Staff Information Report

RAND Reports: Money Matters in Education Depending on How It's Spent

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RAND Reports: Money Matters in Education Depending on How It's Spent

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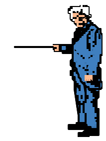
Executive Summary



In July 2000, the RAND Corporation of Santa Monica, California, released a report based on data from the National Assessment of Educational Progress, *Improving Student Achievement: What State NAEP Test Scores Tell Us*. RAND's effort is significant because it identifies and analyzes which state policies and programs account for the differences in achievement across states that cannot be explained by demographics.[1] Further, this analysis covered all seven state-level math and reading tests given between 1990 and 1996. Tennessee students participated in six of the seven tests, the only exception being the 1990 eighth-grade math test. The RAND report ranked Tennessee 35th of 44 states for achievement before and after adjusting for demographic differences and 25th of 36 states for gains in achievement adjusted for differences in demographics and test participation rates—18th of 36 for gains in math.[2]

The RAND research confirmed the conclusions of many other studies that family and demographic characteristics explain the largest part of the variation across states. What the RAND study did that distinguishes it from other analyses was develop several methods of adjusting for these characteristics so that differences across states in achievement and performance gains could be compared as though all states had similar student populations.[3] Having done this, RAND went further and applied the same techniques to control for demographic differences across states in order to more precisely evaluate the cost-effectiveness of different state education policies designed to improve student performance, including pupil-teacher ratios and expenditures; teachers' salaries, education and experience; the percentage of students in public pre-kindergarten programs; and the adequacy of teaching resources.[4]

Findings of the RAND Report

About 75% of the difference across states in average test scores is attributable to differences in family characteristics, primarily socioeconomic status. However, for students with similar family characteristics, different state education policies can have a significant impact. According to RAND's report, the three most cost-effective education policies that states can adopt are

- for all states, regardless of socioeconomic status, providing teachers with more discretionary resources;
- for states with a disproportionate percentage of lower socioeconomic status students,

[1] Grissmer, David W., Ann Flanagan, Jennifer Kawata and Stephanie Williamson, *Improving Student Achievement: What State NAEP Test Scores Tell Us*, Santa Monica, CA: RAND, July 2000. [http://www.rand.org/publications/MR/MR924/]

[2] Ibid., Table A.2, pp. 120-122, Table 6.1, pp. 68-69, and Table 5.3, pp. 60-61. Forty-four states participated in a sufficient number of tests to be included in the analysis of achievement; 36 participated in a sufficient number to be included in the analysis of gains.

[3] Ibid., Chapter 6 "Estimating Scores Across States for Students from Similar Families", pp. 65-71.

[4] Ibid., Chapter 7 "Effects of State Educational Policies and Characteristics", pp. 75-83.

    - ✓ lowering pupil-teacher ratios in the lower grades to below the national average
    - ✓ expanding pre-kindergarten, and
    - ✓ providing teachers additional resources; and
- for states with average socioeconomic status, lowering pupil-teacher ratios in the lower grades to the national averages.

Using in-classroom teacher's aides is far less cost effective than any of these.[5]

Implications for Tennessee

Tennessee renewed its efforts to reform education in 1992 with the passage of the Education Improvement Act, which provided for improvements in two of the three policy areas found by RAND to be most cost-effective. The Act required the implementation of a funding formula to support the Basic Education Program, the hallmark of which was reducing class sizes at all grade levels by an overall average of about 4½ students. The new class size limits become effective on July 1, 2001—four years from the date on which the formula was first fully funded.[6] Based on the RAND study, a 4½-student reduction in the pupil teacher ratio in a medium socioeconomic state could improve achievement scores by as much as three or four percentile[7] points.

> **...the Education Improvment Act, which provided for improvments in two of the three policy areas found by RAND to be most cost-effective.**

The new formula also explicitly funds classroom equipment, materials and supplies[8] and the Act further requires that $200 be allocated to each teacher to purchase instructional supplies. Half of that amount is to be spent as the teacher sees fit and the other half must be pooled within a school and spent as determined by a committee of teachers in that school.[9] Between the school years ending in 1992 and 1999, expenditures for classroom materials, equipment and supplies increased by nearly $80 per student. Based on the RAND study, an increase of this size equates to as much as a 2.5 percentile point increase in student performance.

