terms of explained variance,

except teachers with standard certification, which dropped out of the model. The squared coefficient for teaching experience indicates that as teaching experience increases by one year, teacher salary decreases by less than 1%. Although contrary to expected, the amount of decrease in salary is substantively insignificant. Also contrary to expectation, the district size (quadratic term) coefficient was negative, suggesting a downward slope in relation to salary. The results also indicated that salaries were significantly higher for teachers with graduate degrees; holding other variables constant, the average teacher salary increases by almost 9% when a teacher has a master's degree or above.

As expected, suburban locale and average median income were positively related to teacher salary. Teachers in suburban districts, holding urban districts constant, were paid more than their rural counterparts. Also, teachers in higher income districts were being paid more in comparison to lower income districts. Also expected was the relationship between student poverty and salary, which was negative. Contrary to expectation, urban districts were positively associated with salaries, and minority student percent dropped out of the model. Teachers in urban districts, holding suburban districts constant, were paid more than those in rural districts.

In general, the model predicting Arkansas teacher salaries revealed that of the teacher variables considered, the linear term for experience and the education measure representing graduate degrees positively influenced pay, reflecting adherence to the single salary schedule up to a point. The squared term for experience indicated that there is a downward slope in relation to salary, but not in any substantive way. The only unexpected finding was that pay in urban districts was higher than it was in rural and suburban districts. While the order in which the variables entered into the model is of

interest, the amount of unique variance explained by each predictor is typically small, thus a note of caution is attached to the weighting of these variables. For Arkansas, the amount of unique variance explained by each predictor ranges from .15 to .001.

In Louisiana, the regression analysis for teacher salary revealed that all of the variables entered into the equation contributed significant main effects, the order of which are of particular interest (see Table 5). The full model of independent predictors explained 69% of the variance in teacher salary, $F(12, 19{,}366) = 3523.383$, $p < .001$, $R^2 = .69$.

Table 5

Summary of OLS Regression Analysis for Variables Predicting Teacher Salary in Louisiana

Variable	*B*	*SE B*	β	$R^2\Delta$
1. Teacher experience	.022	.000	1.372***	
2. Teacher experience^2	.000	.000	-.688***	.04
3. Average median household income (in district)	.112	.006	.131***	.02
4. Instructional expenditures per pupil	.265	.010	.125***	.01
5. Teacher education (master's degree and above)	.038	.002	.101***	.008
6. District size^2	.000	.000	.389***	.007
7. Locale (suburban district)	-.010	.002	-.030***	.003
8. Teacher certification (standard)	.036	.003	.047***	.002
9. District size	.000	.000	-.297***	.002
10. Student poverty (district)	-.020	.012	-.016***	.002
11. Student minority (district)	-.057	.008	-.080***	.000
12. Locale (urban district)	.019	.003	.053***	.001

Note. R^2 = .69 for full model. N = 19,379.

*** $p < .001$.

Teacher experience and education were among the first five predictors of salary, with average median income accounted for in the third step; the linear coefficient for experience and teacher education were positive, as expected. The squared term for teacher experience indicated, as found in the Arkansas analysis, that as teaching experience increases by one year the predicted teacher salary decreases by less than 1%. Average income and instructional expenditures per pupil also contributed in a positive direction to the prediction of salary. Both student poverty and minority influenced salary levels in a negative direction. The amount of unique variance explained by each predictor ranged from .04 to .001.

In general, the top five independent variables that had the strongest effects on salary were teacher resource variables and district-level average median household income and instructional expenditures per pupil. District context features of income, size, and locale also played significant roles in the prediction of teacher salary. There was a positive relationship between district size (quadratic term) and salary, suggesting that the larger the district the higher the salaries up to a point, given its curvilinear fit on the range of salaries. Contrary to expectation, however, suburban locale was negatively related to teacher salary, indicating that teachers in suburban districts, holding urban districts constant, were being paid less in comparison to rural districts. Also, contrary to expectation, teachers teaching in urban districts had higher salaries relative to those in suburban or rural districts, even though urban schools typically have higher percentages of minority and poor students. As expected, the higher the percent of student minority enrollment and student poverty, the more likely those districts were to pay less than their counterpart districts. Overall, it appeared that the measures used to set salary schedules were the major contributors to teacher salary levels in Louisiana, along with other indicators associated with resources, such as average household income and instructional expenditures per pupil (i.e., the largest subcategory of which is teacher salaries). The unexpected relationships found were those for district locale, in which suburban districts paid lower salaries and urban districts paid higher ones, which was the reverse of that expected.

In Texas, the teacher variables explained significant proportions of the variance in teacher salary (see Table 6). District-level measures of size, average median income, and student minority were also among the most significant contributors to the model. All of

the variables entered into the stepwise equation contributed significantly, the full model of which explained 85% of the variance in teacher salary, $F(12, 149{,}995) = 68762.827$, $p < .001$, $R^2 = .85$.

Table 6

Summary of OLS Regression Analysis for Variables Predicting Teacher Salary in Texas

Variable	*B*	*SE B*	β	$R^2\Delta$
1. Teacher experience	.023	.000	1.193***	
2. District size	1.366	.000	.398***	.05
3. District size^2	-5.092	.000	-.300***	.03
4. Teacher experience^2	.000	.000	-.378***	.01
5. Average median household income (in district)	.146	.002	.263***	.01
6. Student minority (district)	.001	.000	.187***	.02
7. Teacher education (master's degree and above)	.036	.000	.082***	.006
8. Instructional expenditure per pupil	.084	.002	.052***	.001
9. Locale (suburban district)	.032	.001	.085***	.001
10. Locale (urban district)	.022	.001	.061***	.001
11. Student poverty (district)	.000	.000	.064***	.000
12. Teacher certification (traditional)	.001	.001	.004**	.000

Note. $R^2 = .85$ for full model. $N = 150{,}008$.

** $p < .01$. *** $p < .001$.

Again, as in the other two states, teacher experience was the first and largest contributor to the explanation of variance in salary; district size, teacher experience (squared), and median income, and student minority controls also contributed to the model before education entered. The coefficient for teacher education indicated that salaries were significantly higher for teachers with a master's degree or above. Specifically, holding

other variables constant, the average teacher salary increases by almost 4% when a teacher has a master's degree or above.

As expected, education and experience had a positive influence on teacher salaries, generally showing that higher levels of each were related to higher salaries. While these relationships would be expected, the curvilinear relationship between experience and salary identifies a pattern that reflects a less than 1% decrease in salary as teaching experience increases each year. This trend, seen in all three states, may be explained by salary changes over time, in which the average salary levels that were originally set at much lower starting levels were never able to rise to baseline levels (i.e., comparable to current beginning salaries) more aligned to teachers' years of experience. As expected, traditional teacher certification was positively associated with salary.

District context features describing higher average household incomes, higher instructional expenditures, and suburban locale corresponded to higher levels of teacher salary; unexpectedly, an environment of higher levels of student poverty was related to higher teacher salaries. Urban districts tended to pay higher salaries relative to other locales, as did districts with higher percentages of minority students. The unique amount of variance explained by each predictor ranged from .05 to .001.

In Summary

Regression results support that teacher experience and education, the standard components of the single salary schedule, contributed significantly to the determinations of teacher salary in Arkansas, Louisiana, and Texas. Teacher experience was consistently the most important component of salary, and certified teachers made higher base salaries

than uncertified teachers. Student poverty and minority enrollment also had significant effects on teacher salary, not necessarily in consistent directions.

Research Question 2: Do teacher salary, experience, and education vary for different categories of high-need schools and between high-need and non-high-need schools?

To answer the second research question, SEDL computed descriptive statistics for school-level measures of teacher salaries, teacher characteristics, and student achievement, and compared mean differences on the contextual characteristics distinguishing high versus low need schools.

Descriptive Data on Teacher Resources

To anchor the study states relative to national trends and to provide a broader picture of the three states' salary averages and locale rankings, SEDL displays select means on variables of interest and sample demographics for each state against U.S. figures in Table 7.

Table 7

Select State Sample and U.S. Demographics

	Arkansas	Louisiana	Texas	U.S.
Average teacher salary	$36,380	$34,695	$39,102	$45,771[a]
Average rural teacher salary	$33,911	$33,776	$36,185	$37,117[b]
% Students enrolled in rural schools	40	28	12	19[c]
% Rural public schools	53	34	22	29
Average urban teacher salary	$39,999	$35,600	$40,106	$44,012
% Students enrolled in urban schools	25	33	52	31
% Urban public schools	19	30	44	27
Average suburban[d] teacher salary	$36,734	$34,695	$38,785	$44,941
% Students enrolled in suburban schools	35	39	36	50
% Suburban public schools	28	36	34	45

[a] Data source for average teacher salary 2002–2003 Survey & Analysis of Teacher Salary Trends, American Federation of Teachers.

[b] Data source for average rural and urban teacher salary 1999–2000 Schools and Staffing Survey, NCES.

[c] Data source for student and school statistics: CCD 2002–2003

[d] Suburban locale was included for comparison purposes in all analyses.

These figures reflect that across all three study states, teacher salary averages are lower than the U.S. average, and the grand mean of the study states is 20% lower than the national mean figure. The largest difference for the average teacher salary for a school locale subgroup, when compared to the national average for that subgroup, is suburban teacher salaries, with the grand mean of the study states being 18% less than the national

average. On average, urban and rural teachers in the study states are paid well below the national average, 12% and 7% respectively for the grand mean of those subgroups. Texas is less rural, measured by the percentage of rural schools and pupil enrollment in those schools, while Arkansas and Louisiana are higher in both categories, compared to the U.S. average. Urban student enrollments are strikingly higher than national figures in Texas and somewhat lower in Arkansas and Louisiana. Cross-state comparisons reveal a consistent pattern of teacher salary levels, in which Texas pays the highest, Arkansas is in the mid-range, and Louisiana pays the lowest salaries on average; this pattern holds for average pay across all locale subgroups (e.g., average rural teacher salary).

Table 8 summarizes descriptive data broken out for specific ranges of teaching experience, salary averages for education levels, and salary averages for each experience range.

