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# STANDARDS-BASED REFORM AND THE POVERTY GAP

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AND THE POVERTY GAP

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*Lessons for No Child Left Behind*

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*Editor*

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## *Has NCLB Improved Teacher and Teaching Quality for Disadvantaged Students?*

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Has NCLB improved teacher and teaching quality for disadvantaged students? The central impetus for the No Child Left Behind Act (NCLB) of 2001 was that many children were being “left behind” in our education system. Our analyses focus on how students from low-income families might be left behind in terms of teacher and teaching quality. How large were the teacher quality gaps between advantaged students (students who do not qualify for free or reduced priced lunch) and disadvantaged students (students who qualify for free or reduced price lunch) at the onset of NCLB? Has teacher quality for disadvantaged students improved? Can any improvements that have occurred be associated with NCLB-related policy changes?

To answer these questions, we estimate the relation between state-level implementation of recent standards-based reforms and subsequent improvements in teacher quality, as measured by several key indicators. Given the limits of available data, any conclusions we make must necessarily fall short of direct attribution of the federal NCLB legislation to changes in teacher and teaching quality experienced by disadvantaged students. However, we are

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able to identify trends experienced by disadvantaged students in states where considerable implementation of standards-based reforms, consistent with NCLB, was occurring.

In our analyses, teachers of advantaged students tended to rate higher on indicators of quality than do teachers of disadvantaged students, though these differences were small. Disadvantaged students encountered better teacher quality in low-poverty than in high-poverty schools (low-poverty schools have 0 to 10 percent of students who qualify for free or reduced price lunch; high-poverty schools have 75 to 100 percent of students who qualify for free or reduced price lunch), but disadvantaged students in affluent schools had worse teachers than did advantaged students in poor schools. There was no substantial change in overall teacher quality from 2000 to 2003, nor was there much movement in mitigating gaps in teacher quality between advantaged and disadvantaged students.

We found only occasional small improvements, and in some states a worsening, in the gap in teacher quality in states that were implementing standards-based reforms consistent with NCLB mandates. However, implementation of standards and assessments that are aligned with each other (consistency), the number of sanctions a state can impose (power), and the provision of professional development resources (authority) were associated with better teacher quality for low-income students, but these did not eliminate the relation between poverty and teacher quality. We found that an increase in power mitigated the negative relation between poverty and teacher quality, while whether the state has clear and specific standards in middle school mathematics (specificity) was associated with the worsening of the relation between poverty and teacher quality.

## State Implementation of NCLB

Our analyses tracked changes in teacher characteristics between 2000 and 2003. Although NCLB was passed in 2001, states were not required to complete full implementation until 2005–06. In working toward the deadline, it was necessary for states to put many components of the law in place in 2003. However, acting on their own accord, states had enacted many components of the law since the early 1990s, as part of the standards-based reform movement.<sup>1</sup> In our analyses we examined the narrow window between 2000 and 2003 during which by most accounts implementation activity was quite high.<sup>2</sup>

1. Fuhrman (2001).

2. *Education Week* (2001, 2002, 2003).

## Teacher and Teaching Characteristics

The No Child Left Behind Act calls for a highly qualified teacher in every classroom. According to the legislation, *highly qualified* is defined as full certification or licensure, a college degree, and demonstrated content knowledge in the subject that the teacher is teaching. The bar is set high in absolute terms, with the goal of 100 percent of teachers being highly qualified. NCLB includes provisions stating that all teachers in core academic areas must be highly qualified by the end of the 2005–06 school year. It also requires that newly hired teachers in Title I programs or schools be highly qualified immediately.<sup>3</sup>

Further, NCLB requires that states include in their compliance plans a section specifying what steps they will take to ensure that poor and minority children “are not taught at higher rates than other children by inexperienced, unqualified, or out-of-field teachers.”<sup>4</sup> This provision reflects research that has shown that students from low-income homes are more likely to be taught by inexperienced teachers who are not certified and do not have a degree in the content area in which they are teaching.<sup>5</sup> Research also suggests that low-income students are more likely to have teachers who rely predominantly on basic and procedural instruction rather than on conceptual and higher-order instruction.<sup>6</sup>

This recent work is reflective of the opportunity-to-learn literature, which for decades has chronicled inequities in the quality of schooling experienced by low-income and minority students.<sup>7</sup> Carroll’s (1963) original conception of opportunity to learn has been operationalized as the amount and quality of exposure to new knowledge, which includes the quality of teachers and their instruction.<sup>8</sup>

While there is no definitive consensus in the research on the extent to which teacher qualifications and teaching techniques affect student achievement, a substantial amount of research suggests that teachers with more than a few years of experience and those with strong content knowledge (for example, as reflected by a degree in the content area they are teaching) are more likely to foster gains in student achievement than are their less experi-

3. U.S. Department of Education (2003).

4. No Child Left Behind Act of 2001, sec. 1111, State Plans ([www.ed.gov/policy/elsec/leg/esea02/index.html](http://www.ed.gov/policy/elsec/leg/esea02/index.html)).

5. Ingersoll (2002); Goldhaber and Brewer (2000).

6. Barr and Dreeben (1983); Desimone and others (2005b); Gamoran (1986).

7. Gamoran and Mare (1989); Oakes (1985).

8. Conception of opportunity to learn operationalized: Carroll (1963); Hallinan (1987); Porter (1995); quality of teachers and their instruction: Stevens (1993).

enced, less qualified peers.<sup>9</sup> Similarly, use of conceptual teaching strategies in mathematics has been associated with gains in student achievement.<sup>10</sup> Certification status has mixed results in terms of its associations with good outcomes for students, and certification requirements vary substantially by state, so much so that some scholars believe certification is not a useful metric.<sup>11</sup> However, given that certification is one of the most explicit targets of teacher quality in NCLB, we include it as a key measure of teacher quality.

The reason for focusing on *teaching* quality is based on the belief that better instruction leads to improved student achievement; the focus on *teacher* quality is based on the belief that certain characteristics of teacher background are related to better teaching. In fact, one of the key underlying rationales for the NCLB provisions on teacher quality is that improving teaching quality will address the considerably wide variation in gains in student achievement that currently exists between classrooms. The emphasis on this rationale is reflected in the NCLB's *A Toolkit for Teachers*, which states:

Recent studies offer compelling evidence that teacher quality is one of the most critical components of how well students achieve. For instance, studies in both Tennessee and Texas found that students who had effective teachers greatly outperformed those who had ineffective teachers. In the Tennessee study, students with highly effective teachers for three years in a row scored 50 percentage points higher on a test of math skills than those whose teachers were ineffective.<sup>12</sup>

Drawing on teacher quality research and its corollaries in the NCLB legislation, we focused our inquiry on conceptual and procedural teaching and on several teacher quality indicators: specifically certification, whether the teacher is inexperienced (less than two years of teaching experience), self-reported preparedness to teach mathematics topics, and whether the teacher has an undergraduate or graduate degree in mathematics. We focused on a single subject (mathematics) in a single grade (eighth) to allow us greater

9. Ballou (1996); Darling-Hammond (2000); Ferguson and Ladd (1996); Monk and King (1994); Murnane and Phillips (1981).

10. Carpenter and others (1989); Hiebert and others (1996).

11. Certification status association with good outcomes for students: Darling-Hammond, Berry, and Thorenson (2001); Goldhaber and Brewer (2000); certification not a useful metric: Ballou (1996).

