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Meeting NCLB Goals for Highly Qualified Teachers: Estimates by State from Survey Data

Rolf K. Blank
Doreen Langesen
Elizabeth Laird
Carla Toye
Council of Chief State School Officers

Victor Bandeira de Mello
American Institutes for Research

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Abstract

This article presents results of survey data showing teacher qualifications for their assignments that are comparable from state-to-state as well as data trends over time. The analysis is intended to help state leaders, educators, and others obtain a picture of highly qualified teachers in their state, and to be able to compare their state statistics with states across the nation. Since states have some flexibility in meeting the standard for highly qualified teachers outlined by NCLB, the analyses presented in this paper from a national survey may be useful as a common benchmark for use by states as they develop their own state-specific definitions and measures.

Introduction

States, districts, and schools are now working to implement the many new provisions of the No Child Left Behind (NCLB) law of 2001. One area of the law that has enormous implications for states, districts, and schools is the provisions related to highly qualified teachers. NCLB sets the goal of all teachers in core academic subjects being highly qualified teachers by the 2005-06 school year. According to the recent Secretary's report on Teacher Quality, national estimates show that in some fields only slightly more than half of current teachers in K-12 public education meet key measures of "highly qualified" as defined by the NCLB law.

NCLB requires states to report on the professional qualifications of all teachers as defined by the state, the percentage of classes taught by teachers that are highly qualified, and the percentage of classes in the state not taught by teachers that are highly qualified (see Section 1111(h) of NCLB). In the September 2003, Consolidated Performance Application, states reported to the U.S Department of Education on their state definition of "highly qualified" teacher and their plans for collecting and reporting on the status of their teachers (U.S. Department of Education, 2003). Many states are still working on upgrading state information systems, and the data presented here will help states see the implications in using the certification and major criteria for highly qualified described under NCLB.

To meet the highly qualified standard under NCLB, all teachers must

- Have completed a bachelor's degree;
- Hold full state certification; and
- Pass rigorous subject content and pedagogy tests to demonstrate competence in assigned subject;
- Middle and high school teachers may demonstrate competence in their assigned
- subject(s) by holding a degree major in the assigned subject (or equivalent course work), **or** *For current teachers only,* state may propose another method of evaluating and reporting on competence of teachers in their assigned subject(s).

(NCLB, Section 1111(h); CCSSO, 2002, pp.44-45).

For the present work, the concept of *highly qualified* is measured and reported for each state using two of the criteria required by NCLB—full state certification in the assigned field and college major in assigned field (indicator of subject competency at secondary level). The percentage of teachers that meet these criteria allow for comparison of the quality of teacher preparation in specific subject areas. The paper is organized in two sections:

- Analysis of trends in highly qualified teachers by state
- Factors contributing to shortage of highly qualified teachers in science and mathematics

Analysis of Trends in Highly Qualified Teachers by State

CCSSO has completed a detailed analysis of data reported by teachers in the Schools and Staffing Survey (SASS). SASS is conducted by the National Center for Education Statistics (NCES) of the U.S. Department of Education. Data are collected through mail and phone surveys with 60,000 public school teachers that include representative samples of teachers in each state. The CCSSO analysis is based on data from the surveys with teachers conducted in the 1999-2000 school year and data from the 1993-94 Survey. The sample of elementary and secondary teachers is selected from a stratified random sample of schools in each state (for Survey details see NCES, 2002).

The analysis conducted by CCSSO focuses on three main questions concerning the level of qualifications and preparation of teachers. The subjects of mathematics and science at the secondary level are used for further analyses of recent trends with highly qualified teachers in the nation's public schools.

The analysis questions are:

1. How does the level of qualifications of teachers differ by state? How do states differ on key measures of "highly qualified" teachers?

2. Across all secondary teachers, what are differences in preparation of high school vs. middle grades teachers? How does the level of preparation of math teachers compare to science teachers, and how do these subjects compare to preparation of teachers in other academic subjects?

3. What has been the extent of improvement or change in level of preparation of teachers? What accounts for differences in preparation by state? What accounts for change over time?

Our work includes 50-state tables and bar graphs that portray state-by-state statistics on the characteristics of highly qualified teachers. Our analysis of the SASS data from 1994 and 2000 employs two primary criteria of "highly qualified" teachers as outlined in NCLB, state teacher certification in the assigned teaching subject and college degree major in the assigned subject. These two criteria for highly qualified teachers were reported by NCES in the recent national trends analysis of qualifications of public school teachers (McMillen-Seastrom, et al, 2002). The analysis is based on prior studies at the national level using these variables (Ingersoll, 1996, 1999, 2003), and research on the problem of underqualified teachers and the relationship between teacher qualifications and student achievement (National Commission on Teaching and America's Future, 1996; Ferguson, 1998; Goldhaber & Brewer, 2000; Mayer, Mullens, & Moore, 2000). Note: CCSSO is undertaking a separate analysis of SASS teacher qualifications data by state according to socio-economic characteristics of students and schools.

Highly qualified teachers at the secondary level: Shortages in many states

The SASS instrument asked teachers to report about the status of their teaching certification for the specific subject they are assigned to teach—with three options: regular or standard certification for the assigned field, less than regular/standard certification, or no certification. Secondly, teachers reported on the major and minor field of their undergraduate degree and graduate degree. Teachers could report their preparation for their main assignment and a secondary assignment, if applicable.

The CCSSO analysis of SASS data by state from the year 2000 and trends from 1994 to 2000 provides a state-by-state picture of the status of highly qualified teachers based on reliable, comparable teacher samples. The SASS data do not include the teacher testing results, but we can analyze the certification and teacher major criteria of highly qualified teachers.

Certified teachers in grades 7-12 by state. One criterion of highly qualified teachers is whether teachers hold a full, standard certification in their assigned teaching field or subject. The SASS data on certification analyzed by state indicate that many states are far from the NCLB goal of highly qualified teaching staff in all schools and classrooms.

Table 1.1 on Math Teachers Certification shows that in 17 states less than 90 percent of math teachers (main or secondary assignment) have a regular/standard certification in math, while in 33 states over 90 percent of math teachers are certified. State rates vary from Hawaii at 65 percent to Rhode Island and West Virginia at 100 percent certified. The national rate is 88 percent of math teachers that are fully certified to teach math. Among the states with largest enrollments, California, Florida, New York, North Carolina, and Michigan have rates at or around 80 percent certified in math, indicating severe qualified teacher shortages. Also, several states with small enrollments (e.g. Alaska and Hawaii) have shortages of certified math teachers.