The new formula did not, however, provide for the other policy found by RAND to be one of the three most cost-effective: public pre-kindergarten. This may be the next best policy to implement. Based on the State Board of Education's Early Childhood Policy and the fiscal year 2000-01 Basic Education Program formula, serving all four-year-olds could cost as much as $300 million, which amounts to about $320 per pupil overall. Again based on RAND's work, a difference of this size corresponds to about a 3.5 percentile point improvement in achievement for states with middle of the range socioeconomic status. For a state in the lower range for socioeconomic status, the same increase in expenditures for pre-kindergarten corresponds to more than a nine percentile point increase in achievement.

[5] Ibid., Summary, p. xxvii.

[6] Public Chapter 535, Section 37, Acts of 1992; codified at Tennessee Code Annotated, §49-1-104(a).

[7] A score distribution arranged in order of increasing magnitude and divided into 100 points, each point representing one percent of the scores (e.g., the 75th percentile represents the score that is equal to or better than 75 percent of all of the scores).

[8] Tennessee State Board of Education, *Tennessee Basic Education Program, BEP 2000-2001*, Nashville, TN: 2000. [http://www.state.tn.us/sbe/bep.htm]

[9] Public Chapter 535, Section 3, Acts of 1992; codified at Tennessee Code Annotated, §49-3-359(a).

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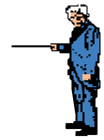

Introduction

In July 2000, the RAND Corporation of Santa Monica, California, released a report based on data from the National Assessment of Educational Progress, *Improving Student Achievement: What State NAEP Test Scores Tell Us*. RAND's effort is significant because it identifies and analyzes which state policies and programs account for the differences in achievement across states that cannot be explained by demographics.[10] Further, this analysis covered all seven state-level math and reading tests given between 1990 and 1996.

The RAND research confirmed the conclusions of many other studies that family and demographic characteristics explain the largest part of the variation in student achievement across states—in this case, about 75 percent. What the RAND study did that distinguishes it from other analyses was develop several methods of adjusting for these characteristics so that differences across states in achievement and performance gains could be compared as though all states had similar student populations.[11]

Then RAND went one step further and applied the same techniques to control for demographic differences across states in order to more precisely evaluate the cost-effectiveness of different state education policies designed to improve student performance, including pupil-teacher ratios and expenditures; teachers' salaries, education and experience; the percentage of students in public pre-kindergarten programs; and the adequacy of teaching resources.[12]

Tennessee Rankings

- ✓ *35th of 44 states for achievement—before and after adjusting for differences in demographics and participation rates*
- ✓ *25th of 36 states for overall gains adjusted for demographics and participation rates*
- ✓ *18th of 36 states for math gains adjusted for demographics and participation rates*

Major RAND Findings

Significant achievement gains are occurring in some states and appear to be the result of systemic programmatic reforms. The RAND research indicates that there is reason to be optimistic about education reform efforts. Between 1990 and 1996, public elementary school students gained a full percentile[13] point in mathematics. This may sound like a small change, but it was statistically significant. Students in some states gained as much as two percentile points per year, while others made no gains.[14] To put these gains in perspective, gains on the national NAEP were closer to one-third of one percentile point per year from 1970 through 1990.[15] By comparison, the gains for 1990 through 1996 are quite remarkable. Tennessee students fell in the middle ground, gaining about one percentile point overall.[16]

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[10] Grissmer, David W., Ann Flanagan, Jennifer Kawata and Stephanie Williamson, *Improving Student Achievement: What State NAEP Test Scores Tell Us*, Santa Monica, CA: RAND, July 2000. [http://www.rand.org/publications/MR/MR924/]

[11] Ibid., Chapter 6 "Estimating Scores Across States for Students from Similar Families", pp. 65-71.

[12] Ibid., Chapter 7 "Effects of State Educational Policies and Characteristics", pp. 75-83.

[13] A score distribution arranged in order of increasing magnitude and divided into 100 points, each point representing one percent of the scores (e.g., the 75th percentile represents the score that is equal to or better than 75 percent of all of the scores).

[14] Ibid., Summary, pp. xxiii.

[15] Ibid., Chapter 5, "Trends in State Scores", pp. 55-63.