12. U.S. Department of Education (2004), p.11; Tennessee study cited in extract: Sanders and Rivers (1996).



control over the potentially confounding effects of grade level and subject field. Further, a focus on mathematics is justified given that U.S. middle school students are achieving at alarmingly low levels in math and that teacher quality is a major contributor to the problem.<sup>13</sup>

### Conceptual Framework: NCLB and State Policy

To characterize state implementation of NCLB, we grounded our study in a theory for analyzing the effectiveness of policy. The theory, developed by Andrew Porter and others and applied in several policy studies, posits five attributes that contribute to successful implementation of a policy:

—*Consistency*, the extent to which all components of the system are aligned with each other

—*Specificity*, the extent to which states provide clear and detailed guidance as to what teachers and students are to do

—*Authority*, the degree to which a policy has the support of relevant individuals or institutions

—*Power*, the rewards and sanctions attached to a policy

—*Stability*, the extent to which policies and practices remain in place over time.<sup>14</sup>

The policy attributes theory is a simple yet powerful framework for identifying and analyzing the policies that states have used to implement NCLB mandates. Ideally the relationship between changes in teacher quality and the policy environment would be studied by analyzing specific policies focused on teacher quality and the attributes of the larger policy system. However, comprehensive, longitudinal state-level data are not available on specific aspects of teacher quality policies. Thus we focus our policy measures on attributes of the larger policy system. The policy attributes framework suggests that the quality of attributes of the wider policy environment will affect the success of policy implementation in multiple areas, such as teacher quality. We relied on these hypothesized links between attributes of the policy environment and teacher quality outcomes to guide our study.

13. Low levels of math achievement: Porter (2005); Schmidt and others (2001); U.S. Department of Education (2003); teacher quality major contributor: Schmidt, McKnight, and Raizen (1997).

14. Porter (1994); Porter and others (1993); Porter and others (1988); Schwille and others (1988); Berends and others (2002); Clune (1998); Desimone and others (2005a); Desimone (2002).

## Research Questions

We seek to shed light on two central questions related to understanding how NCLB policies may be affecting the quality of teachers and teaching for disadvantaged students in the United States:

—*What were the gaps in teacher and teaching quality between students in poverty and their more advantaged peers in 2000, and to what extent did those gaps narrow by 2003?*

—*Are improvements in teacher quality and the narrowing of gaps in teacher quality associated with state implementation of NCLB?*

## Data and Measures

We use three sources of data for this study. The first is a database of state policies related to NCLB implementation. The other two sources are from the National Assessment of Educational Progress (NAEP), the national and state-by-state samples. Specifically, we use the national 2000 NAEP and the 2000 and 2003 state NAEP. Below we briefly describe each of these datasets.

### *State Policy Database*

To develop state-level measures of the policy attributes described in our theoretical framework, we constructed our state policy database from existing national data sources employed by *Education Week's Quality Counts* report, the American Federation of Teachers' report on states, the *Key State Policies* report published by the Council of Chief State School Officers, and the Thomas B. Fordham Foundation.<sup>15</sup>

We characterize the state NCLB policy system by its consistency, specificity, authority, and power.<sup>16</sup> In this analysis we do not measure *stability*, the degree to which policies remain in place over time, because the data available on the change in the content of standards and assessments are available for only a limited number of states.<sup>17</sup>

To address consistency, we focused on the characteristics of a state's standards-based reform environment that are consistent with policies called for in the NCLB legislation. Our consistency measure indicated whether the state

15. *Education Week* (2001, 2002, 2003, 2004); American Federation of Teachers (2001); Blank and Langesen (2001); Finn and Petrilli (2002).

16. The variables for the policy attributes in this analysis were based on indicators in the *Education Week's Quality Counts* reports (*Education Week* 2001, 2002, 2003, 2004).

17. Blank and Langesen (2001).

used criterion-referenced assessments in middle school mathematics that had undergone an external alignment review in 2000 and in 2003. We measured specificity with an indicator of whether the state had clear and specific standards in middle school mathematics.

We had two authority measures. One was an indicator of whether the state provided assistance to low-performing schools; the second was a measure of whether the state provided resources for professional development. We categorize these two measures as authority, given that one way authority is realized is through the backing and support of institutions.<sup>18</sup> We consider the provision of assistance and resources to be mechanisms of institutional authority.

Finally, we measured power with two measures. Our first measure was an indicator of whether or not the state assigned ratings to all schools or identified low-performing schools. Because power in our framework is the rewards and sanctions associated with implementation of a policy, we consider the public identification of a school as successful or not successful as operating as a reward or sanction for the school and its teachers and students. Our second power measure was an additive composite representing six different sanctions that a state can legally impose on failing schools: closure, reconstitution, student transfers, withholding funding, conversion of the school into charters, and turning the school over to private management. Descriptive statistics for each of these measures is in the appendix, table 4A-1.

### *National Assessment of Educational Progress*

We use the national and state student and teacher surveys and student mathematics assessment data from the National Assessment of Educational Progress (NAEP). The NAEP has a sample of fourth and eighth grades from the state and national levels, from which for the current analyses we use the eighth grade national sample.<sup>19</sup> The NAEP 2000 is based on a stratified national probability sample of approximately 16,000 eighth graders and their mathematics teachers at 744 schools. NAEP is one of the few nationally representative datasets that surveys teachers about their educational background, self-reported preparedness to teach mathematics topics, participation in professional development, and their use of a wide range of instructional strategies.<sup>20</sup> Although the NAEP sample was not specifically designed to estimate

18. Porter and others (1988).

19. U.S. Department of Education (1999, 2001).

20. Only the 2000 national NAEP asks about self-reported preparedness to teach mathematics topics, participation in professional development, and use of instructional strategies; these questions were dropped from the 2000 and 2003 state sample of NAEP.

the attributes of the teacher population, by using teachers' responses about each of their classes from which a student was sampled, we can examine the relationship between characteristics of the student and teacher and state policy.

Using the 2000 national NAEP, we created three measures of instruction that reflect two main approaches to teaching: conceptual and procedural. We measure *conceptual emphasis* with a series of questions that asked teachers how much they emphasized reasoning, communication, and an appreciation for mathematics. We included a measure of *conceptual strategies* that asked teachers how often students in their class wrote about mathematics and discussed and worked together with other students on solutions. Our measure of *procedural teaching* was composed of a series of questions that asked about how much emphasis the teacher gave to learning mathematics facts and solving routine problems. Table 4A-1 in the appendix lists the questions that make up each composite.

The measures of teacher quality we used were (1) years of experience, whether the teacher had fewer than two years; (2) certification, whether the teacher was fully or partially certified; (3) self-reported preparation to teach specific mathematics topics; and (4) mathematics degree, whether the teacher had a graduate or undergraduate degree in mathematics. Table 4A-1 in the appendix also provides details about how each of these measures was created.

The state-by-state National Assessment of Educational Progress, which began in 1990, is the only nationally administered, continuing state-representative assessment of what U.S. students know and can do in reading and mathematics. From each state participating in NAEP in a particular year, a representative sample of schools and students was selected. On average in 2000, approximately 2,000 students in sixty-five schools were selected per grade, per subject assessed in each state. In 2003, the number of students increased to approximately 3,000 students, on average, in about 100 schools. The selection of schools is random, within categories of schools with similar characteristics. We used the NAEP because it is comparable both across years and across the states that have participated and because it is the most current dataset on teacher qualifications by state. All fifty states participated and met the minimum guidelines for reporting their results in 2003, but in 2000, only thirty-nine states participated.<sup>21</sup>

21. Nonstate jurisdictions also participated in the 2000 state-by-state assessment, such as American Samoa, Guam, the Department of Defense Domestic Dependent Elementary and Secondary Schools (DDESS), the overseas Department of Defense Dependents Schools (DoDDS), and the Virgin Islands. We did not include these in our analyses because they do not necessarily operate under the same education reform environment as do the states.