Certification rates for science teachers in Table 1.1 show the national rate is also 88 percent of teachers certified in science. Among the largest states, California, Florida, New York, North Carolina, and Ohio all have about 80 percent of secondary science teachers certified in science. Note: the sample of science teachers in SASS could be certified in any field of science; thus, for example, teachers certified in chemistry that are teaching physics would be counted as certified.

Table 1.2 shows that, nationally, the fields of English and Social Studies have a higher percentage of certified teachers than the fields of Math and Science. Sixteen states have less than 90 percent of English teachers in grades 7-12 that are fully certified, while 15 states are below the 90 percent certified level in Social Studies. Rates of certification in most states are substantially higher in English and Social studies than in the fields of Math or Science.

Table 1.1: Math and Science Teachers with Certification in Field, Grades 7-12, 2000

State	Math: % Certified in Math	Math: Std. Error	Science: % Certified in Science	Science: Std. Error
Alabama	**93**	3.8	**89**	2.9
Alaska	**79**	2.9	**90**	2.5
Arizona	**81**	4.5	**80**	6.4
Arkansas	**98**	2.0	**94**	3.1
California	**77**	4.4	**79**	3.5
Colorado	**81**	5.3	**82**	3.9
Connecticut	**83**	5.4	**86**	4.5
Delaware	**83**	11.3	**94**	4.5
District of Columbia	**87**	3.0	**.**	.
Florida	**84**	4.8	**95**	2.2
Georgia	**96**	2.0	**95**	2.7
Hawaii	**65**	5.8	**92**	2.8
Idaho	**95**	1.7	**100**	0.0
Illinois	**92**	4.1	**91**	2.5
Indiana	**96**	1.3	**98**	1.3
Iowa	**91**	4.3	**97**	2.0
Kansas	**94**	2.6	**91**	3.0
Kentucky	**89**	3.8	**77**	6.1
Louisiana	**78**	6.9	**82**	7.5
Maine	**86**	3.0	**95**	1.5
Maryland	**88**	3.4	**81**	5.8
Massachusetts	**94**	1.7	**80**	3.8
Michigan	**82**	6.3	**91**	3.3
Minnesota	**96**	1.6	**93**	2.8
Mississippi	**86**	2.6	**89**	2.9
Missouri	**88**	4.7	**79**	6.3
Montana	**95**	2.0	**96**	1.4
Nebraska	**96**	2.5	**92**	3.7
Nevada	**95**	1.8	**94**	2.5
New Hampshire	**85**	6.5	**81**	5.2
New Jersey	**98**	1.0	**95**	2.4
New Mexico	**83**	6.8	**87**	4.5
New York	**81**	4.0	**82**	4.3
North Carolina	**77**	6.6	**81**	6.6
North Dakota	**98**	0.7	**95**	1.2
Ohio	**92**	4.0	**82**	5.1
Oklahoma	**92**	4.8	**95**	1.7
Oregon	**92**	3.8	**89**	3.7
Pennsylvania	**88**	5.6	**93**	4.4
Rhode Island	**100**	0.0	**94**	1.6
South Carolina	**90**	4.0	**87**	3.4
South Dakota	**99**	0.3	**99**	0.7
Tennessee	**86**	5.7	**83**	6.0
Texas	**86**	3.5	**90**	2.4
Utah	**92**	4.7	**93**	4.0
Vermont	**95**	3.8	**100**	0.0
Virginia	**92**	2.8	**87**	4.4
Washington	**93**	2.6	**98**	1.5
West Virginia	**100**	0.0	**95**	1.8
Wisconsin	**95**	2.0	**92**	2.0
Wyoming	**94**	2.3	**100**	0.0
United States	**88**	0.8	**88**	0.7

% Certified = Regular, standard, or probationary certificate in assigned field (not certified = provisional, emergency, or temporary certificate in assigned field). Teachers = Public school teachers with main or second assignment in subject in grades 7-12 departmentalized instruction
Source: NCES, Schools and Staffing Survey, 1999-2000
Council of Chief State School Officers, Washington, DC, 2003.

Table 1.2: English and Social Studies Teachers with Certification in Field, Grades 7-12, 2000

	English		Social Studies	
State	% Certified in English	Std. Error	% Certified in Social Studies	Std. Error
Alabama	95	2.7	98	1.0
Alaska	85	2.7	84	3.0
Arizona	86	3.7	87	4.4
Arkansas	99	1.4	96	2.3
California	85	2.8	88	4.5
Colorado	90	3.0	93	2.4
Connecticut	87	3.6	93	2.8
Delaware	82	13.9	.	.
District of Columbia	100	0.0	57	6.5
Florida	89	3.4	84	5.9
Georgia	96	2.5	95	2.4
Hawaii	87	4.1	84	4.9
Idaho	97	0.7	97	1.5
Illinois	93	3.3	97	1.4
Indiana	95	3.0	97	1.3
Iowa	91	3.5	93	3.3
Kansas	89	4.1	93	2.6
Kentucky	85	3.8	93	3.0
Louisiana	84	7.5	86	5.3
Maine	92	1.8	93	1.8
Maryland	84	4.6	87	5.5
Massachusetts	95	1.4	98	0.8
Michigan	85	4.0	87	5.0
Minnesota	98	1.3	98	1.3
Mississippi	78	4.3	91	2.2
Missouri	87	5.7	92	4.0
Montana	97	1.0	95	1.7
Nebraska	96	2.6	97	2.2
Nevada	90	3.2	93	2.8
New Hampshire	94	1.9	89	6.2
New Jersey	97	0.9	97	1.1
New Mexico	98	1.4	86	7.8
New York	84	3.9	90	3.5
North Carolina	86	3.1	85	7.6
North Dakota	97	0.9	100	0.0
Ohio	87	4.0	93	2.9
Oklahoma	94	3.5	96	3.5
Oregon	95	1.5	94	3.2
Pennsylvania	91	5.8	96	2.0
Rhode Island	97	1.0	82	2.7
South Carolina	91	1.8	97	1.2
South Dakota	99	0.3	98	1.1
Tennessee	97	1.1	98	1.0
Texas	94	2.2	84	3.9
Utah	98	1.6	98	1.5
Vermont	100	0.0	100	0.0
Virginia	94	3.2	90	3.7
Washington	98	1.2	97	1.9
West Virginia	97	1.2	96	2.7
Wisconsin	92	3.5	95	3.0
Wyoming	97	1.7	87	3.9
United States	91	0.7	92	0.8

% Certified = Regular, standard, or probationary certificate in assigned field (not certified = provisional, emergency, or temporary certificate in assigned field). Teachers = Public school teachers with main or second assignment in subject in grades 7-12 departmentalized instruction.
Source: NCES, Schools and Staffing Survey, 1999-2000.
Council of Chief State School Officers, Washington, DC, 2003.