[16] Ibid., Table 5.4, pp. 62-63. Standard deviation units converted to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

While the RAND analysis did show a statistically significant relationship across states between achievement and changes in spending patterns, it failed to show a relationship between achievement gains and changes in spending patterns. Instead the researchers, citing this and earlier work, saw the gains as further evidence of the success of systemic reform efforts. The systemic reforms cited included

- developing state standards by grade,
- linking assessments to those standards,
- establishing good feedback systems for teachers and principals,
- implementing some accountability measures, and
- deregulating the teaching environment.[17]

Differences in family characteristics explain most of the differences across states in student achievement; however, when demographic differences are factored out, spending patterns are strongly related to differences in achievement. The highest average achievement scores were found in the more rural northern states, while the lowest were usually found in the southern states. The more urban northern states fell in the middle. These differences were explained more by family rather than school characteristics. However, there were statistically significant differences—as large as 11 to 12 percentile points—among students with similar family characteristics, and all regions had states at both ends of the spectrum—even for students with similar family characteristics.[18]

The RAND researchers were able, by controlling for differences in test participation rates and family characteristics, to demonstrate that different state education spending policies do have a significant impact, particularly in states with disproportionately large numbers of minority and less-advantaged students. Their results indicate the most cost-effective education policies states can adopt are

> The RAND researchers were able …to demonstrate that different state education spending policies do have a significant impact…

- for all states, regardless of socioeconomic status, providing teachers with more discretionary resources;
- for states with a disproportionate percentage of lower socioeconomic status students,
  - ✓ lowering pupil-teacher ratios in the lower grades to below the national average,
  - ✓ expanding pre-kindergarten, and
  - ✓ providing teachers additional resources; and
- for states with average socioeconomic status, lowering pupil-teacher ratios in the lower grades to the national averages.

[17] Ibid., Chapter 5, "Trends in State Scores", pp. 58-59; and Grissmer, David, and Ann Flanagan, *Exploring Rapid Score Gains in Texas and North Carolina*, commissioned paper, Washington, D.C.: National Education Goals Panel, 1998.

[18] Ibid., Summary, p. xxiii.

Using in-classroom teacher's aides is far less cost effective than any of these. And higher teacher salaries or higher percentages of teachers with master degrees—at least across states—appear to have no impact on achievement.[19]

The National Assessment of Educational Progress —the Nation's Report Card

The RAND report relied on data from seven math and reading tests given in 1990 through 1996 as part of the National Assessment of Educational Progress (NAEP). This program is the only nationally representative and continuing assessment of student knowledge and achievement. It was begun in 1969 to produce national data on various subjects and has a separate component for tracking long-term trends. A third component is the state-level NAEP, which was begun in 1990 to facilitate comparisons across states and between states and the nation as a whole. NAEP has two major goals: "to reflect current educational and assessment practice and to measure change reliably over time." Two nationally representative samples of students are selected each year to participate in either the main assessments or the long-term trend assessments. The national reports include regional information, but state-level information requires the larger samples from the biennial state NAEP. Along with the student tests are questionnaires for students, principals and teachers, which gather information about courses, homework and home factors related to instruction; professional qualifications of teachers and teaching activities; and school-level practices and policies.[20]

Subject Areas Assessed by State NAEP

Year	Subject Area	Grade Levels
2000	Mathematics	4, 8
	Science	4, 8
1998	Reading	4, 8
	Writing	8
1996	Mathematics	4,8
	Science	8
1994	Reading	4
1992	Mathematics	4,8
	Reading	4
1990	Mathematics	8

Adjusting for Family Characteristics —Controlling Demographic Differences

The RAND researchers relied on data from the National Assessment of Educational Progress, the National Education Longitudinal Study and the U.S. Bureau of the Census to control for demographic differences and make student performance data more comparable across states. To ensure the validity of their work, the researchers developed three different methods of describing demographic differences and used two different statistical methods to test them and develop estimates of their impact. The result was six statistical models, five of which were considered sufficiently reliable for inclusion in the report.[21]

[19] Ibid., Summary, pp. xxvi-xxvii.

[20] U.S. Department of Education, National Center for Education Statistics, *The NAEP Guide*, NCES 2000-456. Washington, D.C.: 1999, pp. 3-5.

[21] Grissmer, Chapter 4 "Methodology", pp. 43-54 and footnote one at pp. 56-57.

Effect of Family Characteristics

Most significant and positive—

- ✓ Non-minority race or ethnicity
- ✓ Higher parental education
- ✓ Higher family income

Highly significant and negative—

- ✓ Larger family size
- ✓ Younger mother at child's birth
- ✓ Single parent status

Not significant—

- ✓ Mother's labor force status

The researchers used information from a report by the National Center for Education Statistics to adjust for cost of living differences among the states in order to make expenditure data and teacher salaries more comparable.[22] TACIR staff applied this same method in two working papers published in 1999: *The True Cost of Education in Tennessee: Alternative Geographic Cost Adjustment Measures* (March 1999) and *Classroom Teacher Salary Disparity Among Tennessee's School Systems* (April 1999).