Table 8

Descriptive Data for Teacher Experience, Education, and Salary

Teacher indicator	Arkansas	Louisiana	Texas
Number of teachers	22,186	19,379	150,248
Percent of teachers with 0–2 years experience	18	15	22
Percent of teachers with 3–6 years experience	16	19	20
Percent of teachers with 7–11 years experience	15	17	17
Percent of teachers with 12–20 years experience	25	21	21
Percent of teachers with 21+ years experience	26	28	20
Percent of teachers with master's degree or above	32	25	21
Average teacher salary	$ 36,380	34,695	38,575
Average salary of teachers with bachelor's degree	$ 36,475	33, 399	37,600
Average salary of teachers with master's degree	$ 40,677	38, 538	44,826
Average salary of teachers with 0–2 years experience	$ 30,988	28, 515	32,697
Average salary of teachers with 3–6 years experience	$ 31,626	30, 486	34,089
Average salary of teachers with 7–11 years experience	$ 34,452	32, 987	36,803
Average salary of teachers with 12–20 years experience	$ 38,625	36, 789	42,714
Average salary of teachers with 20+ years experience	$ 42,132	40, 446	49,074

Note. The teaching experience categories approximate the NCES categories in the NAEP data which include five categories: 2 years or less, 3–5 years, 8–10 years, 11–24 years, and 25 years or more http://nationsreportcard.gov/tuda_reading_mathematics_2005/

With regard to teacher experience across the states, 42% of teachers in Texas, compared to 34% in Arkansas and Louisiana, are in the two lowest ranges, which covers 0–6 years of teaching experience. A higher percentage of Arkansas' teacher sample holds graduate degrees (32%), compared to Louisiana's (25%) and Texas' (21%) teacher samples. The descriptive data reveal a pattern generally assumed for movement along salary schedules; for relative increases in education and experience there are commensurate upward salary shifts. As would be expected, Texas has the highest levels of average salary across all breakouts of salary by experience ranges.

Patterns of Teacher Resources

SEDL was interested in whether there were significant patterns or profiles (i.e., high-poverty, high-minority, and rural schools) discriminating high need across schools within each state. Three-way and two-way ANOVAs aided this empirical approach to find the types of patterns or profiles that demonstrated the most obvious teacher resource variations,[9] SEDL found that

- cross state patterns of teacher resource variations emerged for teacher salary and teacher education in schools characterized by rural locale, high student poverty, high student minority, and low math achievement;
- contrary to expectations, urban schools were less likely to suffer from low teacher resources than rural or suburban schools; and
- across the three states, consistent findings predicting patterns of variation for teaching experience were not found.

[9] Sidak adjustments were used to control for the increased chance that multiple comparisons would produce false positive values.

Three-way ANOVAs. SEDL tested all three-way combinations among the following categories of high-need schools to predict mean differences on teacher salary, education, and experience levels: student achievement in fourth- and eighth-grade math and reading (grouped into quartiles); student poverty measures of greater than 50% and 75%[10] free and reduced-price lunch participation; student minority measures of greater than 50% and 75% minority enrollment; and urban (suburban locale retained as comparison group), and rural school locale. The dependent variables were school-level measures; natural log of salary, percent of teachers with a master's degree or above, and average teaching experience. After testing for heterogeneity using Levene's (1960) test and obtaining nonsignificant results (i.e., assumption of variance homogeneity was satisfied), findings revealed significant three-way interaction effects on teacher salary and teacher education in Texas. In Arkansas and Louisiana, the three-way ANOVA models either did not yield significant findings, could not hold up to the statistical power needed to provide reliable results once the groups were partitioned for comparison, or violated assumptions of homogeneity of variance. Tables 9 and 10 display the summary data for the significant three-way ANOVA findings in Texas.

[10] SEDL addressed in the examination whether higher levels of student poverty and minority discriminated resource patterns differently from the 50% benchmark.

Table 9

ANOVA Summary for the Effects of Student Poverty, Locale, and Achievement on Eighth-Grade Math on Natural Log of Teacher Salary in Texas

Source	*df*	Sum of Square (*SS*)	Mean Square (*MS*)	*F*
> 50% FRPL (A)	1	.12	.12	19.82***
Locale (B)	2	2.15	1.08	181.21***
Eight-Grade Math achievement (C)	3	.03	.01	1.84
A x B	2	.03	.01	2.14
A x C	3	.05	.02	2.69
B x C	6	.06	.01	1.78
A x B x C	6	.08	.01	2.27*
Total	1525	12.77		

* $p < .05$. *** $p < .001$.

Table 10

ANOVA Summary for the Effects of Student Minority, Locale, and Achievement on Eighth-Grade Math on Percentage of Teachers with Master's Degree or Higher in Texas

Source	*df*	Sum of Square (*SS*)	Mean Square (*MS*)	*F*
> 75% Minority (A)	1	.02	.02	1.29
Locale (B)	2	.39	.19	14.70***
Eighth-Grade Math achievement (C)	3	.01	.00	.16
A x B	2	.12	.05	4.07*
A x C	3	.03	.01	.78
B x C	6	.04	.01	.56
A x B x C	6	.20	.03	2.57*
Total	1525	22.59		

* $p < .05$. *** $p < .001$.

The *F* tests showed that both student poverty and school locale were important factors in the teacher salary model, and the combination of all three effects (i.e., student poverty, locale, and student achievement in math) contributed to the salary model. SEDL conducted pair-wise comparisons and examined plots to interpret specifically where differences in salary means existed. Pair-wise comparisons within rural locale revealed significant effects for the lowest math achievement quartiles for both high and low poverty. By examining the within-quartile differences on eighth-grade math achievement, holding the interaction between locale and student poverty constant, SEDL found that the significantly lower paid teachers are located in rural schools characterized by high student poverty and average achievement scores for eighth-grade math in the lowest quartiles, compared to teachers in nonrural schools. The variance in teacher salary was explained by the model accounting for math achievement, locale, and student poverty (R^2 = .29).

As an example of how plots assisted the examination of mean differences, Figures 1 and 2 display the relationships between poverty and locale groups across eighth-grade math quartiles. Shown graphically, rural teachers' average salaries stay significantly below the nonrural trajectories under both student poverty conditions. In the high student poverty group, rural teacher salaries are at approximately the same levels as the suburban teachers only when student achievement on eighth-grade math is in the highest quartile of scores.

Figure 1

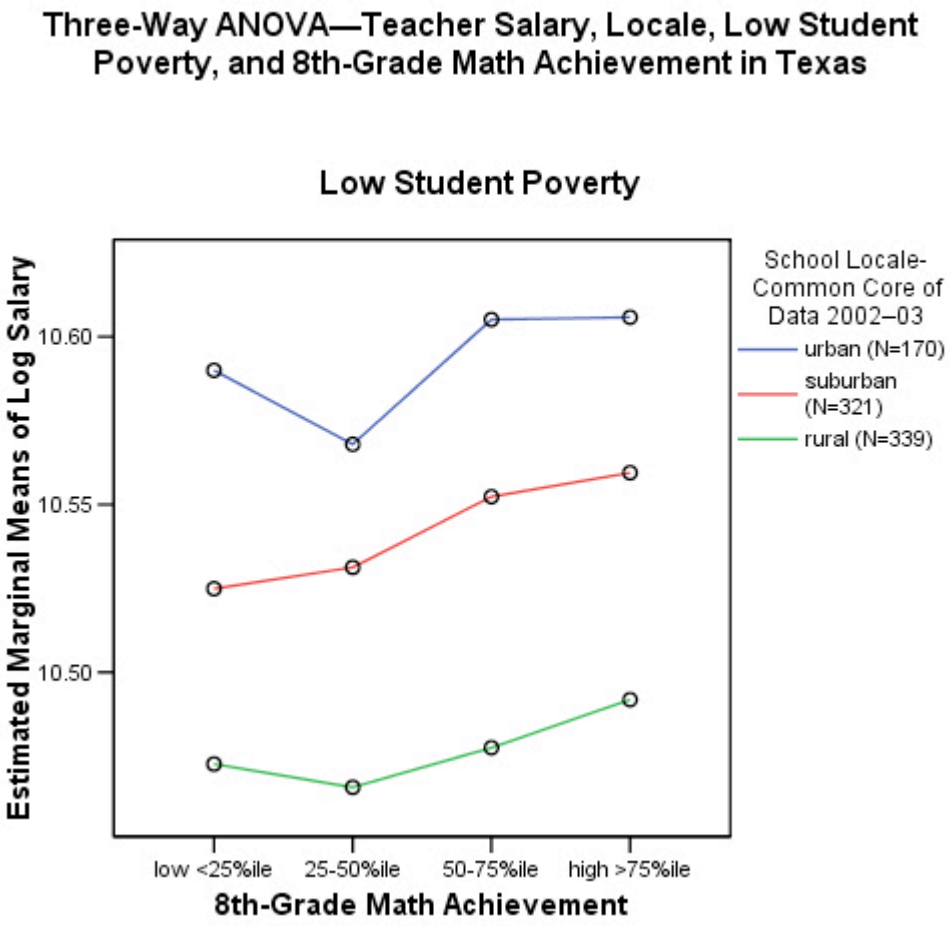
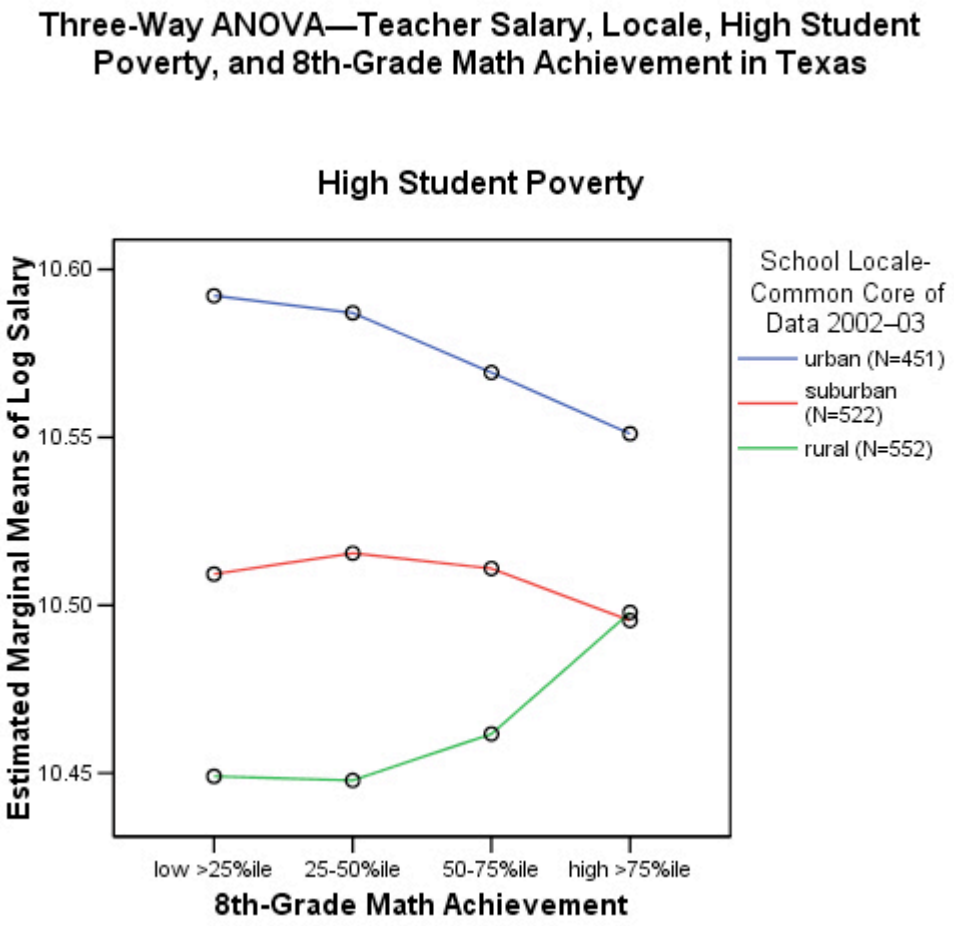