Major in field. In Table 2, CCSSO presents state by state data on the percentage of grade 7-12 teachers with a major in their assigned field and the percentage that have both a major and regular certification in their assigned field. The summary statistics combining the two measures provide two of the key criteria for secondary teachers meeting the NCLB highly qualified standard.

Reviewing Tables 1 and 2, there is a clear link between the states' rate of certified teachers and the rate of teachers with a major in their assigned field. States that have high percentages of certified teachers in their assigned field also have high rates of teachers with a major in their field. There are no states with high rates of teachers with a major in their field, but lower rates of teachers with regular certification.

Mathematics. In Table 2.1, the states are rank-ordered based on percent of teachers with main assignment in math that completed a major in the field. Only one state (Minnesota) has 90 percent of math teachers that are certified and hold a major in mathematics or math education. Only four additional states (New Jersey, Nebraska, Rhode Island, North Dakota) have over 80 percent of math teachers with a major in their field and have full certification. Nationally, 63 percent of grade 7-12 math teachers have a major and full certification.

In most states, only a small percentage of teachers with a major do not have full certification. The percentages of teachers that meet both criteria are typically 0 to 5 percent lower than the percentage of teachers with a major. However, in a few states the percentages are substantial, such as in New York, DC, Alabama, Maine, North Carolina, California, Louisiana. In these states, it is possible that new teachers with a major are hired before they have completed state certification requirements.

When all teachers of math are considered (main or secondary assignment) and we analyze whether they have a major or minor in math, we find a pattern across states of a high proportion of less qualified teachers. (Note about using the SASS data to analyze NCLB requirements: the SASS data on teachers' major or minor in the assigned field may be useful because states can submit their own criteria for evaluating whether teachers are highly qualified in their state, and a state might define holding a college degree minor in the assigned field as an important state-level criterion.) Only 14 states have more than 75 percent of all teachers of math in 7-12 that have a college major or minor in math and certification in math.

Science. Two-thirds of science secondary teachers (main assignment) have a major in a science field and are certified in science, as shown in Table 2.2. In science, 8 percent of teachers nationally with a major in a science field do not have full state certification, and in a few states the differences are larger (e.g., Illinois, Maryland, New Hampshire, New York, Connecticut, Mass., Oregon, Michigan). In 2000, no state had over 90 percent of teachers that met both criteria of highly qualified, and seven states had less than 60 percent meeting both criteria.

Table 2.1: Mathematics Teachers with Major and Regular Certification in Field, Grades 7-12, 2000

	Math Main Assignment		Math Main or Secondary Assignment	
State	Major in Math	Major in Math + Regular Certification	Major or Minor in Math	Major or Minor in Math + Regular Certification
Minnesota	90	90	88	87
New Jersey	90	88	85	83
Nebraska	89	85	85	82
Rhode Island	82	82	87	87
North Dakota	83	81	86	84
West Virginia	79	79	73	73
Arkansas	79	78	90	89
South Dakota	76	76	75	75
Alabama	83	76	86	80
Wisconsin	75	75	86	84
Pennsylvania	81	75	85	82
Wyoming	79	75	86	82
District of Columbia	87	72	77	62
Ohio	77	72	86	79
South Carolina	79	71	80	72
Indiana	72	70	81	78
Delaware	74	70	87	n/a
Iowa	73	69	72	68
Massachusetts	73	68	73	68
Oklahoma	70	68	79	79
New York	79	67	79	67
Georgia	69	67	61	58
Colorado	68	67	65	65
Montana	68	67	76	75
Florida	67	65	66	65
Illinois	65	65	72	73
Maryland	68	64	71	68
New Hampshire	69	63	77	69
Michigan	68	63	74	71
United States	**67**	**63**	**71**	**68**
Utah	63	63	64	65
Connecticut	62	60	60	60
Oregon	60	58	59	57
Kansas	58	58	73	72
Maine	64	58	69	58
North Carolina	64	58	58	55
Mississippi	60	57	59	55
Kentucky	58	56	62	57
Washington	55	54	69	64
Virginia	59	53	70	65
Alaska	57	52	56	50
Texas	57	52	68	63
Vermont	55	51	54	51
Hawaii	76	51	76	54
New Mexico	52	51	64	65
Idaho	49	50	61	62
California	57	50	56	47
Louisiana	58	49	66	57
Arizona	49	47	57	53
Missouri	52	47	77	71
Tennessee	51	47	56	54
Nevada	38	38	48	45

Teachers = Public school teachers with main or second assignment in subject in grades 7-12 departmentalized instruction.
Major = Undergraduate or graduate degree major in math or math education
Source: NCES, Schools and Staffing Survey, 1999-2000.
Council of Chief State School Officers, Washington, DC, 2003.

Table 2.2: Science Teachers with Major and Regular Certification in Field, Grades 7-12, 2000

	Science Main Assignment		Science Main or Secondary Assignment	
State	Major in Science	Major in Science + Regular Certification	Major or Minor in Science	Major or Minor in Science + Regular Certification
Iowa	89	89	89	87
Minnesota	93	88	93	88
New Jersey	93	88	92	86
Hawaii	87	87	84	78
Illinois	93	84	84	76
Rhode Island	81	81	81	74
North Dakota	85	80	86	80
Wyoming	78	78	85	85
Vermont	77	77	83	83
Wisconsin	82	77	88	78
Washington	79	77	74	73
Utah	83	77	89	81
Pennsylvania	79	77	78	75
Maryland	84	76	78	70
Idaho	75	75	87	87
New Hampshire	90	75	78	64
Indiana	77	75	85	82
Nevada	78	75	85	79
Alaska	77	73	87	79
Nebraska	80	73	83	75
South Dakota	72	71	74	73
Alabama	78	71	81	72
New York	86	70	89	70
Connecticut	77	69	85	82
Montana	74	69	76	72
Kansas	73	69	78	71
Delaware	68	68	84	78
Massachusetts	79	68	77	64
United States	**75**	**67**	**77**	**70**
Oklahoma	67	66	73	71
Georgia	70	66	68	63
Oregon	74	66	67	58
Florida	69	65	66	62
Arizona	66	65	68	64
Michigan	72	65	77	69
South Carolina	75	64	74	63
West Virginia	69	63	73	67
North Carolina	75	63	50	42
Virginia	74	63	82	70
Missouri	70	63	78	72
California	77	62	81	63
Mississippi	66	61	66	62
Colorado	72	61	81	70
Maine	63	60	67	62
Ohio	69	59	75	63
Kentucky	65	56	79	66
Arkansas	57	53	74	70
Texas	57	51	69	63
New Mexico	55	51	72	61
Tennessee	53	48	57	53
Louisiana	45	44	49	46
District of Columbia	n/a	n/a	n/a	n/a