## Analysis

To answer our first research question, *What were the gaps in teacher and teaching quality between students in poverty and their more advantaged peers in 2000, and to what extent did those gaps narrow by 2003?*, we describe key teacher and teaching characteristics at the national and state levels in 2000 and 2003, both overall and by free lunch. For this we use national and state NAEP data. We identified national trends in teacher qualifications and instruction and in which states teacher qualifications increased, decreased, or stayed the same. Specifically, we examined the weighted sample means of teacher characteristics and instruction (that is, procedural or conceptual) to determine whether these attributes were different for teachers of students eligible for free lunches from those of teachers of noneligible students using the 2000 NAEP national sample of eighth graders. Data on instructional style are available only in the 2000 national NAEP; it was not included in the 2000 or 2003 state NAEP surveys.

To answer our second research question, *Are improvements in teacher quality and the narrowing of gaps in teacher quality associated with the implementation of NCLB?*, we sought to first understand whether states that were stronger on the policy attributes had smaller poverty gaps in teacher characteristics in 2000 than did states with weaker policy attributes. Since we do not have a random sample of students in each class from which to estimate class-level poverty, we are limited to examining teacher quality gaps across schools with different proportions of students who were receiving free or reduced price lunch. To examine these cross-sectional relationships between state policies, school-level poverty, teacher characteristics, and teaching style, we estimated a three-level hierarchical linear model on the NAEP 2000 national sample, focusing on teachers nested within schools, located within states. Our dependent variables were inexperienced teacher (that is, having two or fewer years of experience); certification status; level of preparedness to teach different mathematics topics; whether or not the teacher has a degree in mathematics, as well as use of different instructional strategies, including conceptual emphasis, conceptual strategies, and procedural teaching. School-level independent variables included the percentage of students receiving free or reduced-price lunches. State-level policy variables included power, consistency, specificity, authority1, and authority2).<sup>22</sup>

22. The equation for this analysis is the following:

$$(1) \quad Q_{js} = \gamma_{000} + \gamma_{010} \%FreeLunch_{js} + \gamma_{001} POLICY_s + u_s + r_{js} + \varepsilon_{ijs}$$

We then examined the relationship between state policies and teacher characteristics over time, while controlling for change in state-level poverty.<sup>23</sup> The specific measures of teacher quality that we used were the percentage of teachers with zero to two years of experience; the percentage of teachers with an advanced, regular, or probationary teaching certificate; the percentage of teachers with any form of a teaching certificate (that is, advanced, regular, probationary, temporary, provisional, or emergency); the percentage of teachers with an undergraduate or graduate degree in math; and the percentage of teachers with a degree in math education or a math undergraduate or graduate degree. We estimated this as a state-specific fixed-effects model, so that the relation between state policies and teacher quality was determined from variation over time within states. Therefore, the estimates of  $\beta$  related the changes in state policy from 2000 to 2003 to the changes in the average teacher quality in the state during the same period, while accounting for the changes in percentages of middle school students in the state who were eligible for free lunch. These models allowed us to assess whether teacher quality had improved more in states with a higher implementation of NCLB-related policies between 2000 and 2003. Here we also examined whether the relationship between policies and teacher quality was different in wealthy schools (with 0 to 10 percent of students eligible for free lunch) than in poor schools (75 to 100 percent eligible for free lunch).

Finally, we tested whether the relation between state-level NCLB implementation and teacher quality changed between 2000 and 2003 and whether the implementation of policy between 2000 and 2003 was associated with a reduction in gaps in policy quality related to student poverty.<sup>24</sup>

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where  $Q_{ijs}$  represents teacher quality for teacher  $i$  in school  $j$  in state  $s$ ,  $POLICY_s$  represents each of the five state policies in the analysis (power, consistency, specificity, authority1, and authority2),  $FreeLunch_{js}$  represents the percentage of students in school  $j$  in state  $s$  who are eligible for free or reduced-price lunches,  $u_s$  is a state-level random effect,  $r_{js}$  is a school-level random effect, and  $\varepsilon_{ijs}$  is a teacher-level random effect.

23. To do this we estimated the following model:

$$(2) \quad Q_{st} = \alpha + \beta POLICY_{st} + \gamma FRL_{st} + \varphi_s + \varepsilon_{st}$$

where  $Q_{st}$  represents average teacher quality in state  $s$  at time  $t$  ( $t = 2000, 2003$ ),  $POLICY_{st}$  represents each of the five state policies in the analysis (power, consistency, specificity, authority1, and authority2),  $FRL_{st}$  represents the percentage of middle school students in the state eligible for free lunch,  $\varphi_s$  is a state-specific dummy variable,  $\varepsilon_{st}$  is a stochastic error term, and  $\alpha$  represents the parameters to be estimated.

24. We estimated the following three-level models:

$$(3) \quad Q_{ijst} = \alpha + \beta POLICY_{st} + \gamma FRL_{jst} + \delta 2003_t + \lambda POLICY^*2003_{st} + \varphi_s + \eta_{ijst}$$

Table 4A-1 in the appendix provides the descriptive statistics (that is, mean, standard deviation, minimum and maximum values) from our national NAEP analysis; table 4A-2 provides descriptives for our state analysis, and table 4A-3 describes the variables in our teacher-level analysis. In our predictive models we control for whether the school is a regular or magnet school.

## Results

*What were the gaps in teacher and teaching quality between students in poverty and their more advantaged peers in 2000, and to what extent did those gaps narrow by 2003?*

Answering our first research question requires examining differences between teachers of disadvantaged students and teachers of advantaged students in 2000 and in 2003.

### *National NAEP 2000 and 2003*

We used national NAEP data to conduct a comparison of means of teacher and teaching quality characteristics by free lunch status of the school (not shown) in 2000 and 2003, with a follow-up Wald test to determine if mean differences were statistically significant.

We found that advantaged students were significantly more likely (at the 0.05 or less level) than their disadvantaged counterparts to have teachers scoring higher on each of our indicators of teacher quality, in 2000 and 2003.

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$$(4) \quad Q_{ijst} = \alpha + \beta POLICY_{st} + \gamma FRL_{jst} + \delta 2003_t + \lambda POLICY*2003_{st} + \theta FRL*2003_{jst} + \varphi_s + \eta_{ijst}$$

$$(5) \quad Q_{ijst} = \alpha + \beta POLICY_{st} + \gamma FRL_{jst} + \delta 2003_t + \lambda POLICY*2003_{st} + \theta FRL*2003_{jst} + \rho FRL*2003*POLICY_{jst} + \varphi_s + \eta_{ijst}$$

where  $Q_{ijst}$  represents the characteristics of teacher  $i$  in school  $j$  in state  $s$  at time  $t$ ,  $POLICY_{st}$  represents each of the five state policies in the analysis as specified in equation 4-1,  $FRL_{jst}$  now represents the percentage of students eligible for free lunch (in school  $j$  in state  $s$  at time  $t$ ), 2003 is a dummy variable = 1 for  $t = 2003$  and 0 for  $t = 2000$ , and  $\eta_{ijst}$  is a random error term. In equations (4-2) through (4-4), the estimates of  $\beta$  describe the overall relationship between state policies and teacher characteristics; the estimates of  $\gamma$  describe the overall relationship between the school poverty status and teacher characteristics; the estimates of  $\delta$  describe the overall change in teacher characteristics between 2000 and 2003; the estimates of  $\lambda$  demonstrate whether the relationship between state policies and teacher characteristics has strengthened or weakened in 2003 with the introduction of different policies associated with NCLB; the estimates of  $\theta$  assess whether the relationship between school poverty status and teacher characteristics has strengthened or weakened over time; the estimates of  $\rho$  demonstrate whether the relationship between state policies and teacher characteristics has strengthened on the basis of school poverty status; and the estimates of  $\varphi$  represent state-level random effects.