Three-Way ANOVA—Teacher Salary, Locale, Low Student Poverty, and 8th-Grade Math Achievement in Texas
Low Student Poverty
Estimated Marginal Means of Log Salary
10.60
10.55
10.50
low <25%ile
25-50%ile
50-75%ile
high >75%ile
8th-Grade Math Achievement
School Locale-Common Core of Data 2002–03
urban (N=170)
suburban (N=321)
rural (N=339)

Figure 2



Likewise, the *F* tests showed that school locale, the interaction of high minority enrollment and locale, and the combination of all three factors are important effects on teacher education. Pair-wise comparisons within the eighth-grade math achievement quartiles revealed significant effects in the lowest math achievement quartiles for urban and rural locales, holding high student minority constant. A significantly lower percentage of teachers with advanced degrees are located in rural, high-poverty, low-achieving schools, compared to teachers in urban, high-poverty, schools in which

teachers held the highest levels of education. The full model accounted for 12% of the variance in teacher education (R^2 = .12).

Two-way ANOVAs. SEDL continued the analysis of patterns of teacher resource variations in Arkansas and Louisiana by testing two-way ANOVA models to discriminate features of high-need schools. SEDL tested all two-way combinations among the same categories of high-need schools used in the three-way models. Before interpreting any interaction effects, the data were subjected to the standard test of variance homogeneity (Levene, 1960).

In Arkansas, findings revealed two significant two-way interaction effects on teacher salary, one significant interaction effect on teacher experience, and four significant interaction effects on teacher education. Closer inspection of the statistical findings and the pair-wise comparisons revealed that two of the two-way ANOVA models reflected patterns found in Texas. The summary data for Arkansas are displayed in tables 11 and 12.

Table 11

ANOVA Summary for the Effects of Student Poverty and Locale on Natural Log of Teacher Salary in Arkansas

Source	*df*	Sum of Square (*SS*)	Mean Square (*MS*)	*F*
> 50% FRPL (A)	1	.48	.48	52.06***
Locale (B)	2	4.18	2.09	225.21***
A x B	2	.06	.03	3.39*
Total	912	14.10		

* $p < .05$. *** $p < .001$.

Table 12

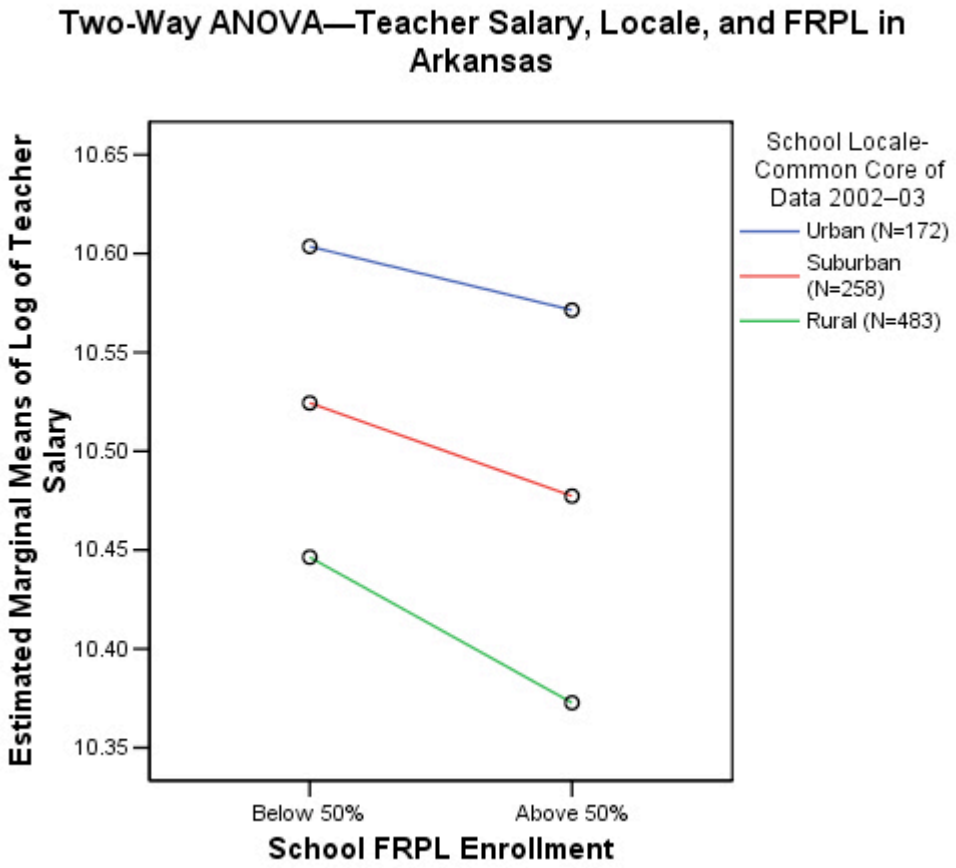
ANOVA Summary for the Effects of Fourth-Grade Math and Student Minority on Percent of Teachers with Master's Degree and Above in Arkansas

Source	*df*	Sum of Square (*SS*)	Mean Square (*MS*)	*F*
Fourth-Grade Math (B)	3	.66	.22	9.53***
> 50% Minority (A)	1	.31	.31	13.55***
A x B	3	.19	.06	2.73*
Total	509	12.29		

* $p < .05$. *** $p < .001$.

As they did in Texas, the *F* tests on Arkansas data showed that both student poverty and school locale are important factors in the teacher salary model. Pair-wise comparisons and inspection of the interaction plots indicated statistically significant variations in the relationship between high student poverty and teacher salary for school locale. The lowest paid teachers are located in rural schools characterized by high student poverty, compared to all other teachers. The highest paid teachers are located in urban, low-poverty schools. The full model explained 6% of the variance in teacher salary ($R^2 = .06$). Figure 3 shows the relationships between student poverty levels and locale, graphically depicting the lower salary levels of rural teachers and the higher salaries among urban teachers in low-poverty schools.

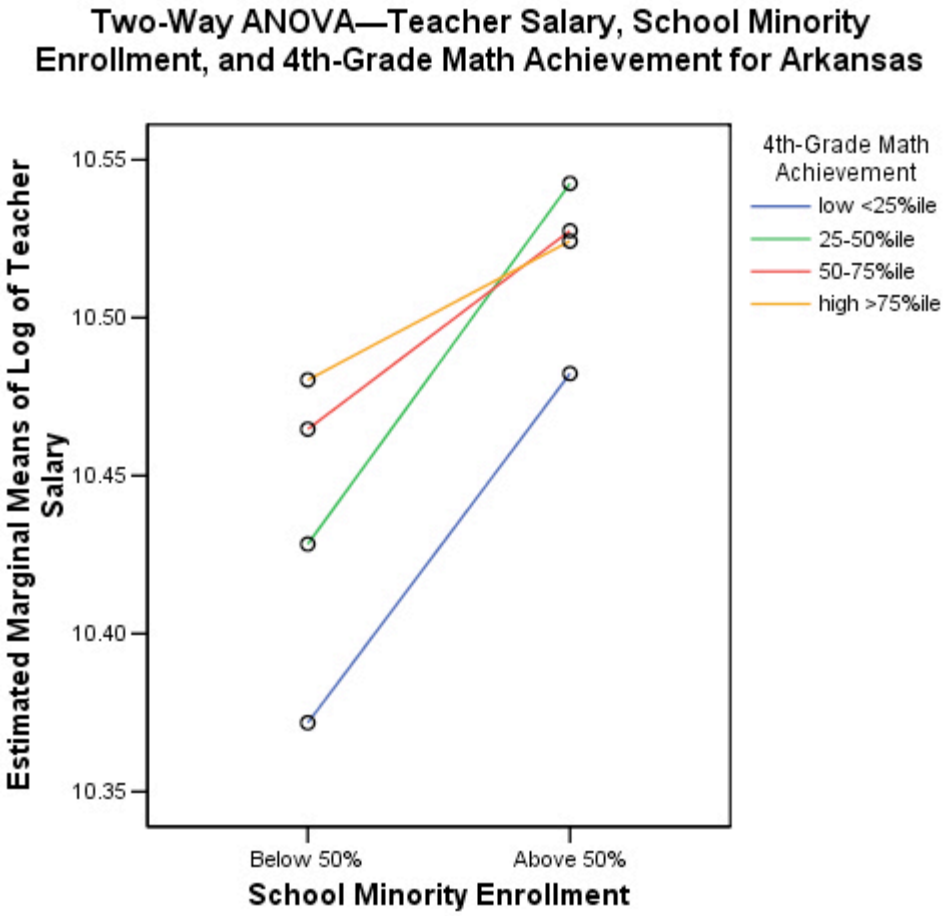
Figure 3



The combination of either low or high student minority and low student achievement in fourth-grade math was most descriptive of schools exhibiting teacher education variations in Arkansas. Schools with low minority student enrollment and low fourth-grade math achievement employed the lowest percentage of teachers with a master's degree or higher, while the largest percentage of teachers with graduate degrees were in schools with high student minority and scores in the highest quartile of math achievement. In general, the plotted pattern of effects revealed higher levels of teacher education within each fourth-grade math achievement quartile for high-minority schools, with the most dramatic trajectory reflecting differences between low- and high-minority schools for the highest quartile of math achievement. The full model explained 5% of the variance in

teacher education (R^2 = .05). Figure 4 displays the relationship between teacher salary for student minority and fourth-grade math.

Figure 4



The remaining significant findings for the two-way ANOVA models in Arkansas revealed within-state patterns that diverged slightly from the Texas findings. These patterns were relatively similar variations on the cross-state ones, but involved interactions between fourth-grade reading achievement rather than math in the prediction of teachers with graduate degrees. Low reading scores and high levels of student poverty and minority population were associated with low percentages of teachers with advanced

education levels. Although none of the three-way ANOVA models predicted teacher-experience levels in Texas, one two-way ANOVA model for teacher experience in Arkansas yielded significant findings for the interaction between high student poverty and fourth-grade math scores. Follow-up pair-wise comparisons did not produce any statistically significant pairs, rendering the findings on teacher experience invalid for the interpretation of interaction effects. Similarly, a two-way ANOVA model for Arkansas teacher salary produced significant interaction effects for high student poverty and eighth-grade math, but the follow-up tests invalidated the findings due to the lack of significant pair-wise comparisons across all levels of the measures.