Teachers = Public school teachers with main or second assignment in subject in grades 7-12 departmentalized instruction
Major = Undergraduate or graduate degree major in science or science education.
Source: NCES, Schools and Staffing Survey, 1999-2000.
Council of Chief State School Officers, Washington, DC, 2003.

Other grade levels and subjects. For purposes of comparison, we conducted a separate analysis of the SASS data for only high school teachers (9-12)—not shown in a table. The analysis showed that over 75 percent of both math and science teachers (main assignment) met both the major in field and certification criteria of highly qualified. These figures show that less than 60 percent of grade 7-8 teachers have major and certification in their assigned field in math or science (that is, to produce the 7-12 national averages, 63 percent math, 67 percent science).

Additional state-by-state data for secondary teachers in four academic subjects, including percentages of teachers with a major in field and percentages of all teachers with a major or minor, are shown on the CCSSO website:
http://www.ccsso.org/projects/State_Education_Indicators.

Change from 1994 to 2000 in Teachers with Major in Field, Grade 7-12 Teachers

Since SASS was given to a representative sample of teachers in each state in 1994 and 2000, the rates of preparation of teachers can be compared to determine whether a pattern of change exists between those years. (Most recent SASS is 2000; it was also conducted in 1988 and 1991.) Using the data from the two years, it is possible to determine whether lower or higher proportion of schools and classrooms had well-prepared teachers in 2000 as compared to six years earlier, with a major in field being used as a primary measure of qualifications.

Decline in proportion of math and science teachers with major in field. The data in Table 3.1 for mathematics show that in 1994, only 12 states had over 80 percent of teachers with main assignment in math that had a major in math or math education. Figure 1 provides a bar graph display of change by state.) By 2000, only 7 states had over 80 percent with a major in field. A majority of states (29) experienced significant declines in the level of preparation of their math teaching force over six years, as measured by degree major in teaching field (math). In 2000, Nevada, Missouri, Arizona, Louisiana, California, Idaho, New Mexico, Texas, and others are below 60 percent of secondary math teachers with a major in math.

Only 14 states increased the percent of math teachers with a major in math, including New Jersey, Arkansas, Hawaii, Michigan, South Carolina, South Dakota, and Utah. One factor in comparing percentage differences over time from the SASS sample survey results is the sampling error—i.e., projecting to the whole state population from a small random sample of from 30 to 100 teachers per state per subject. We computed the statistical significance of the difference in percentages between 1994 and 2000 at the 95 percent level of confidence, and the states with significant results are indicated with an asterisk in Table 3.

The data in Table 3.2 and Figure 2 for science show that in 1994, a total of 17 states had over 80 percent of teachers with main assignment in a science field that had a major in a science field or science education. By 2000, only 13 states had 80 percent or more science teachers with degree major in science. As with math, a number of states experienced significant declines in the level of preparation of their science teaching force over six years, including Connecticut, Massachusetts, Mississippi, Nevada, and Oregon. As of 2000, Texas, Tennessee, New Mexico, and Louisiana had below 60 percent of science teachers with a science major. From 1994 to 2000, nine states did show significant increase in the percent of 7-12 science teachers with a science major.

Proportion of English and Social Studies show similar shortages. In Table 3.2 the differences in percent of teachers with a major for English and Social Studies for 1994 and 2000 indicate that the supply of well-prepared English teachers showed a similar decline as mathematics. In 2000, only 70 percent of English teachers with primary assignment in English had a major in English, which was a decline from 78 percent in 1994. The rate of Social Studies teachers with a major stayed close to 80 percent in the six year period. Note that social studies is similar to Science – the statistic for percent with major includes teachers with primary assignment that may be in history, government, geography, economics or other specific subject areas/fields.