Specifically, advantaged students were more likely to have a teacher with a regular teaching certificate (92 percent compared with 88 percent in 2000, 93 percent and 87 percent in 2003) and a BA or a higher degree in mathematics (57 percent compared with 49 percent in 2000, 32 percent and 30 percent in 2003) and were less likely to have an inexperienced teacher (13 percent compared with 16 percent in 2000, 13 percent and 17 percent in 2003).<sup>25</sup>

We also examined whether disadvantaged students in advantaged schools were better off or worse off than advantaged students in disadvantaged schools (mean comparisons not shown). Specifically, we compared students who were not eligible for free lunch (that is, advantaged students) in schools with 75 to 100 percent of students eligible for free lunch with students eligible for free lunch (disadvantaged students) in schools with 0 to 10 percent eligible for free lunch and followed up with a Wald test for significance.

Results showed that disadvantaged students in wealthy schools fared better than their advantaged counterparts in poor schools in 2000 and 2003 (see table 4-1). In both years significantly more disadvantaged students in wealthy schools than advantaged students in poor schools had teachers with certification (94 percent compared with 88 percent in 2000 and 94 percent and 83 percent in 2003) and with a major in mathematics (42 percent compared with 13 percent in 2000 and 23 percent and 19 percent in 2003). And in 2003 advantaged students in poor schools were more likely than were disadvantaged students in wealthy schools to have an inexperienced teacher (19 percent to 13 percent). Thus disadvantaged students do experience a teacher quality benefit when they attend lower-poverty schools.

Continuing to explore the contextual effects of schools on the teacher quality gap, we examined whether being in a high- or low-poverty school had an added benefit for disadvantaged or advantaged students. We found that disadvantaged students were more likely to have a highly qualified teacher if they were in a low-poverty school (see table 4-1). On most indicators of teacher quality in 2000 and 2003, advantaged students fared significantly better when they were in low-poverty schools (0 to 10 percent of students eligible for free lunch) than in high-poverty schools (75 to 100 percent eligible for free lunch). Similarly, disadvantaged students had more qualified teachers in low-poverty schools than in high-poverty schools.

These findings show that disadvantaged students are more likely to have better-qualified teachers if they are in wealthy schools. Significant differences

25. These figures combine the percentage of students who had a teacher with a graduate degree and the percentage of students who had a teacher with a BA degree in mathematics.



Table 4-1. *Advantaged and Disadvantaged Students' Teacher Quality in High- and Low-Poverty Schools*<sup>a</sup>

Percent

<i>Teacher quality indicators</i>	<i>Advantaged students<sup>b</sup></i>		<i>Disadvantaged students<sup>c</sup></i>	
	<i>Low-poverty schools<sup>d</sup></i>	<i>High-poverty schools<sup>e</sup></i>	<i>Low-poverty schools<sup>d</sup></i>	<i>High-poverty schools<sup>e</sup></i>
<i>2000</i>				
Certification	95	88	94	84
Graduate major	n.a.	n.a.	21	13
Mathematics major	16	13	42	35
Mathematics education major	n.a.	n.a.	10	13
Inexperienced teacher	n.a.	n.a.	n.a.	n.a.
<i>2003</i>				
Certification	93	83	94	79
Graduate major	n.a.	n.a.	n.a.	n.a.
Mathematics major	28	19	23	20
Mathematics education major	15	11	15	8
Inexperienced teacher	12	19	13	22

Source: Authors' calculations based on NAEP data.

n.a. Not available.

a. Only results significant at the 0.05 level or a higher significance level are shown.

b. Advantaged = No free lunch status.

c. Disadvantaged = Free lunch status.

d. Low-poverty schools = 0 to 10 percent of students are eligible for free lunch.

e. High-poverty schools = 75 to 100 percent of students are eligible for free lunch.

ranged from 15 percent (79 percent of disadvantaged students had a certified teacher in 2003 if they were in a high-poverty school compared with 94 percent of disadvantaged students in low-poverty schools) to only 3 percent (for example, in 2003, 23 percent of disadvantaged students in low-poverty schools had a teacher with a BA in mathematics compared with 20 percent in high-poverty schools).

### *State by State Data*

A second strategy we used to examine gaps in teacher qualification associated with student poverty was to examine changes in state means from 2000 to 2003 for each state, according to eligibility status for free lunch. This enabled us to see how teacher quality has changed for disadvantaged and advantaged students and whether the gaps in teacher quality between advantaged and disadvantaged students have changed. Here it is important to examine the absolute levels of teacher quality as well as the gaps between high- and low-

Table 4-2. *Summary of State-by-State Mean Comparisons on Teacher Quality Indicators<sup>a</sup>*

<i>Number of states where...</i>	<i>Regular certification</i>	<i>BA degree or higher in mathematics</i>	<i>New teacher</i>
Disadvantaged students were better off in 2003 than in 2000 in this category	7	0	8
Disadvantaged students were worse off in 2003 than in 2000 in this category	7	36	3
There was a teacher quality gap in 2000	15	19	0
Advantaged students were better off than disadvantaged students by greater than 5 percentage points in 2000	3	8	0
Disadvantaged students were better off than advantaged students by greater than 5 percentage points in 2000	0	0	0
There was a teacher quality gap in 2003	16	16	1
Advantaged students were better off than disadvantaged students by greater than 5 percentage points in 2003	5	5	0
The teacher quality gap increased from 2000 to 2003	3	2	2
The increase in the teacher quality gap was 5 percentage points or more	0	0	0
The teacher quality gap decreased from 2000 to 2003	6	10	4
The decrease in the teacher quality gap was 5 percentage points or more	0	4	0

Source: Authors' calculations based on NAEP data.

a. All tests are one-tailed tests. The numbers in the table reflect states with statistically significant differences at the 5 percent level. Only forty states have data in 2000. A teacher quality gap means that advantaged students are better off than disadvantaged students.

poverty students. Findings are presented in table 4-2. Only statistically significant differences are reported.

For the states for which we had data in 2000 and 2003, the teacher quality gap in teacher certification remained the same on average, although in seven states, disadvantaged students became better off in 2003, and in seven states they became worse off (in terms of whether their teachers were certified).<sup>26</sup> So states shifted but the average remained about the same. The

26. Nine states and the District of Columbia did not have NAEP data available in 2000: Alaska, Colorado, Delaware, Florida, New Hampshire, New Jersey, Pennsylvania, South Dakota, and Washington.

inequity in teachers having a BA degree was more pronounced. In thirty-six states disadvantaged students were worse off in 2003 than in 2000, although it was only in five states where they were at more than a 5 percent disadvantage. The teacher quality gap in having a BA in mathematics decreased in 2003 in ten states and increased in only two. Only one state had a teacher quality gap in 2003 in terms of inexperienced teachers.

*Are improvements in teacher quality and the narrowing of gaps in teacher quality associated with the implementation of NCLB?*

As explained in the analysis section, we used several strategies to answer this second research question. First, we performed a cross-sectional, multi-level analysis to predict the relation between state policy and teacher and teaching indicators in 2000. Second, we modeled change in state policy from 2000 to 2003 and examined whether a change in state policy predicted a gain in teacher quality. Third, we examined whether state policy mitigated the relationship between poverty and teacher quality. The results of each analysis are described below.