In Louisiana, findings for two of the two-way ANOVA models mirrored the patterns of teacher resource variations found in Texas. Significantly lower percentages of teachers with graduate degrees were found in urban schools with low eighth-grade math achievement levels, compared to all other schools. Additionally, under both high-minority and low-minority conditions, rural schools employed the lowest percentage of teachers with advanced education in low-minority schools, and the second lowest in high-minority schools; urban schools were staffed with the highest percentages of educated teachers in both conditions. Tables 13 and 14 summarize the ANOVA findings for teacher education variations in Louisiana.

Table 13

ANOVA Summary for the Effects of Eighth-Grade Math and Locale on Percent of Teachers with Master's Degree and Above in Louisiana

Source	*df*	Sum of Square (*SS*)	Mean Square (*MS*)	*F*
Eighth-Grade Math (A)	3	.22	.07	4.16**
Locale (B)	2	.21	.11	6.14**
A x B	6	.31	.05	2.94**
Total	409	7.42		

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 14

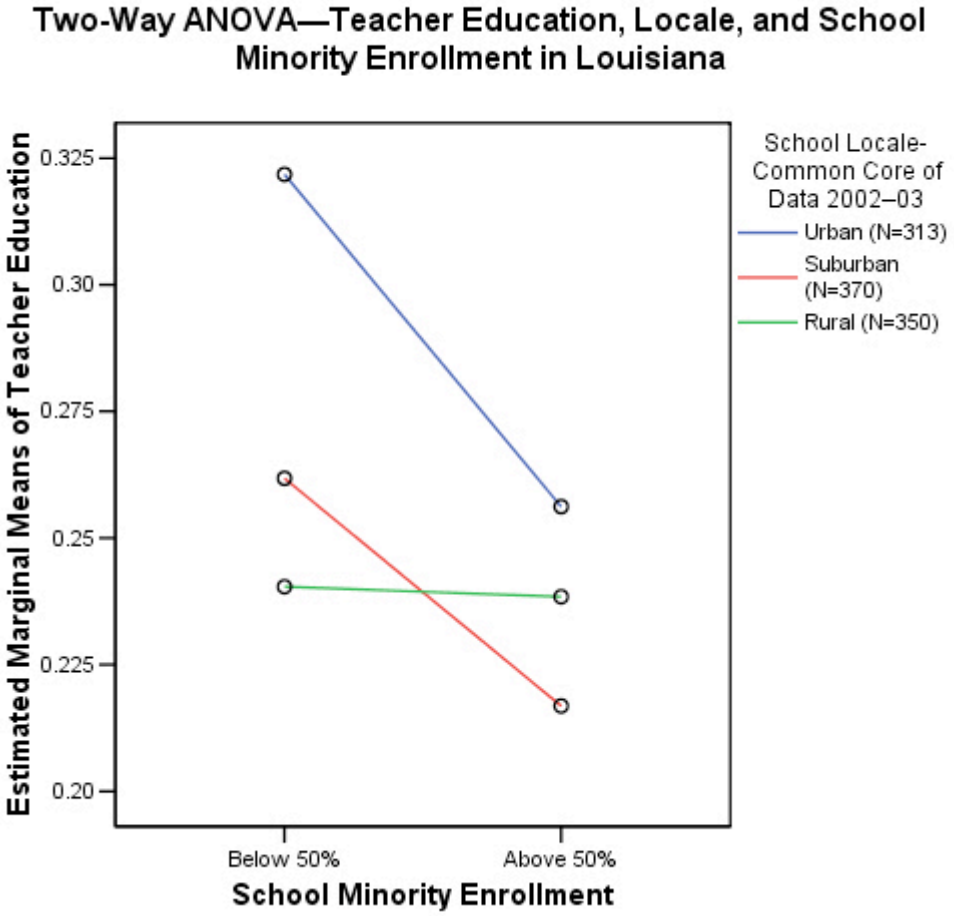
ANOVA Summary for the Effects of Student Minority and Locale on Percent of Teachers with Master's Degree and Above in Louisiana

Source	*df*	Sum of Square (*SS*)	Mean Square (*MS*)	*F*
> 50% Minority (A)	1	.26	.26	13.39***
Locale (B)	2	.34	.17	8.59***
A x B	2	.13	.06	3.23*
Total	1032	20.65		

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

The combinations of school locale and low student achievement in eighth-grade math, and school locale and high student minority were most descriptive of schools experiencing teacher education variations in Louisiana. The full models explained 5% and 2% of the variance in teacher education, respectively. Figure 5 graphically depicts the relationship between student minority and locale on teacher education. None of the two-way models contributed to the prediction of teacher salary in Louisiana.

Figure 5



There were several other significant findings for the two-way ANOVA models of teacher experience and education that did not correspond to cross-state patterns. Two significant findings for the two-way ANOVA models described within-state patterns of teacher experience variations. These patterns involved interactions between fourth-grade math achievement and locale in the prediction of teacher experience. Pair-wise comparisons revealed that holding urban school locale constant, the lowest math scores were associated with the lowest levels of teacher experience, while math achievement in

the highest quartiles was associated with the highest percentage of teaching experience across all school locales.

There were four additional significant two-way ANOVA models that predicted teacher education patterns. They involved fourth-grade math and fourth- and eighth-grade reading achievement and school locale interactions, reflecting some of the previous findings regarding rural schools, low achievement, and low percentages of teachers with graduate educations. Additionally, schools that were most likely to be staffed with lower percentages of teachers with graduate degrees were those in high-poverty, high-minority schools. The total amount of variance explained by the full models predicting teacher education ranged between 3% and 4%.

In Summary

The findings for the second research question revealed that in Texas, the combination of high student poverty, high student minority, low student achievement in eighth-grade math, and rural locale factors was most descriptive of schools exhibiting patterns of variation on teacher salary and education. While the patterns found in Arkansas and Louisiana were less refined, a similar profile of high need emerged for teacher education, and for salary in Arkansas only. Consistent with much of the research, high student poverty and high student minority enrollment factor heavily in the teacher quality gap. Low math achievement also significantly contributed to schools characterized by lower levels of teacher pay, education, and experience. Table 15 summarizes the high-need characteristics that predicted schools with low teacher salary and teacher education patterns, by state.

Table 15

Patterns of Low Teacher Salary and Teacher Education by State

High-need school characteristics	Arkansas		Louisiana		Texas	
	Low teacher salary	Low teacher education	Low teacher salary	Low teacher education	Low teacher salary	Low teacher education
High student poverty	✓	✓			✓	✓
High student minority enrollment		✓		✓		
Rural location	✓			✓	✓	✓
Low math achievement		✓		✓	✓	✓

Research Question 3:What effects do teacher salary, experience, and education have on student achievement, particularly in high-need schools?

To examine the contributions of teacher salary, teaching experience, and teacher education to the prediction of student achievement, SEDL estimated several multiple regression models. In particular, SEDL regressed mean school fourth- grade and eighth-grade math and reading scores on the variables of interest while controlling for prior year achievement as measured by the school mean previous year's grade scores (third grade and seventh grade) where available (Texas), or using the school mean previous year's fourth-grade and eighth-grade reading and math scores (Arkansas, Louisiana).

In estimating school student achievement, SEDL accounted for the influence of teacher salary, education, and experience, controlling for a number of potential direct effects, including whether the teacher was traditionally certified, district per-pupil instructional expenditures, district median family income, school locale, school size, student minority enrollment at the school, student poverty enrollment at the school, and

average parent education in the district. SEDL also tested the same set of variables to predict school-level student achievement in reading and math in a subsample of rural and high-poverty schools (i.e., greater than 50% student poverty enrollment). The subanalysis was constructed from the information gained in the analysis of the second research question, which consistently specified the rural and high-poverty indicators as a refined definition of high need for the three states under investigation.

The models discussed in detail in the following sections yielded significant findings on teacher resource variables in five models for math achievement and five models for reading achievement. All 10 of the significant models met assumptions of independence, meaning that errors were uncorrelated with one another. Additionally, all Durbin-Watson tests of independence were within the range considered acceptable.

Regression Analyses Predicting School Student Achievement in Fourth- and Eighth-Grade Math

In the regression models examining fourth- and eighth-grade math achievement in Arkansas, none of the teacher resource variables significantly contributed to the prediction of achievement.[11] In the fourth-grade math achievement model, the district and school-level student demographic variables appeared to be the most influential towards the prediction of fourth-grade math achievement. The level of student minority enrollment, student poverty, and average median household income were all significant and negatively associated with math achievement. Parent education was significant and positively related to math achievement (see Table 16).

[11] The unstandardized coefficients (*B*) from all regression analyses were used to interpret effects.

Table 16

Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Fourth-Grade Math in Arkansas

Variable	*B*	*SE B*	β
Prior year math achievement (fourth grade 2001–2002)	.512	.039	.515***
Teacher salary	12.321	16.030	.039
Teacher experience	-.596	.823	-.062
Teacher experience^2	.019	.036	.047
Teacher education (master's degree and above)	6.239	8.322	.023
Teacher certification (traditional)	-34.983	19.817	-.048
District per pupil instructional expenditure	2.405	5.236	.014
Locale (urban school)	-.573	3.556	-.006
Average median household income	-18.654	8.714	-.086*
Student minority enrollment	-39.101	6.669	-.284***
School size (total K–12 enrollment)	.022	.027	.088
School size (total K–12 enrollment)^2	-.000	.000	-.095
Student poverty	-25.238	10.343	-.115*
Parent education	69.406	20.013	.133***

Note. R^2 = .65 for full model. N = 516 schools.

*$p < .05$. ***$p < .001$.

The only significant predictor in the remaining Arkansas regression models of fourth-grade rural and high-poverty schools, eighth grade, and eighth-grade rural and high-poverty schools was the level of student minority enrollment. The only exception was in the eighth-grade math analysis, in which parent education also made a positive and significant contribution to the prediction of eighth-grade math achievement. Appendix A contains tables summarizing the results for all remaining math achievement models for Arkansas.

In Louisiana, the analysis regressing fourth-grade math achievement on the same set of predictors, revealed significant effects for teaching experience (and its squared term), standard teacher certification, level of minority student enrollment, and student poverty (see Table 17). The full model of independent predictors explained 73% of the variance in fourth-grade math achievement, $F(14, 753) = 146.025$, $p < .001$, $R^2 = .73$.