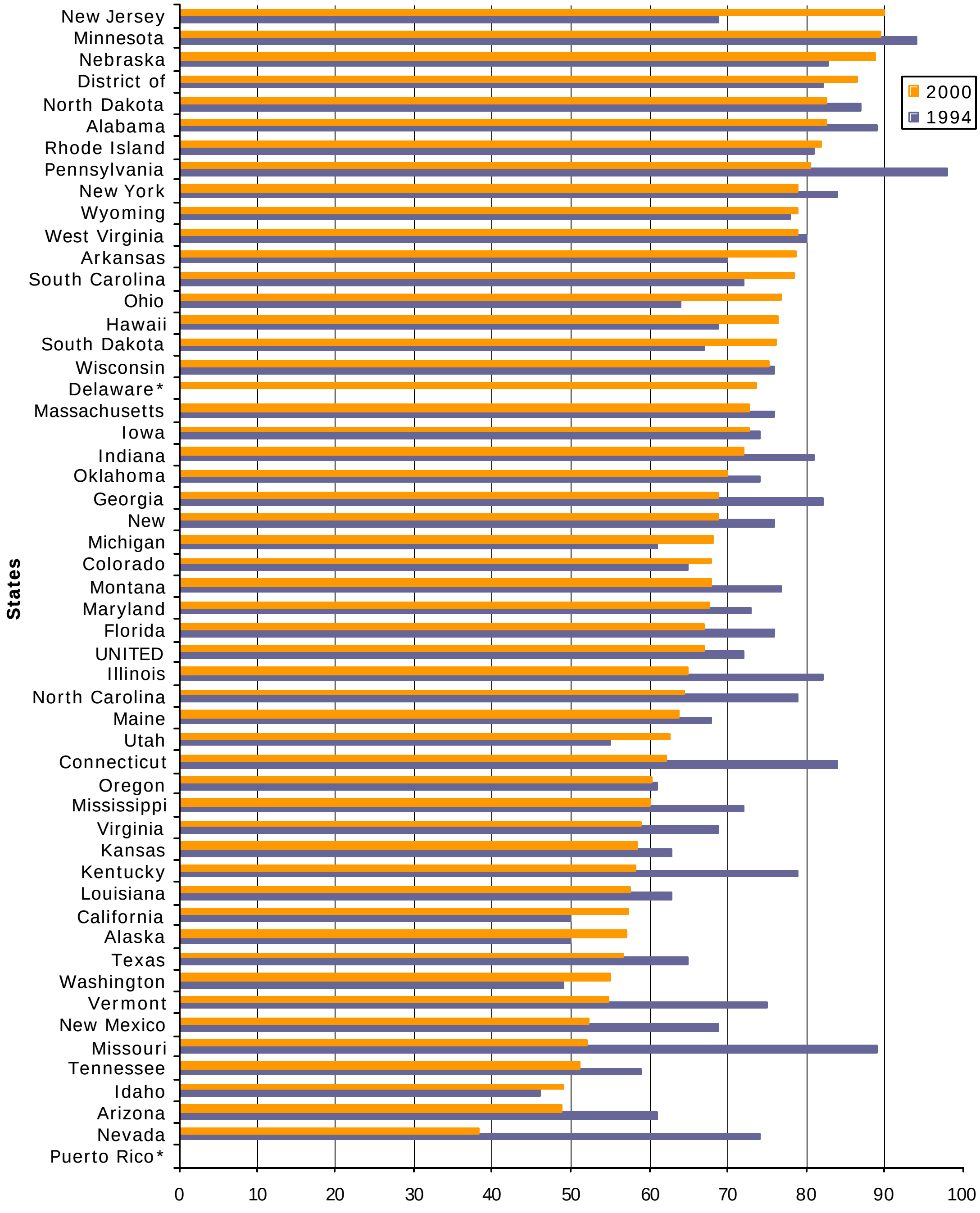
Summary of Finding on Trends. The prospect of states meeting the standard of highly qualified teachers (set by NCLB) using the measures outlined in the law (full state certification and major in field) appears very difficult to accomplish, based on recent data trends. Results of the present analysis of trends from 1994 to 2000 show that a majority of states have not been able to keep up with the demand for teachers at the secondary level. The demand for teachers has increased, and while many states appear to be maintaining a consistent level of certified teachers even while the teaching force has grown at the secondary level (see 10-year trends presented in Blank & Langesen, 2001), the SASS data presented here show that many states have fewer teachers with a major in their assigned field than they did in 1994.

Table 3: Math and Science Teachers with Major in Field, Grades 7-12, 1994 and 2000

State	Math -- Main Assignment Percent with Major 1994	Math -- Main Assignment Percent with Major 2000	Science -- Main Assignment Percent with Major 1994	Science -- Main Assignment Percent with Major 2000
New Jersey	69*	90	82*	93
Minnesota	94*	90	97*	93
Nebraska	83*	89	79	80
District of Columbia	82	87	n/a	n/a
North Dakota	87*	83	85	85
Alabama	89*	83	73*	78
Rhode Island	81	82	94*	81
Pennsylvania	98*	81	85*	79
New York	84*	79	85*	86
Wyoming	78	79	80	78
West Virginia	80	79	76*	69
Arkansas	70*	79	66*	57
South Carolina	72*	79	74	75
Ohio	64*	77	75*	69
Hawaii	69*	76	74*	87
South Dakota	67*	76	72	72
Wisconsin	76	75	68*	82
Delaware	n/a	74	82*	68
Massachusetts	76*	73	89*	79
Iowa	74	73	86*	89
Indiana	81*	72	78	77
Oklahoma	74*	70	62*	67
Georgia	82*	69	68	70
New Hampshire	76*	69	91	90
Michigan	61*	68	73	72
Colorado	65*	68	78*	72
Montana	77*	68	76*	74
Maryland	73*	68	86	84
Florida	76*	67	52*	69
United States	**72***	**67**	**74***	**75**
Illinois	82*	65	77*	93
North Carolina	79*	64	73*	75
Maine	68*	64	67*	63
Utah	55*	63	66*	83
Connecticut	84*	62	90*	77
Oregon	61	60	93*	74
Mississippi	72*	60	73*	66
Virginia	69*	59	67*	74
Kansas	63*	58	78*	73
Kentucky	79*	58	55*	65
Louisiana	63*	58	57*	45
California	50*	57	62*	77
Alaska	50*	57	79	77
Texas	65*	57	70*	57
Washington	49*	55	83*	79
Vermont	75*	55	81	77
New Mexico	69*	52	71*	55
Missouri	89*	52	70	70
Tennessee	59*	51	52	53
Idaho	46*	49	77*	75
Arizona	61*	49	73*	66
Nevada	74*	38	88*	78