#### *Cross-Sectional Findings for National NAEP 2000*

Providing assistance to low-performing schools (authority1) dropped out of the analysis because of colinearity. Looking at the direct relations between policy attributes and instruction, only offering resources for professional development (authority2) was associated with instruction—more conceptual emphasis ( $\beta = 3.51$ ,  $p = 0.02$ , or 35 percent of a standard deviation difference) and procedural teaching ( $\beta = 2.37$ ,  $p = 0.05$ , or 23 percent of a standard deviation difference). Consistency, specificity, and authority2 were significantly related to measures of teacher quality. Specifically, consistency was associated with an increase in regular certification ( $\beta = 0.42$ ,  $p = 0.03$ ), specificity was marginally related to increased odds of being an inexperienced teacher ( $\beta = 2.17$ ,  $p = 0.10$ ), and authority2 was related to increased self-reported preparedness to teach mathematics ( $\beta = 2.20$ ,  $p = 0.05$ ). Neither of our power measures—ranking low-performing schools or implementing sanctions—was significantly related to teaching or teacher quality.

Our interest here centers on children in poverty, so we included a measure of school poverty, interactions of school poverty, and each of the policy attributes to examine whether the attributes might work differently in high-poverty schools. Examination of results for direct effects shown in table 4-3 indicates that in high-poverty schools, teachers are less likely to use conceptual strategies ( $\beta = -0.33$ ,  $p = 0.001$ ) and have a conceptual emphasis ( $\beta = -0.25$ ,  $p = 0.001$ ), are less likely to be less prepared to teach mathematics ( $\beta = -0.28$ ,  $p = 0.001$ ), and are more likely to be inexperienced ( $r$  [odds ratio] =

1.06,  $p = 0.01$ ).<sup>27</sup> Findings in table 4-3 suggest that several of the policy attributes mitigate these negative associations with poverty. In particular, power2 and authority2 are related to several teacher outcomes, and specificity and consistency are marginally related. In high-poverty schools, power2 is associated with marginally more conceptual strategies ( $\beta = 0.03$ ,  $p = 0.07$ ), more self-reported preparedness ( $\beta = 0.04$ ,  $p = 0.001$ ), and the increased likelihood of having a degree in mathematics ( $r = 1.01$ ,  $p = 0.001$ ). Similarly, in high-poverty schools, authority2 is associated with more use of conceptual strategies ( $\beta = 0.09$ ,  $p = 0.01$ ), more conceptual emphasis ( $\beta = 0.10$ ,  $p = 0.01$ ), and marginally more self-reported preparedness ( $\beta = 0.05$ ,  $p = 0.07$ ).

Both consistency (having standards and assessments that are aligned with each other) and specificity (having clear and detailed standards) were marginally related to more conceptual emphasis in high-poverty schools ( $\beta = 0.10$ ,  $p = 0.07$  for consistency\*free lunch and  $\beta = 0.09$ ,  $p = 0.09$  for specificity\*free lunch). Specificity interacted with high poverty was marginally significant in predicting more self-reported preparedness ( $\beta = 0.09$ ,  $p = 0.08$ ) and more experienced teachers ( $r = 0.96$ ,  $p = 0.08$ ).

### Changes in State Policy Related to Changes in Teacher Quality: 2000 to 2003

There was substantial movement on several policy fronts between 2000 and 2003. During that time period, eleven states adopted measures to assist low-performing schools; nine states started or increased the resources they gave to professional development; and twenty-nine states began ranking schools according to achievement results. Most states had clear and detailed standards as early as 2000, but a handful of states implemented them between 2000 and 2003. Similarly, most states conducted an alignment review in 2000; four states conducted an alignment of their standards and assessments in 2003.

#### *State NAEP*

In our second analysis linking policy to teacher quality, we examined how change in state policy (that is, states without the policy in 2000 that adopted it in 2003) was associated with improvements in teacher quality from 2000 to 2003. These results are shown in table 4-4. None of the policy variables except consistency were associated with any changes in our three teacher

27. An odds ratio of 1.06 indicates that in high-poverty schools teachers are 6 percent more likely to be inexperienced than are teachers in other schools.

Table 4-3. Cross-Sectional Relation between State Policies and Teacher and Teaching Quality<sup>a</sup>

	Conceptual strategies			Conceptual emphasis			Procedural teaching			Self-reported preparedness to teach mathematics topics			Inexperienced teacher <sup>b</sup>			Regular certification <sup>b</sup>			BA degree in mathematics or higher <sup>b</sup>			
	Beta	SE	P value	Beta	SE	P value	Beta	SE	P value	Beta	SE	P value	Beta	SE	P value	Beta	SE	P value	Beta	SE	P value	
<i>Level 1 (teacher)</i>																						
Intercept	46.21	2.31	0.00	46.29	2.42	0.00	48.65	3.24	0.00	45.59	1.92	0.00	-1.72	0.56	0.01	2.78	0.48	0.00	-0.93	0.40	0.03	
<i>Level 2 (school)</i>																						
Free lunch	-0.33	0.08	0.00	-0.25	0.07	0.00	-0.15	0.11	0.17	-0.28	0.06	0.00	1.06	0.02	0.01	0.96	0.03	0.21	1.00	0.03	0.90	
*Consistency	0.12	0.11	0.22	0.10	0.05	0.07	0.10	0.13	0.47	0.09	0.07	0.25	0.97	0.03	0.36	0.97	0.02	0.35	1.00	0.02	0.99	
*Specificity	0.09	0.07	0.22	0.09	0.05	0.09	-0.005	0.11	0.97	0.09	0.05	0.08	0.96	0.02	0.08	1.04	0.03	0.15	0.97	0.02	0.14	
*Authority2	0.09	0.03	0.01	0.10	0.04	0.01	0.05	0.03	0.14	0.05	0.03	0.07	0.99	0.01	0.57	1.00	0.01	0.68	0.98	0.01	0.17	
*Power2	0.03	0.02	0.07	-0.01	0.02	0.65	0.03	0.01	0.03	0.04	0.01	0.00	1.00	0.00	0.52	1.00	0.01	0.66	1.01	0.00	0.00	
<i>Level 3 (state)</i>																						
Consistency	1.50	1.31	0.26	1.59	1.51	0.30	-1.26	1.73	0.47	1.46	0.89	0.11	0.92	0.29	0.80	0.42	0.38	0.03	1.03	0.33	0.92	
Specificity	0.98	1.69	0.56	-1.34	1.72	0.44	-0.45	2.65	0.87	0.60	1.40	0.67	2.17	0.45	0.10	0.81	0.48	0.66	0.91	0.41	0.82	
Authority2	1.81	1.25	0.16	3.51	1.38	0.02	2.37	1.16	0.05	2.20	1.10	0.05	0.80	0.31	0.48	2.00	0.51	0.18	1.04	0.23	0.83	
Power2	0.23	0.79	0.77	-0.10	0.74	0.90	-0.02	0.64	0.97	0.18	0.77	0.82	0.92	0.22	0.73	0.63	0.39	0.25	1.04	0.15	0.78	
<i>Variance components</i>																						
Level 1 variance	62.62			61.23			84.14			59.30			0.58			0.15			0.76			
Level 2 variance	14.19			17.10			12.67			11.34			1.77			27.05			0.99			
df	284			284			284			284			284			284			284			
Chi square	624.07			591.98			492.04			554.02			472.58			-552.32			3,981.37			
p value	0.00			0.00			0.00			0.00			0.00			> 0.5			0.00			
Level 3 variance	8.24			9.84			5.68			4.38			0.52			4.05			0.19			
df	37			37			37			37			37			37			37			
Chi square	126.12			144.98			105.14			82.35			67.41			192.61			73.70			
p value	0.00			0.00			0.00			0.00			0.00			0.00			0.00			

Source: Authors' calculations based on NAEP data.