Table 17

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Math in Louisiana

Variable	*B*	*SE B*	β
Prior year math achievement (fourth grade 2001–2002)	.630	.027	.640***
Teacher salary	-1.739	6.300	-.007
Teacher experience	-2.119	.715	-.312**
Teacher experience^2	.070	.025	.286**
Teacher education (master's degree and above)	-.879	4.056	-.005
Teacher certification (standard)	26.862	6.609	.091***
Locale (urban school)	-.024	1.408	.000
Average median household income	-5.031	3.232	-.037
District per pupil instructional expenditure	1.675	3.480	.011
School size (total K–12 enrollment)	.009	.010	.063
School size (total K–12 enrollment)^2	-.000	.000	-.051
Student minority enrollment	-8.427	3.127	-.113**
Student poverty	-18.776	4.828	-.155***
Parent education	4.997	11.362	.010

Note. $R^2 = .73$ for full model. $N = 768$ schools.

** $p < .01$. *** $p < .001$.

The finding for teacher experience (squared term) revealed that for a 1-year increase beyond the school average for teaching experience, which was 13 years for the fourth-

grade sample, the average school-level fourth-grade math achievement score decreases by .24 scaled score points[12]. The teacher certification measure reflected a positive influence in the prediction of fourth-grade math scores, indicating that when a school has a higher percentage of teachers with a standard teacher certificate, the average school's fourth-grade math score increased. Both student demographic control variables significantly contributed to the explained variance, revealing that in Louisiana, both student poverty and the level of student minority enrollment had a negative influence in the prediction of fourth-grade math scores. These results reflect several previous research studies, both with regard to the effect of student demographics and in relation to the lack of influence of teacher salary and education in the prediction of student achievement.

In the regression analysis of the Louisiana subsample of rural and high-poverty schools, teacher experience (and its squared term) and student minority enrollment were significant predictors of eighth-grade math achievement (see Table 18). Overall, the model explained 59% of the variance in eighth-grade math, $F(13, 112) = 15.071$, $p < .001$, $R^2 = .59$.

[12] The combination of the linear coefficient for experience, which was negative and larger in effect, and the quadratic term, translated to a decrease in student achievement even though the quadratic term was positive.

Table 18

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Eighth-Grade Math in Louisiana Rural and High-Poverty Schools

Variable	*B*	*SE B*	β
Prior year math achievement (eighth grade 2001–2002)	.638	.094	.596***
Teacher salary	10.286	12.641	.063
Teacher experience	-3.421	1.449	-.773*
Teacher experience^2	.111	.053	.662*
Teacher education (master's degree and above)	11.299	8.671	.093
Teacher certification (standard)	15.025	10.101	.109
Average median household income	-10.345	6.934	-.106
District per pupil instructional expenditure	-1.246	5.954	-.015
School size (total K–12 enrollment)	.006	.032	.052
School size (total K–12 enrollment)^2	-.000	.000	-.003
Student minority enrollment	-12.916	6.461	-.243*
Student poverty	6.591	11.617	.053
Parent education	7.946	20.391	.025

Note. $R^2 = .59$ for full model. $N = 126$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Regression results for rural and high-poverty schools revealed that eighth-grade math achievement scores were significantly influenced by teacher experience measured at the average teacher experience of 13 years; for every 1-year increase in experience, school eighth-grade math achievement scores increase by .046 scaled score points. In this case, teacher experience had a positive influence on student achievement, suggesting the importance of this teacher resource in an environment of rural and high-poverty schools in Louisiana. Findings also revealed that eighth-grade math achievement scores were

significantly lower in schools with high student minority enrollments. Holding other variables constant, a school's average eighth-grade math achievement score decreases by almost 13 scaled score points on the Louisiana LEAP 21 exam when the percent of minority students at a school increases by one percent. None of the teacher resource variables were significant for the regression analysis predicting fourth-grade math in rural and high-poverty schools or eighth-grade math (see Appendix B for summary tables of regression findings).

In Texas, the analysis model regressing fourth-grade math achievement on the set of predictor variables, revealed significant effects for teacher salary and teacher education (see Table 19). The results indicate that teacher salary had a significant and positive effect on fourth-grade math achievement scores, indicating that when a school's average teacher salary increases, fourth-grade math achievement scores increased. However, the results also indicate that the teacher education variable has a significant and negative effect on fourth-grade math achievement. Further, traditional teacher certification, median household income, student poverty, and parent education also significantly affect fourth-grade math achievement scores. The full model of independent predictors explained 50% of the variance in fourth-grade math achievement, $F(14, 3275) = 236.016$, $p < .001$, $R^2 = .50$.

Table 19

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Math in Texas

Variable	*B*	*SE B*	β
Prior year math achievement (3rd grade)	.337	.009	.541***
Teacher salary	2.396	.801	.068**
Teacher experience	.050	.071	.051
Teacher experience^2	-.003	.003	-.066
Teacher education (master's degree and above)	-1.693	.388	-.064***
Teacher certification (traditional)	1.144	.369	.055**
District per pupil instructional expenditure	.352	.316	.016
Locale (urban school)	-.077	.097	-.012
Average median household income	-1.329	.258	-.137***
Student minority	.001	.003	.009
School size	.001	.001	.085
School size^2	-.000	.000	-.052
Student poverty	-.025	.003	-.233***
Parent education	2.973	.554	.118***

Note. R^2 = .50 for full model. N = 3,290 schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Of the teacher resource variables, the most substantive result was an approximately 2.4 point increase on fourth-grade math achievement TLI (Texas Learning Index)[13] score for a 1% increase in average school teacher salary. In other words, while holding other variables constant, a school's average fourth-grade math achievement TLI score increases by approximately 2.4 TLI points when the school's average teacher salary increases by 1%. The regression results also indicated that school achievement scores were

[13] A TLI score defines typical progress as maintaining the same position relative to one's peers from grade to grade; the standard error of TLI across all analyses ranged from .05 to .08.

significantly lower when the percent of teachers with a master's degree or above increased. Specifically, when holding other variables constant, average school fourth-grade math achievement decreases by almost 1.7 TLI unit points when a school's average percent of teachers holding a master's degree increases. Findings also revealed that student poverty had a significant and negative effect on school math achievement, suggesting that schools with higher student poverty were associated with lower school fourth-grade math achievement. District parent education level was also significant and was positively associated with fourth-grade math scores.

In the regression analysis of the Texas subsample of fourth-grade math achievement in rural high-poverty schools, teacher experience and education were significant (see Table 20). The full model of independent predictors explained 39% of the variance in fourth-grade math achievement, $F(13, 314) = 17.057$, $p < .001$, $R^2 = .39$.

Table 20

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Math in Texas Rural and High-Poverty Schools

Variable	*B*	*SE B*	β
Prior year math achievement (3rd grade)	.340	.030	.552***
Teacher salary	2.912	3.222	.064
Teacher experience	.553	.274	.533*
Teacher experience^2	-.022	.010	-.549*
Teacher education (master's degree and above)	-4.205	1.425	-.138**
Teacher certification (traditional)	2.334	1.363	.091
District per pupil instructional expenditure	1.742	.925	.101
Average median household income	-1.096	1.105	-.058
Student minority enrollment	-.004	.009	-.031
School size	-.001	.003	-.035
School size^2	.000	.000	.089
Student poverty	-.014	.018	-.051
Parent education	4.717	2.727	.085

Note. R^2 = .39 for full model. N = 328 schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

The regression results indicated that a 1-year increase beyond the average school teaching experience of approximately 12 years, increases school fourth-grade math in rural and high-poverty schools by .011 TLI points. Additionally, the average fourth-grade school achievement appears to decrease by almost 4.2 TLI points when the percent of teachers with a master's degree or above increases by 1%.

The analysis of Texas student achievement in eighth-grade math indicated that teacher salary, teaching experience, traditional certification, and student minority all were significant predictors of eighth-grade math achievement (see Table 21). An increase in

teacher salary appears to positively affect eighth-grade math achievement, yet an increase in teaching experience appears to negatively affect eighth-grade math achievement. Overall, the model explained 76% of the variance in eighth-grade math achievement, $F(14, 1484) = 333.102$, $p < .001$, $R^2 = .76$.

Table 21

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Eighth-Grade Math in Texas

Variable	*B*	*SE B*	β
Prior year math achievement (7th grade)	.678	.014	.806***
Teacher salary	4.949	.754	.158***
Teacher experience	-.133	.060	-.148*
Teacher experience^2	.003	.002	.087
Teacher education (master's degree and above)	-.547	.355	-.023
Teacher certification (traditional)	.718	.338	.036*
District per pupil instructional expenditure	-.186	.251	-.011
Locale (urban school)	.024	.108	.004
Average median household income	-.269	.254	-.028
Student minority enrollment	-.007	.003	-.077**
School size	-.001	.000	-.092
School size^2	.000	.000	.095
Student poverty	-.005	.004	-.041
Parent education	.568	.535	.022

Note. $R^2 = .76$ for full model. $N = 1{,}499$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Of the teacher resource variables, salary contributed the most substantively to student achievement. This finding indicates that, holding other variables constant, a school's

average eighth-grade math achievement TLI score increases by approximately five TLI points when the average school teacher salary increases by 1%. The finding for the measure of minority student enrollment indicated that, a school's average eighth-grade math achievement TLI score decreases by less than one TLI point when the percent of minority students at a school increases by 1%. This effect appears to be substantively insignificant. Similarly, the same level of effect, but in a positive direction, was revealed when the percent of traditionally certified teachers increases.

Regression analysis findings for Texas eighth-grade math achievement in rural and high-poverty schools showed no significant results (see Table C.1 in Appendix C).

Regression Analyses Predicting School Student Achievement in Fourth- and Eighth-Grade Reading

In the analysis of Arkansas fourth-grade reading achievement, teacher salary, teaching experience (and its squared term), traditional certification, student minority enrollment, and student poverty were all significant predictors (see Table 22). The results indicate that teacher salary had a significant and positive effect on fourth-grade reading achievement scores, indicating that when the average school teacher salary increases, fourth-grade reading achievement scores increased. However, the results also indicate that the teaching experience variable has a significant and negative effect on fourth-grade reading achievement. Overall, the model explained 56% of the variance in fourth-grade reading achievement, $F(14, 501) = 47.169$, $p < .001$, $R^2 = .56$.