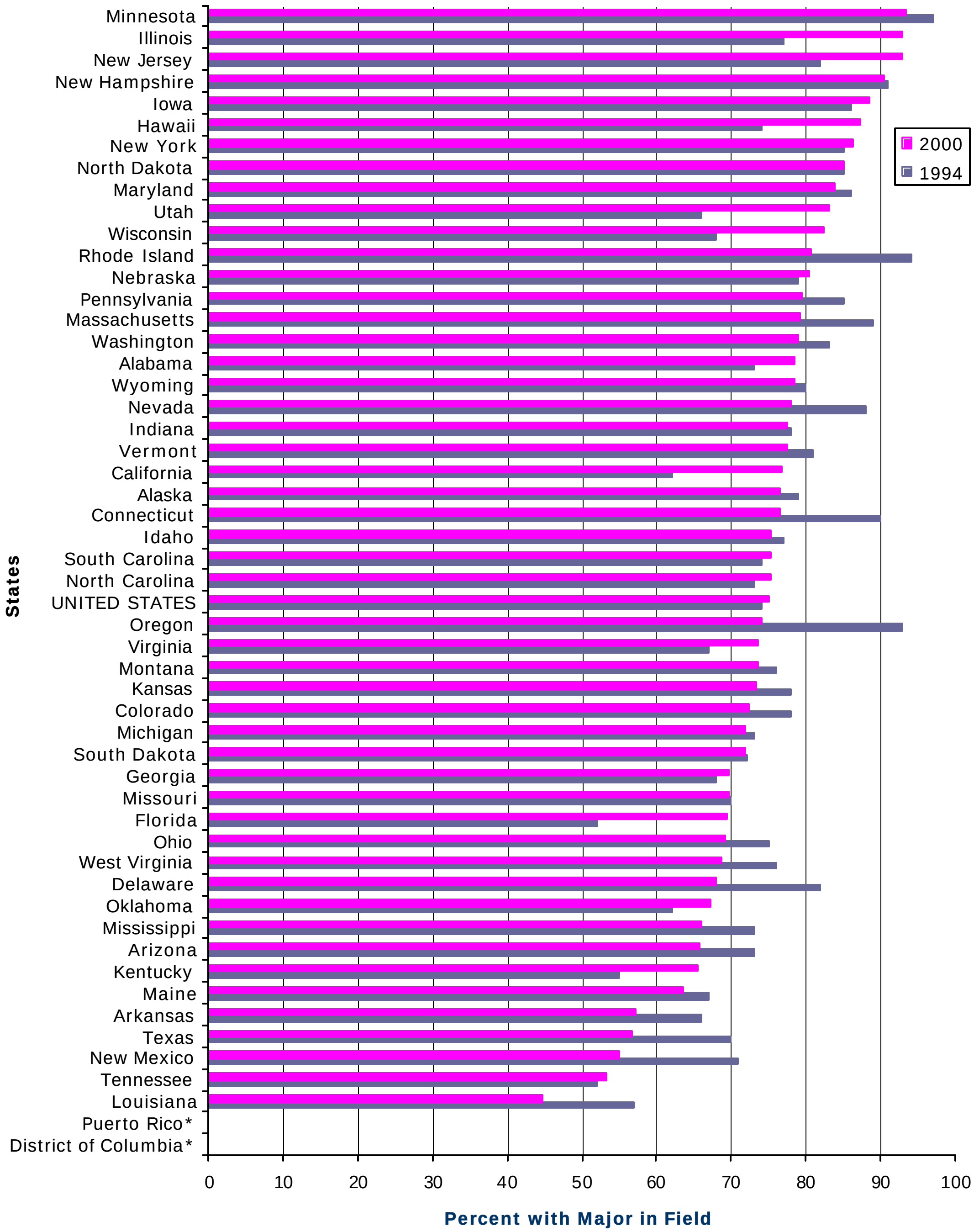
Notes: Teachers=Public school teachers with main assignment in subject in grades 7-12 departmentalized instruction.
Major=Undergraduate or graduate degree major in math or math education (science or science education).
* Difference from 1994 to 2000 is significant at 95% Confidence Level (x<-1.96 or x>1.96); n/a=Insufficient Data
Source: NCES, Schools and Staffing Survey 1999-2000.
Council of Chief State School Officers, Washington, DC, 2003

Figure 1: Math Teachers with Major in Field, 1994 to 2000



Notes: See following Tables for significance tests. Teachers=Public school teachers with main assignment in mathematics in grades 7-12 departmentalized instruction. Major=Undergraduate or graduate degree in mathematics or mathematics education. *Insufficient data.

Figure 2: Science Teachers with Major in Field, 1994 to 2000



Notes: See following Tables for significance tests. Teachers=Public school teachers with main assignment in science in grades 7-12 departmentalized instruction. Major=Undergraduate or graduate degree major in science or science education. *Insufficient data.

Factors Contributing to the Shortage of Highly Qualified Teachers in Science and Math

Three measures of change in the state context of public education contribute to the problem of teacher supply and demand and might be hypothesized as major contributors to the pattern of declining percentages of teachers meeting the highly qualified standard in the 1990s, observed in the data in Table 3. These measures are

- increasing school enrollment
- increasing numbers of teachers in science and math
- decreasing class size

Several major studies of teacher supply/demand have analyzed the effects of these changes in education on providing a qualified teacher force (NCTAF, 1996; National Commission, 2000).

There are many other factors that can affect the supply of qualified teachers in a state, including pay level for teaching, policies for licensures/certification, funding support for education, and status of teaching profession (Gilford & Tenenbaum/NRC, 1990; NCTAF, 1996; National Commission, 2000). In this paper, the analysis focuses on change from 1994 to 2000 on the three variables of demographic changes and class size using sample data from SASS and state data from CCSSO's recent State Science-Math Indicators project (Blank & Langesen, 2001).

This method tests the relationship in two ways, by statistical correlation analysis and by examining change in three demographic measures for the states with the greatest ***decrease*** in the proportion of highly qualified teachers from 1994 to 2000 in both math and science (as shown in Table 3.1). Listed below are the 11 states with 5 percent or greater decline in highly qualified teachers and those states with below 80 percent of teachers with major in field. For each of the 11 states, change is reported for

- increase/decrease in student enrollment
- change in number of math and science teachers
- increase/decrease in class size (accompanied by average Math class size in 2000)

States with Decrease in Highly Qualified Math and Science Teachers (7-12) (1994 to 2000) By State Education Demographics

State	7-12 Total Enrollment % Change	Math, Sci. Teachers % Change	Avg. Class Size Change	Avg. Class Size 7-12 Math
Arizona	+ 23	NA	- 0.7	27
Connecticut	+ 18	+ 16	- 0.4	20
Kansas	+ 8	NA	- 0.5	20
Louisiana	- 0.1	- 8	None	22
Massachusetts	+ 15	+ 15	- 1.0	22
Mississippi	- 4	+ 3	- 2.7	20
Missouri	+ 8	+ 13	- 1.5	23
Nevada	+ 40	+ 5	None	27
New Mexico	+ 6	NA	+ 0.9	24
Texas	+ 15	+ 60	- 2.0	20
Vermont	+ 13	+ 36	+ 0.8	21
National Avg.	+ 10	+ 9	- 0.5	23

Note: States listed had more than 5 percent decline in highly qualified teachers and were below 80 percent highly qualified in 2000. National average was 5 percent decline in math teachers with major in field. Sources: States: Table 3; Enrollment, M/S Teachers: State education data, CCSSO, 2001, Class size: SASS, 1994, 2000.

The cross-tabulation analysis of states with declining percent of teachers with a major in their field shows that across the 11 states, the following patterns were found:

- 6 of 11 states had above average increases in student enrollment
- 6 of 11 states had increases in the number of M/S teachers
- 7 of 11 had decreases in class size for 7-12 math/science classes

In several states such as Texas, Massachusetts, Connecticut, and Arizona, the average class size in math and science declined even though student enrollment in these grades sharply increased. In these states, state and local policies to decrease class size even during a period of student growth placed increased pressure on schools to hire math and science teachers, and the result was a declining level of overall preparation of the teaching force.