SE = standard error; df = degrees of freedom.

a. \* signifies that there is no level 1 variance because these variables are dichotomous; authority1 and power1 dropped out of the analysis because of collinearity.

b. For dichotomous variables (inexperienced teacher, certification, and BA or higher degree in mathematics), odds ratio are reported.

Table 4-4. *Change in State Policy from 2000 to 2003 Associated with Change in Teacher Quality from 2000 to 2003*

	<i>Inexperienced teacher</i>			<i>Regular certification</i>			<i>Mathematics major or higher</i>		
	<i>Beta</i>	<i>SE</i>	<i>p value</i>	<i>Beta</i>	<i>SE</i>	<i>p value</i>	<i>Beta</i>	<i>SE</i>	<i>p value</i>
Intercept	0.212	0.137	0.132	0.945	0.058	0.00	1.063	0.269	0.00
Consistency	-0.005	0.016	0.757	0.012	0.007	0.083	0.068	0.032	0.040
Specificity	0.049	0.048	0.319	0.009	0.020	0.651	-0.082	0.094	0.389
Authority1	0.044	0.033	0.194	-0.001	0.014	0.933	-0.002	0.644	0.974
Authority2	-0.022	0.017	0.207	-0.007	0.007	0.355	0.027	0.033	0.417
Power1	0.022	0.026	0.414	0.005	0.011	0.647	-0.064	0.051	0.218
Power2	-0.004	0.007	0.519	-0.004	0.003	0.220	-0.016	0.014	0.251
Free lunch	-0.003	0.003	0.405	0.001	0.001	0.525	-0.015	0.006	0.015

Source: Authors' calculations based on NAEP data.

SE = standard error.

quality variables. In states that aligned their standards and assessments (consistency) in 2003 but not in 2000, there was a small increase in the percentage of certified teachers ( $\beta = .012, p = 0.08$ ) and teachers with a mathematics major ( $\beta = 0.07, p = 0.04$ ).

*Does an increase in the percentage of students in poverty predict changes in teacher quality?* Since the focus here is on conditions for disadvantaged students, we examined several aspects of how poverty enters into the relation between state policy and teacher quality. First, in the set of models just described, we controlled for free lunch status. A significant coefficient for free lunch would indicate that as the percentage of students in a state who are eligible for free lunch increases (from 2000 to 2003), there was a subsequent increase or decrease in a particular teacher quality variable. As table 4-4 shows, an increase in the percentage of students eligible for free lunch was associated with a small percentage point decrease in the number of teachers with an undergraduate or graduate degree in mathematics ( $\beta = -0.015, p = 0.015$ ).

*Are the state policy attributes more or less predictive of changes in teacher quality for disadvantaged students?* To analyze whether the relationships we found between state policy and teacher quality (reported in table 4-4) were different for advantaged and disadvantaged students, we conducted the analysis on two subsets of our sample—schools in the lowest poverty quartile (advantaged or low-poverty schools) and schools in the highest poverty quartile (disadvantaged or high-poverty schools).

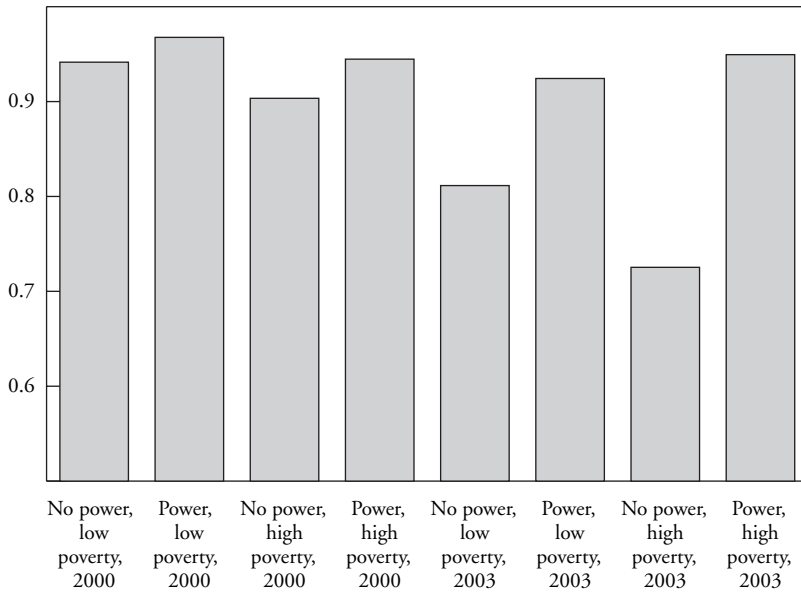
We found that in advantaged schools (results not shown), consistency and power2 were associated with better teacher quality. In states that aligned their standards and assessments in 2003 (consistency), there were increases in the percentages of teachers with certification ( $\beta = 0.03, p = 0.09$ ) and with a mathematics degree ( $\beta = 0.08, p = 0.03$ ), and an increase in the number of sanctions a state can impose on schools (power2) predicted a 6 percentage point decrease in the percentage of new teachers ( $\beta = -0.016, p = 0.07$ ).

In disadvantaged schools (the lowest quartile), changes in policy variables were not as significantly predictive of changes in teacher quality as in advantaged schools, though power2 was marginally significant in predicting changes in teacher degree status. Specifically, an increase in the number of sanctions that the state imposed was associated with a decrease in the percentage of teachers with a BA or higher degree in mathematics ( $\beta = -0.038, p = 0.15$ ).

*Did the strength of the relationship between poverty and teacher quality change, given changes in state policy?* For our final analysis, we examined whether state policy played a role in changing the relation between poverty and teacher quality. Specifically, were disadvantaged students better off (or

Figure 4-1. *The Influence of Power and Poverty on Teacher Certification*

Predicted values of the probability of teacher certification



Source: Authors' calculations based on NAEP data.

not as worse off) because of state policy changes? To answer this question, we estimated a set of models that interacted each policy attribute in 2003 with free lunch status (results not shown).

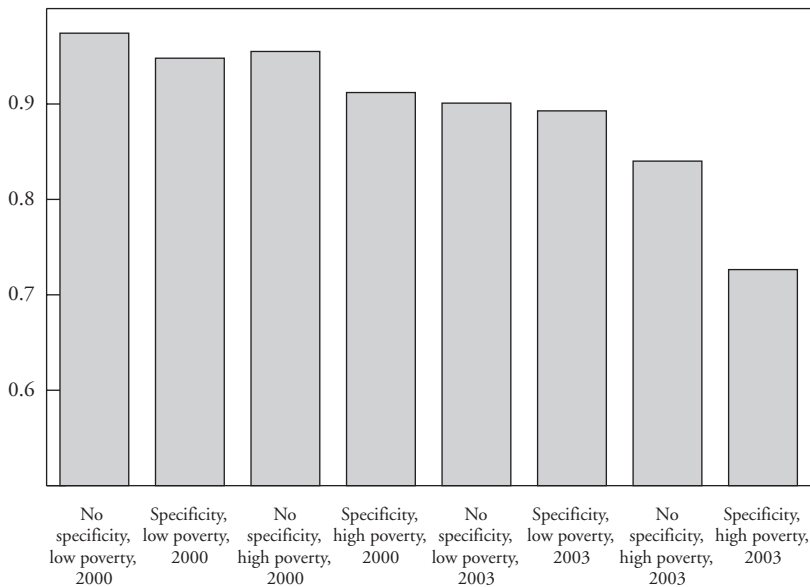
Poor schools were more likely to have teachers without regular certification ( $\beta = -0.012, p = 0.001$ ) and without a BA or higher degree in mathematics ( $\beta = -0.006, p = 0.001$ ). The policy attributes did not affect the relationship between poverty and inexperienced teachers (which was not significant), but the story is more complicated for degree and major. In states that offered professional development resources in 2003 (authority2), the negative relationship between specificity and having fewer certified teachers increased for children in poverty ( $\beta = -0.007, p = 0.09$ ). The act of ranking schools (power1) had the opposite effect. In states that ranked schools, the relationship between power and having more certified teachers increased for disadvantaged students ( $\beta = 0.020, p = 0.027$ ). None of the policy variables significantly affected the relationship between poverty and the likelihood of having a teacher with a BA or higher degree in mathematics.