Table 22

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Reading in Arkansas

Variable	*B*	*SE B*	β
Prior year reading achievement (fourth grade)	.440	.039	.432***
Teacher salary	14.323	5.233	.152**
Teacher experience	.542	.271	.193*
Teacher experience^2	-.025	.012	-.205*
Teacher education (master's degree and above)	.155	2.747	.002
Teacher certification (traditional)	-15.202	6.504	-.072*
District per pupil instructional expenditure	.361	1.722	.007
Locale (urban school)	1.797	1.165	.063
Average median household income	-4.218	2.830	-.066
Student minority enrollment	-10.295	2.047	-.254***
School size	.000	.009	.000
School size^2	-.000	.000	-.038
Student poverty	-12.389	3.375	-.193***
Parent education	10.483	6.569	.068

Note. R^2 = .56 for full model. N = 516 schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Of the findings for teacher resource variables, the most substantive result was for teacher salary; a school's average fourth-grade reading achievement score increases by approximately 14 scaled score points on the Arkansas Benchmark exam with a school's 1% increase in average teacher salary. Additionally, when teacher experience increases by 1 year beyond the average, which is 12.5 years for this sample, a school's average

fourth-grade reading achievement score decreases by .09 scaled score points on the Benchmark exam.

Regression results for Louisiana fourth-grade reading achievement revealed that teaching experience (and its squared term), standard certification, instructional expenditures per pupil, and student poverty were significant predictors of reading achievement (see Table 23). The full model of independent predictors explained 75% of the variance in fourth-grade reading achievement, $F(14, 753) = 164.782$, $p < .001$, $R^2 = .75$.

Table 23. Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Reading in Louisiana

Variable	*B*	*SE B*	β
Prior year reading achievement (fourth grade)	.534	.021	.706***
Teacher salary	-9.001	4.963	-.042
Teacher experience	-1.210	.563	-.217*
Teacher experience^2	.051	.020	.254**
Teacher education (master's degree and above)	1.021	3.193	.007
Teacher certification (standard)	14.622	5.243	.060**
District per pupil instructional expenditure	6.400	2.744	.050*
Locale (urban school)	-.209	1.108	-.005
Average median household income	-2.269	2.539	-.020
Student minority enrollment	-3.969	2.451	-.065
School size	.005	.008	.044
School size^2	-.000	.000	-.008
Student poverty	-12.715	3.916	-.127***
Parent education	-4.736	8.940	-.012

Note. $R^2 = .75$ for full model. $N = 768$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

While a number of control variables contributed to this model, teacher experience was the only teacher resource variable that contributed significantly to the prediction of the fourth-grade reading scores in Louisiana. The finding for teacher experience (and the experience squared term) revealed that for a 1-year increase beyond the school average for teaching experience, which was 13 years for the fourth-grade sample, the average school-level fourth-grade reading achievement score increased by .16 scaled score points (standard error is .78), controlling for other variables. Teachers holding standard certification status were also associated with increases in fourth-grade reading exam

scores, as were district per-pupil instructional expenditures. An increase in school student poverty was negatively associated with reading achievement.

Regression analysis results for Texas fourth-grade reading achievement revealed that teacher salary, instructional expenditures per pupil, median household income, student poverty, and parent education all were significant in the prediction of fourth-grade reading achievement.(see Table 24). The average school teacher salary had significantly positive effects on the fourth-grade reading achievement scores. The full model of independent predictors explained 63% of the variance in fourth-grade reading achievement, $F(14, 3275) = 407.375$, $p < .001$, $R^2 = .63$.

Table 24

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Reading in Texas

Variable	*B*	*SE B*	β
Prior year reading achievement (third grade)	.527	.013	.585***
Teacher salary	3.143	.958	.064**
Teacher experience	.039	.086	.028
Teacher experience^2	-.003	.003	-.057
Teacher education (master's degree and above)	-.556	.465	-.015
Teacher certification (traditional)	.756	.442	.026
District per pupil instructional expenditure	.795	.378	.025*
Locale (urban school)	.058	.116	.007
Average median household income	-1.196	.307	-.088***
Student minority enrollment	-.006	.003	-.043
School size	.001	.001	.049
School size^2	-.000	.000	-.052
Student poverty	-.038	.004	-.253***
Parent education	2.260	.664	.064***

Note. R^2 = .63 for full model. N = 3,290 schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

The findings for teacher resources revealed that teacher salary had a significant and positive effect on fourth-grade reading. While holding other variables constant, a school's fourth-grade reading average increases by approximately 3.1 TLI points when a school's average teacher salary increases by 1%.

In the subsample of Texas rural and high-need schools, teaching experience (and its squared term) and parent education were both significant in the prediction of fourth-

grade reading achievement (see Table 25). The model explained 44% of the variance in fourth-grade reading achievement, $F(13, 314) = 20.690$, $p < .001$, $R^2 = .44$.

Table 25

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Fourth-Grade Reading in Texas Rural and High-Poverty Schools

Variable	*B*	*SE B*	β
Prior year reading achievement (3rd grade)	.480	.039	.570***
Teacher salary	3.408	3.790	.061
Teacher experience	.673	.324	.525*
Teacher experience^2	-.026	.012	-.518*
Teacher education (master's degree and above)	-.291	1.689	-.008
Teacher certification (standard)	.937	1.610	.030
Average median household income	.541	1.308	.023
District per pupil instructional expenditure	.509	1.083	.024
School size (total K–12 enrollment)	-.003	.004	-.140
School size (total K–12 enrollment)^2	.000	.000	.123
Student minority enrollment	-.007	.010	-.046
Student poverty	-.021	.021	-.064
Parent education	6.343	3.230	.093*

Note. $R^2 = .44$ for full model. $N = 328$ schools

* $p < .05$. ** $p < .01$. *** $p < .001$.

In the Texas rural and high-poverty schools, when teacher experience increases by 1 year beyond the average, which is 12 years for this sample, a school's average fourth-grade reading achievement score decreases by .035 TLI points while controlling for other variables. The only other significant predictor in the model was parent education, which

was positively associated with fourth-grade reading achievement in rural and high-need schools.

The regression results for eighth-grade reading achievement in Texas revealed significant effects for teacher salary, school size (and its squared term), and parent education (see Table 26). Overall, the model explained 78% of the variance in eighth-grade reading achievement, $F(14, 1484) = 371.355$, $p < .001$, $R^2 = .78$.

Table 26

Summary of OLS Regression Analysis for Variables Predicting School Student Achievement in Eighth-Grade Reading in Texas

Variable	*B*	*SE B*	β
Prior year reading achievement (7th grade)	.620	.014	.816***
Teacher salary	4.376	.834	.121***
Teacher experience	-.123	.067	-.119
Teacher experience^2	.003	.002	.084
Teacher education (master's degree and above)	-.390	.392	-.014
Teacher certification (traditional)	.175	.373	.008
District per pupil instructional expenditure	.055	.278	.003
Locale (urban school)	.148	.119	.021
Average median household income	-.456	.281	-.042
Student minority enrollment	-.004	.003	-.041
School size	-.002	.000	-.196***
School size^2	.000	.000	.134**
Student poverty	-.007	.004	-.052
Parent education	1.249	.592	.042*

Note. $R^2 = .78$ for full model. $N = 1{,}499$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

The most substantive result regarding teacher resources from the regression analysis on eighth-grade reading achievement was the teacher salary measure. Specifically, holding other variables constant, a school's average eighth-grade reading achievement score increases by approximately 4.4 TLI points when a school's average teacher salary increases by 1%. Additionally, school size and parent education were significant and positively related to reading achievement.

In Summary

Overall, regression results did not yield consistent results about the importance of salary, education, or experience levels to math and reading achievement across the three states. In Texas, teacher salary was a positive contributor to elementary and middle school math and reading achievement, except in high-need schools. Salary was also important to reading achievement in Arkansas, again in a positive direction, meaning that when the school's average teacher salary increased, its average student achievement increased. Cross-state findings for teacher experience were inconsistent. Aside from fourth-grade math achievement in Texas, there were no other significant findings for the relationship between teachers' graduate degrees and student achievement across the three states.

Conclusions

Given current policy interest in teacher resources and their effects on student performance, SEDL focused on the question of whether teacher resources such as salary, education, and experience relate to student achievement in varying school contexts. SEDL examined these relationships and generated three major findings: (1) teacher salaries are related to teacher experience and education, but variations exist depending on whether the schools are in rural settings, student poverty and minority enrollment are high, and math achievement is low; (2) schools in rural locations, in conditions of high poverty and low achievement in math, were staffed with the lowest-paid teachers, with lower percentages of teachers with graduate education, especially compared to urban schools; and (3) overall, student achievement is not explained consistently by teacher resources investigated in this study.

Single Salary Schedule Factors Significantly Predict Teacher Salary

SEDL was interested in confirming the contributions of experience and education to salary levels and exploring the possibility that a number of other district features played significant roles as well. Over the last 2 decades, little research has been conducted on this topic. Results support that teacher experience and education, the standard components of the single salary schedule, contributed significantly to the determinations of teacher salary in Arkansas, Louisiana, and Texas. Teacher experience was consistently the most important component of salary. Certification also factored into teacher salary, but inconsistently; certified teachers made higher base salaries than uncertified teachers, except in Arkansas. Current federal mandates requiring state teacher

certification to teach core courses should soon diminish this effect on base pay levels of teacher salary.

In the three study states, the prominence of teacher experience and education in predicting teacher salaries corroborated that the elements of a typical single salary schedule were operating in salary decisions. Considered in a policy context, this finding suggests that, in most cases, policymakers rely on the single salary schedule as the best available guideline for salary determinations, and districts/schools follow the state guidelines for salary. The findings for experience and salary also lent support to the notion that, holding education constant, increases in experience do not linearly increase teacher salary levels across all teachers. One explanation is the practice of "front-loading" or "back-loading" teacher salaries to account for the need to artificially increase base salary levels to address teacher recruitment or retention needs. These "bumps" would create a curvilinear trajectory when plotting experience against salary levels.

A number of limitations influenced the findings for teacher salaries. The measurement of teacher compensation, which includes pay, health benefits, stipends, and extra-duty pay, would have offered a more complete assessment of the pay teachers receive to perform duties than measurement of base pay alone allows. Unfortunately, the state data available at the time of collection did not include the elements needed for a comprehensive measure of total teacher compensation, limiting the ability to test how a more complete measure of compensation contributes to student achievement. Further, many important factors that influence teacher pay, including paying teachers "off schedule" or providing bonuses and incentives could not be studied here.

Student Poverty and Rurality Identify Cross-State Teacher Resource Patterns

SEDL tested indicators typically associated with high-need schools as defined in the research literature (Betts et al., 2000; Collins, 1999; Lankford et al., 2002), to investigate whether they discriminated patterns of teacher resource variations. In previous research, direct examination of high-need indicators, conducted systematically and with a large-scale database, had not been undertaken. The findings provided a picture of high-need schools across all the study states, revealing that the most descriptive indicators were rural location and high student poverty. Overall, the findings revealed that high student poverty, high student minority enrollment, low student achievement in eighth-grade math, and rural locale were most descriptive of schools exhibiting patterns of variation in teacher salary and education. Several relationships were found for teacher resource variations in rural schools, but, contrary to much of the research, only a few suggested that urban schools were suffering from a poorly paid and poorly educated teaching staff. More generally, findings support that salaries and teachers with higher levels of education were distributed unevenly.