Student Enrollment Growth. Table 4 shows the change in numbers of students in grades 7-12 over six years from 1994 to 2000. The enrollment of secondary students increased in a majority of states, but enrollment declined in 10 states. One hypothesis is that states with increasing enrollment would have greater demand for teachers and lower rates of qualified math and science teachers. In scanning the rates presented in Tables 3 and 4, it appears that the two variables may be related—states with decreasing rates of highly qualified teachers are also enrollment growth states. A correlation analysis using the Pearson correlation statistic showed the two variables are related (r = -.21), but the relationship is not statistically significant at the .05 level (for statistical data analysis, see Beaudoin, 2003). Thus, it is not possible to say conclusively that change in preparation of teachers is linked to increasing enrollment at the state level.

Number of Teachers. Table 5 lists the change in the total numbers of teachers by state in math and science. These data on 9-12 teachers are compiled from state education information systems through the CCSSO Science-Math indicators project. These data address the question of trends in teacher hiring and assignments in math and science. Most states showed significant increase in the numbers of teachers assigned to math and science from 1994 to 2000, and this trend would place pressure on schools to find qualified teachers.

The increased demand for teachers, due to increased enrollment in math and science courses, places pressure on maintaining the level of subject preparation of the whole teaching force. Of 28 states with complete data, only 4 declined in numbers of math teachers while 24 states had increases. In science, 8 states declined in number of science teachers and 20 increased. Among states with decline in highly qualified teachers, most had a sharp increase in numbers of secondary math and science teachers. During this period, the national statistics showed significant increase in the percent of students taking math and science courses in high school (Blank & Langesen, 2001).

The correlation analysis showed a relationship between increase in numbers of math teachers and a decline in highly qualified teachers in math (r = -.33), but the results were not significant due to the limited number of states with complete data. In science, the analysis showed inconclusive results.

Table 4: Change in Student Enrollment, Grades 7-12, 1994 to 2000

State	Enrollment 2000	% Increase/Decrease '94 to '00
Nevada	135,145	+39.4%
Arizona	360,387	+23.4%
Florida	1,024,013	+23.0%
New Hampshire	93,910	+20.1%
Colorado	310,437	+18.9%
Connecticut	234,010	+17.9%
California	2,546,583	+17.2%
Maryland	364,050	+17.1%
Alaska	60,048	+16.9%
Washington	463,439	+16.1%
Massachusetts	412,502	+14.8%
Texas	1,703,042	+14.5%
Georgia	594,554	+14.0%
Vermont	48,130	+12.8%
Minnesota	406,100	+12.5%
North Carolina	537,219	+12.5%
Virginia	487,721	+11.6%
Illinois	861,796	+10.8%
Delaware	50,698	+10.4%
Rhode Island	66,437	+10.3%
United States	**20,459,675**	**+10.1%**
Wisconsin	416,295	+10.0%
Oregon	250,492	+9.9%
New Jersey	494,060	+9.9%
Pennsylvania	824,771	+8.4%
Kansas	216,093	+8.1%
Missouri	402,011	+7.2%
Oklahoma	273,123	+6.5%
Michigan	701,335	+6.4%
Nebraska	135,485	+6.3%
New Mexico	146,373	+5.7%
Idaho	113,925	+5.7%
New York	1,190,135	+5.6%
Hawaii	79,473	+5.1%
Tennessee	386,460	+4.9%
Montana	75,547	+4.6%
Iowa	229,779	+4.4%
North Dakota	55,609	+2.9%
South Carolina	287,564	+2.6%
Maine	94,356	+2.5%
Ohio	822,438	+2.2%
Arkansas	203,563	+2.2%
Utah	216,113	+1.6%
Louisiana	319,989	-0.1%
Indiana	436,565	-0.5%
Kentucky	284,329	-1.0%
South Dakota	62,356	-1.0%
Wyoming	45,540	-1.0%
Alabama	317,215	-1.1%
Mississippi	205,536	-3.8%
Puerto Rico	255,419	-5.2%
West Virginia	132,917	-9.9%
District of Columbia	24,588	-12.8%

Source: NCES, Common Core of Data, 1994, 2000.
Council of Chief State School Officers, Washington, DC, 2003.

Table 5: Teachers in Mathematics and Science, Grades 9-12, 1994 to 2000

	MATHEMATICS		SCIENCE	
State	All Teachers 2000	Increase/Decrease '94 to '00	All Teachers 2000	Increase/Decrease '94 to '00
Texas	24,103	+12,888	10,992	-2
California	10,562	+1,261	7,465	+704
Puerto Rico	2,926	+1,214	1,245	+608
Arkansas	1,311	+624	724	-543
New York	8,406	+583	12,313	+981
Massachusetts	2,980	+461	2,749	+308
Wisconsin	2,412	+402	2,277	+278
New Jersey	4,566	+386	3,002	+210
Connecticut	1,831	+302	1,845	+211
Alabama	1,955	+285	1,773	+186
New Hampshire	759	+283	486	+169
Minnesota	2,054	+244	1,865	+102
Missouri	2,341	+232	2,603	+384
Oklahoma	2,019	+227	1,967	+144
Indiana	2,542	+207	2,612	+331
Colorado	1,460	+141	1,366	+209
Tennessee	2,033	+124	1,446	-70
Vermont	379	+105	441	+151
Idaho	856	+92	712	+38
Mississippi	1,187	+54	1,372	+10
North Dakota	509	+39	582	-4
Rhode Island	422	+6	334	-13
South Dakota	481	-3	618	+41
Nebraska	1,237	-4	1,428	-22
Kentucky	1,601	-5	1,500	+83
Wyoming	265	-10	261	-108
Nevada	562	-14	538	+59
West Virginia	1,129	-76	643	-170
Oregon	1,067	-100	317	-65
Iowa	1,389	-106	1,630	-128
Louisiana	1,339	-133	879	-60
North Carolina	3,976	-287	3,244	+605
Utah	692	-629	760	-304
Ohio	4,180	-576	3,420	-760
Florida	5,201	—	3,764	—
Georgia	3,061	—	1,295	—
Kansas	1,531	—	1,552	—
Maine	667	—	858	—
Michigan	2,384	—	1,071	—
Alaska	—	—	—	—
Arizona	—	—	—	—
Delaware	—	—	—	—
Dist. of Columbia	—	—	—	—
DoDEA	—	—	—	—
Hawaii	—	—	—	—
Illinois	—	—	—	—
Maryland	—	—	—	—
Montana	—	—	—	—
New Mexico	—	—	—	—
Pennsylvania	—	—	—	—
South Carolina	—	—	—	—
Virgin Islands	—	—	—	—
Virginia	—	—	—	—
Washington	—	—	—	—
United States	**133,945**	**+17,415**	**106,889**	**+1671**

All Teachers: Assigned to subject one or more periods. — No data reported by state.
Science =Sum of Biol.,Chem.,Physics, Earth Sci. Texas: 2/3 of total Math are second assign.
Arkansas: 1994 math = main assign.only; Delaware: main assign.only;
Vermont: data includes imputation.NJ, PA: grades 7-12
Source: State Departments of Education, Data on Public Schools, 1999-00.
Council of Chief State School Officers, Washington, DC, 2003.