Figures 4-1 and 4-2 illustrate one potentially useful way of interpreting these results. Figure 4-1 shows the relationship of ranking schools (power) and poverty on teacher certification. Note the gap between the second and



Figure 4-2. *The Influence of Specificity and Poverty on Teacher Certification*

Predicted values of the probability of teacher certification



Source: Authors' calculations based on NAEP data.

fourth bars, “power, low poverty 2000” and “power, high poverty, 2000.” Compare this gap with the gap between “power, low poverty, 2003” and “power, high poverty, 2003.” As the figure illustrates, the gap between advantaged and disadvantaged students has shifted so that disadvantaged students were more likely to have certified teachers in 2003, if they are in a state with high power, though not by much. If they are in a state with no power, advantaged students are more likely to have a certified teacher (compare “no power, low poverty” with “no power, high poverty”). Also there is a noticeably stark contrast between the percentages of low-income students with certified teachers in states with power (much larger) and without power in 2003. These comparisons suggest that power might play a role in addressing gaps between advantaged and disadvantaged students in term of their teacher’s certification.

Figure 4-2 tells a different story. Examining the effects of having clear and detailed standards (specificity) shows that there is no evidence that specificity has helped to close the certification gap; in fact, the gap in states that adopted clear and detailed standards in 2003 has widened (compare the gap between low- and high-poverty states with clear and detailed standards in 2000 with the gap between low- and high-poverty states with clear and

detailed standards in 2003). This chart suggests that in states that have adopted clear and detailed standards in 2003 teacher certification has decreased, and this trend is worse for high-poverty schools.

## Discussion

Our analyses show that on three key indicators—teacher certification, having a bachelor’s degree or higher in mathematics, and teaching experience—disadvantaged students were worse off than advantaged students in 2000, and this did not change much by 2003. But the differences in teacher quality across high- and low-poverty schools were quite small. Thus, in the context of looking at inequalities in opportunities to learning related to teacher quality, the NAEP data suggest that it is more of a problem for all students rather than being a problem for low-income students in particular.

We also saw little change in the gaps in teacher quality from 2000 to 2003 in our state-by-state analysis. The evidence we examined suggests that as of 2003 there have been no great gains in teacher quality overall or in the distribution of teachers so as to lessen the likelihood that disadvantaged students had more less qualified teachers than their advantaged counterparts.

The finding that low-income students had more qualified teachers when they were in wealthy schools than when in poor schools suggests that disadvantaged students do reap some benefits from being in an advantaged school. One of the policy questions this raises is the extent to which the “equitable” distribution of teachers both within and across schools should become more of a focal point of current initiatives on teacher quality. Of course, such a line of thinking raises complex issues of fairness and efficiency that apply to making decisions about who should get the most qualified teachers, given the limited supply. Basing teacher assignment to students on evidence of a teacher’s effectiveness with certain groups of students is a potentially useful strategy to consider.<sup>28</sup>

There were several states where the quality of teachers of disadvantaged students decreased on several indicators, which warrants further examination. Since policy initiatives are often a zero-sum game, it is likely that particular policy strategies designed to strengthen one area weaken another. For example, the class size initiative in California, designed to make classes smaller (and thus requires more teachers), could reasonably have the effect of putting less qualified teachers in the classroom. And the chance that the less qualified

28. Gamoran and others (2005).

teachers are distributed nonrandomly to disadvantaged students would be consistent with previously documented local practices.<sup>29</sup>

*Are NCLB-related policies associated with improvements in teacher quality?*

One of the main questions we wish to shed light on is whether state adoption of NCLB-related policies had any effect on the teacher quality gap between disadvantaged and advantaged students. This is a difficult issue to address, given the complex nature of state policy, the simultaneous implementation of multiple policy levers, and the challenge of capturing the effect of change of global state-level policies. Another challenge is that often states implement a particular policy in reaction to a problem (for example, low teacher quality), so associations between policy implementation and teacher quality first reflect this relationship, and only later would cause and effect come into play—but the question of how long it takes a state policy to affect a trend in teacher quality is not clear. Further, in this analysis we examined general NCLB-related policies, not policies directly related to improving teacher quality. In effect we are examining how teacher quality changed, in the context of state movement on NCLB-related policies. Still another factor to consider is how much real change compared with random fluctuation could be expected in teacher quality indicators over a three-year period.

In general we found that for states that are implementing NCLB-related policies if there was any positive movement in teacher quality it was small and that sometimes it was negative. Given the nation's challenges in finding and keeping qualified teachers in the classroom, it is unclear whether the state policy implementation mitigated a decrease in teacher quality that would have been worse or whether state implementation of NCLB-related policies did have a real impact on decreasing teacher quality. In these same estimations, we found that being in a high-poverty school predicted having a teacher with less desirable qualifications. Implementation of certain state policies occasionally was associated with better teacher quality, but implementation did not eliminate this relationship between poverty and teacher quality. Our other findings provide evidence that in states where the percentage of disadvantaged students has increased, teacher quality has decreased. But the relationship between policy attributes and teacher quality for advantaged students is not much different from that of disadvantaged students.

A few findings warrant highlighting because of their similarity to findings from other studies. Specifically, low-income students in states that had aligned standards and assessments (consistency) and provided professional

29. Darling-Hammond (2000); Gamoran and others (1995).

development resources (authority) were more likely to have better outcomes on several teacher and teaching quality measures. These findings are consistent with other policy studies that suggest that implementing policies that work through authority may be more likely to foster positive outcomes than those that work mainly through power.<sup>30</sup>

But in our analysis of whether policies changed the strength of the relationship between poverty and teacher quality, we did find that an increase in power mitigated the negative relation between poverty and teacher quality, while specificity was associated with the worsening of the relation between poverty and teacher quality. This set of findings might reflect the complexity of charting changes in state policy, initial associations of state policy with negative conditions where states enact measures to address weaknesses in their system, and the time it takes for policies to have a productive effect, as mentioned earlier. For example, it might be that states especially low on teacher quality were the ones more likely to adopt power policies (which would explain the negative association between power and teacher quality), and the findings might suggest that power does eventually play a positive role, given that over time the implementation of power policies was associated with a decrease in the relation between poverty and low teacher quality. Further, we found that both power2 (number of sanctions a state could impose) and authority2 (offering professional development resources) were related to better teaching and teacher quality in high-poverty schools.

These findings should be considered in light of previous research that has found teacher credentials to have weak links with teaching practice and student achievement, while high-quality professional development has been shown to have strong links. Given the slow movement on improvements in certification and degree requirements (that is, credentials), perhaps the provision of and participation in high-quality professional development should serve as more of a focal point for addressing teacher quality disparities.