This study revealed that rural schools in the three states under investigation paid low teacher salaries. While not unexpected, these findings make a strong case for the need for policy initiatives directly targeting rural schools and districts. More research is needed to investigate the influence of alternative approaches to teacher compensation and professional development for teachers in these hard-to-reach areas. Although teachers were underpaid in certain contexts such as rural settings, current findings do not support policies aimed at across-the-board salary increases. A number of other promising state policies related to teacher salaries and high-need areas, such as revamping salary models

to include measures of knowledge and skills and directing incentives to hard-to-staff areas, are currently being considered.

Equally important, SEDL found that teacher resource patterns typically found in urban schools were not observed among the sample. Policymakers would benefit from more information about this finding. An in-depth analysis of the revenue sources contributing to high urban teacher salaries and other potential reasons driving high salary and education levels in these schools would be warranted, as would a follow-up investigation of how higher urban teacher salaries and education predict student achievement over several years of data. More generally, in-depth qualitative or descriptive work is needed in order to better understand what contributes to and how districts use their salary schedules.

The findings also challenge the assumption that suburban schools are staffed with better paid, better educated, and more experienced teachers, and have, on average, the high achievement rankings that rural and urban schools are striving for. More research is needed to understand the variation in student achievement among suburban schools. This topic could be studied using suburban schools as a subsample, analyzed to reflect substantive differences between types of suburban schools, contextual factors contributing to those descriptive differences, and the teacher resource patterns among them. One contextual explanation may involve enrollment growth in rapidly expanding suburban areas, requiring new hires of less experienced teachers, contributing to low experience and pay levels in suburban areas. With regard to student achievement, the most critical question is whether those differences are driven by differences among

instructional resources, teacher resources, contextual reasons, or student demographic characteristics.

Another approach that would shed light on the current findings involves multilevel modeling, which would allow the investigation of interdistrict salary variations; for example, some districts may have lower salaries because teachers are leaving difficult teaching situations and low pay in one district, and new teachers are then hired to replace experienced teachers. The differences inherent in teacher contracts and how they influence teacher salary variations across districts and schools would add to the explanation of salary variation as well.

Teacher Resources Minimally and Inconsistently Related to Student Achievement

Across the three study states, few consistent conclusions can be made about the influence of teacher resources on student achievement. The most important finding was for teacher salaries, showing that salary made a positive contribution to elementary and middle school student achievement in Texas, and to fourth-grade reading achievement in Arkansas. Across the high-need schools in all three states, teacher salaries did not play a role in student achievement. Also in Texas, graduate-level teacher education was negatively associated with fourth-grade math scores and on fourth-grade math in rural and high-poverty schools.

Aside from a negative association, teachers' graduate degrees had no other significant effect on student achievement across the three states. One limitation that may be operating in the lack of findings for education is the use of master's degree as a proxy for teacher education. As mentioned previously, measures that were unavailable but may be better proxies for education would include degree subject-matter, selectivity of

institution attended, and amount and type of post-undergraduate courses taken. Similarly, cross-state findings for teacher experience were inconsistent, which may be partially explained by the lack of reliable data; in Arkansas and Texas teaching experience was negatively related to student achievement and positively related to student achievement in Louisiana.

Overall, study results for teacher salary offered some support to the consideration of teacher compensation reform efforts targeting elementary and middle school achievement. There were consistent findings, across the three states, for the influence of student poverty and student minority enrollment level, which tended to be negatively associated with student scores. The findings for parent education were consistently positive in relation to student achievement.

Similar to previous research in the area of teacher resources and student achievement dating back several decades and up to the present (Coleman et al., 1966; Podgursky, 2004; Rice, 2003), the current study found little consistent verification that the teacher resources studied here had positive effects on student achievement. The findings affirm that policymakers must decide whether existing salary structures based on education and experience are effectively promoting student achievement initiatives. SEDL did find some support, however, for the positive effect of salary on student achievement, but not for achievement in high-need schools. Taken together, the findings suggest that salary may still be a viable approach to improving student achievement, but that the qualifications used to set salary amounts should be reconsidered.

The current study findings are timely given that many states are adopting policy initiatives to increase teacher salaries and to provide incentives aimed at staffing and

improving teacher quality in high-need schools. While SEDL could not study whether the new policies were effective due to the recency of their consideration or adoption, the current study findings contribute information about teacher salaries and their relationship to educational goals, which is high on policymakers' agendas.

The databases available at the time of data collection and assembly for the current study did not contain the more current years of information. Teachers included in the study were only a subset of the overall pool of teaching staff in each of the states under investigation. Furthermore, the schools represented in the investigations were those that recorded fourth-and eighth-grade achievement scores, again, a percentage of the overall pool of schools in each state. As a result, the study presents findings on a subset of state data, a sample of total teachers and students in the states, and therefore findings do not generalize to the entire population of teachers, schools, districts, or region. Additionally, student achievement measures varied across and within states. For example, in Arkansas and Louisiana, the criterion-referenced tests were administered in several grade levels, but the tests for each grade were not scored on the same scales, rendering them incomparable across grades for tracking the achievement of a cohort of students. This limited SEDL's ability to follow a cohort of students across time.

Finally, in the interest of using state data, which had limitations, and containing the scope of the study, many of the factors that could potentially influence student achievement were not included. Factors such as selectivity of the institution where teachers received their degrees, amount and type of coursework taken beyond the undergraduate degree, factors contributing to teacher mobility, and other teacher resource

measures that may influence student achievement would yield important information, yet could not be considered here.

Recommendations for State and Local Policymakers

Taken together, the results of the study lend themselves to specific recommendations for state and local policymakers regarding teacher compensation reform and efforts to improve student achievement and close the achievement gap.

- Policymakers should consider the context of schools when determining salary structures. For instance, if policymakers implement strategies to address disparate salary levels, schools with high rates of student poverty, in rural locations, and with low student achievement comprise a high-need target group for education policy initiatives.
- The study revealed that the attainment of advanced degrees is not related to student outcomes. Basically, policymakers should consider whether pay structures that routinely reward advanced degrees should be continued, given that research continues to show that graduate degrees have little connection to student scores. Alternatively, policymakers could work with higher education institutions to better connect the knowledge gained in advanced degree programs with the improvement of student performance or policies that support obtaining degrees that improve teachers' content or pedagogical content knowledge.
- While the use of state data strengthened the findings' applicability to questions in particular school contexts deemed important to state policymakers and education researchers, improvements to state databases are needed. For example, the inconsistency of the findings for teacher experience, which revealed both positive

and negative connections to student achievement, may be related to the quality of the teacher experience data. The improved accuracy of teacher experience data would increase researchers' abilities to assess the degree to which teacher experience is associated with student achievement. Further, policymakers' abilities to make policy decisions based on reliable and complete data on other related issues are implicated in this study finding. For instance, the improvement of teacher compensation data would raise the quality of study results on teacher compensation and their usefulness to policymakers. Additional teacher compensation data, such as individual benefits, incentives, and bonuses, available at the individual teacher level in state databases would assist informed decision-making about teacher resources.

- Findings validate that experience and education were the major components of salary, but the statistical link between teacher experience and teacher education and student achievement is tenuous at best. This finding has policy implications with regard to the attributes used to determine salary. Policymakers need to find alternative teacher qualities upon which to base teacher compensation systems if improved student achievement is the focus of policy reform.
- Reform efforts aimed at ameliorating conditions of low teacher quality should investigate teacher characteristics other than master's degrees or advanced teaching experience to address staffing in schools identified as low performing.
- While few findings emerged for the influence of teacher resources on student achievement, in Louisiana's rural, high-poverty schools, eighth-grade math scores were negatively associated with teacher experience, as was the case with Texas'

fourth-grade math (which was also negatively associated with teachers with master's degrees) and reading achievement in high-need schools. Policymakers should consider whether more experience represents higher teacher quality when judged according to student achievement in high-need schools.

Rice (2003), on the basis of an extensive review of research studies, concluded that teacher quality is one of the most important factors associated with student achievement, lending support to the current policy efforts targeting more attention to teacher quality and their influence on student achievement, especially in high-need schools. Overall, the current study did not find conclusive support for the importance of teacher experience, no support for promoting teachers with advanced degrees, and no conclusive support for the influence of traditional teacher certification to student achievement in either math or reading. These findings reveal a problem with current conceptualizations of teacher quality in terms of the outcomes on student achievement.

When applying the findings to policy issues, it is important to keep in mind that the study was conducted in only three of the five states in SEDL's region, decreasing the generalizability of findings for the overall region. Additionally, the quantitative approach used to examine the complex relationships between teacher salary, student achievement, and contextual factors provided a limited view of the full picture. For example, test scores are only an approximate measure of student learning. The quantitative measures available through state databases cannot fully represent the complexity of the entire learning experience.

In Closing

The results of this study confirm a number of factors related to teacher resources in high-need schools and their association with student achievement. Although the results are not surprising, SEDL confirmed that Arkansas, Louisiana, and Texas were paying teachers along the parameters of the single salary schedule, laying groundwork for the investigation of teacher resource patterns. Schools in conditions of high student poverty, high student minority enrollment, rural locales, and low student achievement were staffed with the lowest paid and least educated teachers across all three states. These findings confirm patterns already well known to education policymakers, but lend support to decisions currently under consideration regarding teacher incentives for difficult to staff regions and the adoption of alternative teacher quality and compensation models.

Overall, the results of the study confirm previous findings in the literature that teacher education and experience have little to do with teacher quality. Further, these results explain the lack of significant linkages between teacher salary, experience, and education and student achievement. Findings also specifically addressed the contribution of salary, education, and experience to the achievement of students in high-need schools. None of the findings for the subsample of high-need schools were significant for teacher salary, education, or experience. These results suggest that the research community must develop other approaches to studying the influence of teacher quality on student achievement, which may result in better information to assist in the development of alternative compensation systems.