Class Size. A final factor possibly explaining the shortages of qualified teachers is change in class size. Policies setting lower maximum class size, either made at state or district levels, can place significant new demands for teachers. One hypothesis is that decreasing class size produces more classes, thus increasing the need for teachers and possibly lower rates of highly qualified teachers.

Table 6 shows the differences in average class size for math and science classes in grades 7-12 in 2000, and the change in class size from 1994 to 2000. Several states, notably, California and Florida, and others passed state policies in the 1990s limiting class size, and the data by state demonstrate the effect of policy initiatives to decrease class size.
A correlation analysis of the relationship between class size and preparation of teachers showed a small correlation ($r = -.06$), but at the state level the relationship is not statistically significant. Thus, we cannot say definitely whether decreasing class size is related to change in the proportion of teachers that are highly qualified.

Conclusions

The analysis of SASS data by state and trends from 1994 to 2000 indicates that changes in demographics of education in the 1990s have made the issue of ensuring qualified teaches in each classroom even more pressing for states and school districts. The data show that in all four academic subjects, the rate of highly qualified teachers (using certification and major in field as primary measures) did not improve in the majority of states during the 1990s; and, in 2000, only about two-thirds of secondary teachers in science and math would meet the current NCLB criteria of highly qualified. The analysis of demographic changes in enrollments, teachers, and class size during the 1990s indicated that growth in education, increases in teacher hiring, and class size policies may have been key factors in reducing the chances of improving the qualifications of the teaching force.

With the challenge under current NCLB law of providing highly qualified teachers in each classroom, the analysis indicates that most states will need to take significant policy actions to meet the requirements. States do have flexibility under NCLB to propose alternate definitions of highly qualified teachers that would provide greater latitude to include teachers as qualified that do not meet the specific criteria analyzed here, such as major in field. As states begin to report their data required under NCLB, CCSSO will use state-specific definitions and accompanying rates of highly qualified teachers to compare trends along with the trends provided from sample data from SASS.

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Table 6: Average Class Size in Math and Science, Grades 7-12, Change from 1994 to 2000

	Mathematics		Science	
State	Avg. Class 2000	Change '94 to '00	Avg. Class 2000	Change '94 to '00
Iowa	20.7	+2.5	21.2	-0.9
Maine	21.7	+2.3	18.3	-1.8
Wyoming	21.4	+2.0	20.5	+2.4
Washington	26.7	+1.8	25.2	-0.1
New Hampshire	22.5	+1.8	23.8	+0.9
New Jersey	21.3	+1.5	19.5	-0.1
Virginia	21.2	+1.0	22.5	+0.4
New Mexico	24.0	+0.9	25.3	+1.3
New York	22.8	+0.9	22.1	-1.9
Rhode Island	22.6	+0.9	20.2	-0.4
Oregon	23.3	+0.8	26.9	+2.0
Vermont	21.0	+0.8	—	NA
Wisconsin	23.7	+0.7	23.0	-0.4
Georgia	24.1	+0.6	22.1	-2.0
Kentucky	22.5	+0.6	23.1	-0.6
Maryland	25.5	+0.5	25.2	+0.5
Indiana	22.7	+0.3	22.6	-0.5
Alabama	22.2	+0.3	22.7	-0.9
Nevada	26.6	+0.1	27.3	+0.3
Louisiana	21.2	+0.1	24.0	-0.3
Colorado	23.8	+0.1	23.8	+0.1
Florida	25.0	+0.05	28.7	+0.7
Montana	18.0	-0.2	19.0	0.0
South Carolina	21.8	-0.2	24.0	+0.8
Nebraska	18.8	-0.3	24.3	+5.3
Connecticut	19.0	-0.4	21.5	+2.4
Kansas	19.0	-0.5	21.4	-0.4
Minnesota	24.1	-0.5	26.5	+0.7
United States	**22.4**	**-0.5**	**23.7**	**-0.1**
Arkansas	17.8	-0.6	21.7	+1.8
Delaware	22.4	-0.7	24.4	-3.9
Oklahoma	18.2	-0.7	20.6	+1.6
South Dakota	17.5	-0.7	19.3	-2.1
Arizona	25.9	-0.7	24.0	-3.2
California	27.1	-0.8	30.1	+1.1
North Carolina	21.7	-1.0	21.9	-1.3
Massachusetts	20.5	-1.0	22.9	+0.8
Ohio	20.9	-1.1	23.7	+1.2
Alaska	19.3	-1.1	26.6	+6.0
District of Columbia	19.0	-1.4	23.4	NA
Illinois	22.2	-1.5	21.4	-2.5
Tennessee	23.1	-1.5	24.6	-2.2
Missouri	21.3	-1.5	21.1	-2.2
West Virginia	19.2	-1.7	21.8	-1.2
Texas	19.4	-2.0	21.6	-0.2
Idaho	21.1	-2.1	22.7	-1.3
Pennsylvania	22.5	-2.1	22.7	-0.3
North Dakota	17.9	-2.2	17.3	-3.2
Utah	26.0	-2.4	29.1	+0.1
Hawaii	19.3	-2.5	24.1	-0.1
Michigan	22.6	-2.6	24.3	-0.8
Mississippi	19.4	-2.7	21.5	-1.1

Source: NCES, Schools and Staffing Survey 1993-94, 1999-00.
Council of Chief State School Officers, Washington, DC, 2003.

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About the Authors

Rolf Blank (RolfB@ccsso.org) is Director of Education Indicators at the Council of Chief State School Officers, Washington, DC, where he is assisted in state policy and program analyses by Doreen Langesen, Elizabeth Laird, and Carla Toye. Victor Bandeira de Mello is a senior statistician with the American Institutes for Research, Palo Alto, CA.

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