## Conclusions

NCLB delineated substantial changes in teacher quality that were required to occur on a rapid timetable. We examined the time period from 2000 to 2003 and found no evidence of substantial improvement in teacher quality for disadvantaged (low-income) students. Further, we found that some policies seem to be working in the expected direction, but in no case have the NCLB-

30. Desimone (2002); Desimone, Smith, and Phillips (2007).

related policies that states have put into place had a major impact on teacher quality.

Is it difficult for states to meet high-quality teacher requirements, since resources and personnel are being allocated to meet other NCLB requirements? It might be that closing the gap in teacher quality is more difficult in states that are strong in other areas. Given limited resources, school improvement is a zero-sum game. Resources spent on new curricula and tutoring mean that fewer resources are available to devote to teacher quality. This analysis suggests that most states are not on target for making the kind of improvements in teacher quality required by NCLB. Our analysis provides limited evidence that particular state policies may eventually move states in the right direction, but it raises concern that results may not be substantial enough, or fast enough, to satisfy the legislation or our own ideals about equality in teacher quality.

## Appendix

Table 4A-1. *National NAEP Sample*

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<i>Level 1 (teachers)</i>				
Years of experience: 0–2 years	0.17	0.38	0	1
“Counting this year, how many years in total have you taught mathematics?” Recoded as 1 = 2 years or less				
Advanced, regular, or probationary state certificate	0.91	0.29	0	1
“What type of teaching certificate do you have in this state in your main assignment field?” Recoded as 1 = full certification (including advanced professional, regular or standard, probationary)				
Advanced, regular, probationary, temporary, provisional, or emergency state certificate	0.97	0.16	0	1
“What type of teaching certificate do you have in this state in your main assignment field?” Recoded as 1 = full certification (including advanced professional, regular or standard, probationary) or partial certification (including temporary, provisional, or emergency state certificate)				
Conceptual emphasis (standardized)	50.19	9.78	20.25	61.16
“How much emphasis did you or will you give each of the following: (a) developing reasoning and analytical ability to solve unique problems, (b) learning how to communicate ideas in mathematics effectively, and (c) developing an appreciation for the importance of mathematics?” Recoded as 1 = little or no emphasis, 2 = moderate emphasis, 3 = heavy emphasis				

*continued on next page*

Table 4A-1. *National NAEP Sample—Continued*

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<i>Level 1 (teachers)—Continued</i>				
Conceptual strategies (standardized)	50.17	9.83	20.41	72.50
“How often do the students in this class do each of the following: (a) write a few sentences about how to solve a mathematics problem, (b) write reports or do mathematics projects, (c) discuss solutions to mathematics problems with other students, (d) work and discuss mathematics problems that reflect real-life situations, (e) solve mathematics problems in small groups or with a partner, and (f) talk to the class about their mathematics work?” Recoded as 1 = never or hardly ever, 2 = once or twice a month, 3 = once or twice a week, 4 = almost every day				
Procedural teaching (standardized)	50.05	9.88	8.60	56.49
“How much emphasis did you or will you give each of the following: (a) learning mathematics facts and concepts and (b) learning skills and procedures needed to solve routine problems?” Recoded as 1 = little or no emphasis, 2 = moderate emphasis, 3 = heavy emphasis				
Teacher preparedness (standardized)	50.76	9.13	-7.93	57.49
“How well prepared are you to teach each of the following topics: (a) number sense, properties, and operations; (b) measurement; (c) geometry and spatial sense; (d) data analysis, statistics, and probability; (e) algebra and functions; (f) estimation; and (g) mathematical problem-solving?” Recoded as 0 = not at all prepared, 1 = not very well prepared, 2 = moderately prepared, 3 = very well prepared				
Math undergraduate or graduate degree	0.40	0.49	0	1
“What were your undergraduate major fields of study?” “What were your graduate major fields of study?” Recoded as 1 = math graduate major or math undergraduate major				
Math undergraduate or graduate degree or any math education degree	0.69	0.46	0	1
“What were your undergraduate major fields of study?” “What were your graduate major fields of study?” Recoded as 1 = math graduate major or math undergraduate major or math education major				
<i>Level 2 (schools)</i>				
Regular school	0.93	0.26	0	1
Magnet school or regular school with a magnet program	0.07	0.26	0	1
Percentage of students eligible for free or reduced-price lunch	43.59	28.52	0	100
“During this school year, about what percentage of students in your school was eligible to receive a free or reduced-price lunch through the National School Lunch Program?” Recoded as a continuous variable using the median values of the categories of response				

*continued on next page*

Table 4A-1. *National NAEP Sample—Continued*

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<i>Level 3 (states)</i>				
Consistency = state uses criterion-referenced assessments aligned to state standards in math	0.77	0.43	0	1
Specificity = state has clear and specific standards in math	0.86	0.35	0	1
Authority1 = state provides assistance to low-performing schools	0.60	0.49	0	1
Authority2 = professional development resources	1.28	0.55	0	2
Power1 = state assigns ratings to all schools or identifies low-performing schools	0.60	0.49	0	1
Power2 = number of possible sanctions	0.86	1.08	0	3

Note: Sample size is 895 teachers, 328 schools, and 43 states.

Table 4A-2. *State NAEP (State-Level Fixed Effects) Sample<sup>a</sup>*

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Percentage of teachers with 0–2 years of experience	0.164	0.038	0.079	0.268
Percentage of teachers with advanced, regular, or probationary state certificate	0.929	0.053	0.747	1
Percentage of teachers with advanced, regular, probationary, temporary, provisional, or emergency state certificate	0.989	0.014	0.915	1
Percentage of teachers with a math undergraduate or graduate degree	0.374	0.139	0.071	0.724
Percentage of teachers with a math undergraduate or graduate degree or any math education degree	0.525	0.156	0.139	0.899
Average schoolwide percentage of students eligible for free lunch	38.744	9.762	17.599	62.091
Consistency = state uses criterion-referenced assessments aligned to state standards in math	0.511	0.503	0	1
Specificity = state has clear and specific standards in math	0.878	0.329	0	1
Authority1 = state provides assistance to low-performing schools	0.667	0.474	0	1
Authority2 = professional development resources	1.078	0.657	0	2
Power1 = state assigns ratings to all schools or identifies low-performing schools	0.822	0.384	0	1
Power2 = number of possible sanctions	1.200	1.537	0	5

Sample size: forty states in 2000 and fifty states in 2003.

a. Variables are defined as in table 4A-1, except that they are aggregated to the state level.

Table 4A-3. *Teacher-Level Interaction Model Sample*<sup>a</sup>

<i>Variable</i>	<i>Observations</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Years of experience: 0–2 years	23,065	0.166	0.372	0	1
Advanced, regular, or probationary state certificate	22,941	0.922	0.268	0	1
Advanced, regular, probationary, temporary, provisional, or emergency state certificate	22,941	0.990	0.100	0	1
Math undergraduate or graduate degree	21,991	0.370	0.483	0	1
Math undergraduate or graduate degree or any math education degree	22,354	0.521	0.500	0	1
Regular school	27,027	0.930	0.256	0	1
Magnet school	27,027	0.070	0.256	0	1
Percentage of students eligible for free or reduced-price lunch	26,506	40.071	26.946	0	100
2003 dummy variable	28,050	2002.028	1.404	2000	2003
Consistency = state uses criterion-referenced assessments aligned to state standards in math	28,050	0.484	0.500	0	1
Specificity = state has clear and specific standards in math	28,050	0.913	0.282	0	1
Authority1 = state provides assistance to low-performing schools	28,050	0.715	0.452	0	1
Authority2 = professional development resources	28,050	1.051	0.627	0	2
Power1 = state assigns ratings to all schools or identifies low-performing schools	28,050	0.883	0.321	0	1

a. Variables are defined similarly to those in table 4A-2.

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