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Appendix A

Research Question 3: Regression Analyses for Arkansas

Table A.1

Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Fourth-Grade Math in Arkansas Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year math achievement (fourth grade 2001–2002)	.486	.071	.484***
Teacher salary	-12.941	36.081	-.030
Teacher experience	-1.024	2.114	-.093
Teacher experience^2	.069	.079	.164
Teacher education (master's degree and above)	24.887	14.922	.092
Teacher certification (traditional)	-18.578	37.620	-.026
District per pupil instructional expenditure	4.763	11.658	.026
Average median household income	-32.642	18.011	-.120
Student minority enrollment	-37.772	13.142	-.262**
School size (total K–12 enrollment)	.000	.050	.000
School size (total K–12 enrollment)^2	.000	.000	.043
Student poverty	-27.506	31.503	-.077
Parent education	80.406	52.465	.088

Note. R^2 = .53 for full model. N = 193 schools

** $p < .01$. *** $p < .001$.

Table A.2

Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Math in Arkansas

Variable	*B*	*SE B*	β
Prior year math achievement (eighth grade 2001–2002)	.403	.048	.417***
Teacher salary	3.637	8.254	.025
Teacher experience	-.058	.379	-.015
Teacher experience^2	.001	.014	.008
Teacher education (master's degree and above)	2.020	3.855	.018
Teacher certification (traditional)	-7.198	6.672	-.035
District per pupil instructional expenditure	2.509	2.338	.039
Locale (urban school)	1.931	2.284	.035
Average median household income	-.892	4.522	-.010
Student minority enrollment	-25.187	3.358	-.424***
School size (total K–12 enrollment)	.006	.009	.076
School size (total K–12 enrollment)^2	-.000	.000	-.126
Student poverty	-8.217	6.100	-.081
Parent education	25.762	11.399	.100*

Note. R^2 = .68 for full model. N = 331 schools.

*$p < .05$. ***$p < .001$.

Table A.3

Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Math in Arkansas Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year math achievement (eighth grade 2001–2002)	.249	.080	.274**
Teacher salary	-2.151	14.986	-.011
Teacher experience	.339	.669	.087
Teacher experience^2	-.005	.024	-.036
Teacher education (master's degree and above)	-1.985	7.597	-.016
Teacher certification (traditional)	-12.496	10.914	-.068
District per pupil instructional expenditure	-3.052	5.850	-.036
Average median household income	2.904	9.430	.023
Student minority enrollment	-24.684	5.463	-.450***
School size (total K–12 enrollment)	-.031	.032	-.212
School size (total K–12 enrollment)^2	.000	.000	.184
Student poverty	-30.204	16.450	-.194
Parent education	-.328	28.480	-.001

Note. $R^2 = .66$ for full model. $N = 110$ schools.

** $p < .01$. *** $p < .001$.

Table A.4

Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Fourth-Grade Reading in Arkansas Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year math achievement (fourth grade)	.362	.069	.372***
Teacher salary	8.887	11.755	.074
Teacher experience	.342	.688	.111
Teacher experience^2	-.010	.026	-.089
Teacher education (master's degree and above)	.877	4.879	.011
Teacher certification (traditional)	-14.073	12.297	-.069
Average median household income	-3.333	5.797	-.043
District per pupil instructional expenditure	.576	3.775	.011
School size (total K–12 enrollment)	.002	.016	.024
School size (total K–12 enrollment)^2	-.000	.000	-.052
Student minority enrollment	-9.391	3.849	-.231*
Student poverty	-14.685	10.288	-.146
Parent education	14.446	17.094	.056

Note. R^2 = .37 for full model. N = 193 schools.

* $p < .05$. *** $p < .001$.

Table A.5. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Reading in Arkansas

Variable	*B*	*SE B*	β
Prior year reading achievement (eighth- grade)	.376	.045	.391***
Teacher salary	-1.262	7.387	-.011
Teacher experience	-.063	.339	-.020
Teacher experience^2	.001	.013	.006
Teacher education (master's degree and above)	3.121	3.446	.036
Teacher certification (traditional)	-2.933	5.964	-.018
District per pupil instructional expenditure	3.555	2.092	.070
Locale (urban school)	2.924	2.039	.066
Average median household income	.504	4.040	.007
Student minority enrollment	-19.455	2.754	-.412***
School size	.009	.009	.157
School size^2	-.000	.000	-.261*
Student poverty	-5.020	5.402	-.062
Parent education	33.515	10.111	.163***

Note. $R^2 = .60$ for full model. $N = 331$ schools.

* $p < .05$. **** $p < .001$.

Table A.6. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Reading in Arkansas Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year math achievement (eighth grade 2001–2002)	.244	.074	.262***
Teacher salary	-6.623	12.203	-.044
Teacher experience	.216	.545	.073
Teacher experience^2	-.005	.020	-.049
Teacher education (master's degree and above)	-2.628	6.255	-.029
Teacher certification (traditional)	-11.038	8.888	-.079
Average median household income	12.370	7.676	.130
District per pupil instructional expenditure	5.163	4.777	.081
School size (total K–12 enrollment)	.010	.026	.091
School size (total K–12 enrollment)^2	-.000	.000	-.145
Student minority enrollment	-21.128	4.157	-.507***
Student poverty	-10.049	13.254	-.085
Parent education	17.994	23.216	.053

Note. $R^2 = .61$ for full model. $N = 110$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Appendix B

Research Question 3: Regression Analyses for Louisiana

Table B.1. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Fourth-Grade Math in Louisiana Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year math achievement (eighth grade 2001–2002)	.558	.065	.539***
Teacher salary	8.962	14.131	.041
Teacher experience	-3.101	1.796	-.511
Teacher experience^2	.098	.070	.412
Teacher education (master's degree and above)	-9.175	9.240	-.060
Teacher certification (standard)	44.389	13.930	.200**
Average median household income	-20.819	7.768	-.164**
District per pupil instructional expenditure	-.140	7.624	-.001
School size (total K–12 enrollment)	.008	.031	.063
School size (total K–12 enrollment)^2	.000	.000	-.050
Student minority enrollment	-10.059	6.641	-.143
Student poverty	-11.932	13.829	-.077
Parent education	-10.474	25.613	-.022

Note. $R^2 = .52$ for full model. $N = 204$ schools

** $p < .01$. *** $p < .001$.

Table B.2. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Math in Louisiana

Variable	*B*	*SE B*	β
Prior year math achievement (eighth grade 2001–2002)	.706	.033	.705***
Teacher salary	-1.827	5.838	-.009
Teacher experience	-1.280	.710	-.213
Teacher experience^2	.046	.025	.205
Teacher education (master's degree and above)	3.135	4.060	.020
Teacher certification (standard)	10.056	5.331	.050
Locale (urban school)	.009	1.487	.000
Average median household income	-3.056	3.025	-.029
District per pupil instructional expenditure	3.775	3.114	.032
School size (total K–12 enrollment)	.004	.007	.051
School size (total K–12 enrollment)^2	.000	.000	-.088
Student minority enrollment	-8.123	2.985	-.128**
Student poverty	-12.868	4.209	-.125**
Parent education	15.975	10.530	.041

Note. $R^2 = .81$ for full model. $N = 408$ schools

** $p < .01$. *** $p < .001$.

Table B.3. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Fourth-Grade Reading in Louisiana Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year reading achievement (fourth grade)	.435	.047	.589***
Teacher salary	-14.366	10.297	-.089
Teacher experience	-.661	1.313	-.146
Teacher experience^2	.016	.051	.090
Teacher education (master's degree and above)	5.976	6.775	.052
Teacher certification (standard)	18.098	10.272	.109
Average median household income	-10.393	5.680	-.110
District per pupil instructional expenditure	11.317	5.618	.130*
School size (total K–12 enrollment)	.025	.023	.253
School size (total K–12 enrollment) ^{2}	-.000	.000	-.179
Student minority enrollment	-10.196	4.929	-.195*
Student poverty	-4.835	10.094	-.042
Parent education	-2.448	18.790	-.007

Note. $R^2 = .54$ for full model. $N = 204$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table B.4. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Reading in Louisiana

Variable	*B*	*SE B*	β
Prior year reading achievement (eighth grade)	.546	.028	.638***
Teacher salary	-4.719	5.557	-.024
Teacher experience	-.836	.677	-.153
Teacher experience^2	.034	.024	.169
Teacher education (master's degree and above)	-.493	3.865	-.003
Teacher certification (standard)	10.882	5.111	.060*
District per pupil instructional expenditure	3.578	2.964	.033
Locale (urban school)	-1.675	1.413	-.035
Average median household income	-.832	2.881	-.009
Student minority enrollment	-10.112	2.765	-.176***
School size	.009	.006	.121
School size^2	.000	.000	-.148*
Student poverty	-11.857	4.056	-.126**
Parent education	15.087	10.037	.043

Note. $R^2 = .79$ for full model. $N = 408$ schools.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table B.5. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Reading in Louisiana Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year reading achievement (eighth grade)	.335	.077	.383***
Teacher salary	12.411	12.154	.086
Teacher experience	-1.816	1.421	-.465
Teacher experience^2	.061	.052	.416
Teacher education (master's degree and above)	-2.303	8.343	-.022
Teacher certification (standard)	23.844	9.792	.196*
Average median household income	-11.379	6.686	-.132
District per pupil instructional expenditure	1.290	5.735	.018
School size (total K–12 enrollment)	.006	.031	.062
School size (total K–12 enrollment)^2	-.000	.000	-.054
Student minority enrollment	-14.713	5.864	-.314*
Student poverty	-3.218	11.208	-.030
Parent education	10.976	19.749	.039

Note. $R^2 = .52$ for full model. $N = 126$ schools.

* $p < .05$. *** $p < .001$.

Appendix C

Research Question 3: Regression Analyses

Table C.1. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Math in Texas Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year math achievement (7th grade)	.734	.039	.807***
Teacher salary	3.929	2.556	.105
Teacher experience	-.059	.157	-.070
Teacher experience^2	.003	.005	.093
Teacher education (master's degree and above)	-.576	.972	-.024
Teacher certification (traditional)	.988	.855	.048
District per pupil instructional expenditure	.117	.758	.007
Average median household income	-.110	.892	-.005
Student minority enrollment	-.007	.007	-.055
School size	-.001	.003	-.038
School size^2	.000	.000	.009
Student poverty	-.007	.016	-.023
Parent education	-3.946	2.469	-.065

Note. $R^2 = .72$ for full model. $N = 202$ schools.

*** $p < .001$.

Table C.2. Summary of OLS Regression Analysis for Variables Predicting Student Achievement in Eighth-Grade Reading in Texas Rural and > 50% FRPL Schools

Variable	*B*	*SE B*	β
Prior year reading achievement (7th grade)	.579	.044	.708***
Teacher salary	4.077	3.116	.104
Teacher experience	.015	.191	.017
Teacher experience^2	.001	.006	.027
Teacher education (master's degree and above)	-.934	1.182	-.037
Teacher certification (traditional)	-.005	1.035	.000
Average median household income	-2.101	1.086	-.099
District per pupil instructional expenditure	-.693	.923	-.039
School size (total K–12 enrollment)	-.004	.003	-.190
School size (total K–12 enrollment)^2	.000	.000	.085
Student minority enrollment	-.011	.009	-.077
Student poverty	-.017	.019	-.057
Parent education	1.280	3.031	.020

Note. $R^2 = .62$ for full model. $N = 202$ schools.

$p < .05$. ** $p < .01$. *** $p < .001$.

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