Using all of this information and some fairly sophisticated statistical techniques, the researchers found that about 75 percent of the differences across states in average test scores could be attributed to differences in family characteristics,[23] demonstrating that analyses of the impact of different state policies and programs must control for differences in family characteristics.[24] Analyses of educational policies that fail to do so run the risk of producing questionable results.

Tennessee's Achievement and Gain Rankings

Tennessee participated in six of the seven tests included in the RAND study, the only exception being the 1990 eighth grade mathematics test. Tennessee's overall rank was determined to be 35th out of 44 states. Average scores for Tennessee students improved on all three areas tested over the period analyzed by RAND. (Rankings for Tennessee and other states in the region on all seven tests are shown in Table 1. Table 1 also includes the highest and lowest ranking states on all tests.)

Tennessee's demographics were not sufficiently different from the nation as a whole to affect its rankings, but several other southern states' demographics were. As shown in Table 2, Tennessee's rank for student achievement remained the same (35th) when family characteristics were held constant across all states. Louisiana's rank also stayed the same (43rd). Alabama, Arkansas and Mississippi's ranks improved only slightly, and Kentucky and West Virginia's actually dropped. All of these states ranked lower than Tennessee before and after the adjustment for demographic differences.

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[22] Ibid., Appendix F, "Variable Definitions", p. 195 [Chambers, Jay, *The Patterns of Teacher Compensation*, Washington, DC: National Center for Education Statistics, NCES 95-829, January 1996].

[23] The report very carefully points out in footnote one on page 65 that explaining 75 percent of the differences across states in average achievement scores is not the same thing as explaining 75 percent of differences in individual achievement scores. Many other factors not accounted for in the study affect differences between individual children. This study addresses only differences between scores when aggregated at the state level.

[24] Five equations, each based on a different set of measures, were used to control for demographic differences in predicting average test scores for the states. The values resulting from those equations and demographic data for each state were used to adjust actual average scores for demographic differences among the states. For a full discussion of this methodology, see Chapter 4 of the RAND report (footnote one), pp. 43-54.

Table 1. Unadjusted Reading and Math Achievement Rankings on the 1990 through 1996 National Assessment of Educational Progress, Tennessee and Selected States[25]

		Test						
	All Seven Tests	**Reading**		**Math**				
		4th Grade		**4th Grade**		**8th Grade**		
State		**1992**	**1994**	**1992**	**1996**	**1990**	**1992**	**1996**
Maine	***1*** [a]	2	***1*** [a]	***1*** [a]	***1*** [a]	n/a	4	2
North Dakota	***1*** [a]	3 [a]	*2*	*4* [a]	*4* [a]	***1*** [a]	***1*** [a]	*4* [a]
Iowa	3	5	4 [a]	2 [a]	6 [a]	3	***1*** [a]	***1*** [a]
New Hampshire	4	***1*** [a]	4 [a]	2 [a]	n/a	7	5 [a]	n/a
Minnesota	7	10 [a]	14	6	***1*** [a]	5	3	***1*** [a]
Connecticut	10	9	7 [a]	7 [a]	***1*** [a]	11 [a]	10 [a]	8
Missouri	19	15 [a]	15 [a]	14 [a]	17 [a]	n/a	15 [a]	18
Virginia	24	10 [a]	19 [a]	16 [a]	21 [a]	16 [a]	18 [a]	19 [a]
West Virginia	30	22 [a]	19 [a]	27 [a]	21 [a]	28 [a]	34 [a]	28
Kentucky	31	27 [a]	24 [a]	27 [a]	27 [a]	27	28	26 [a]
North Carolina	34	28 [a]	18	32 [a]	20	34	36	24 [a]
Tennessee	**35**	**28** [a]	**19** [a]	**35**	**29**	**n/a**	**34** [a]	**30** [a]
Georgia	36	28 [a]	30	26	33 [a]	25	31	32 [a]
Florida	37	36	33 [a]	31	31 [a]	32	32 [a]	29
Arkansas	39	31 [a]	28	36	31 [a]	28 [a]	37	31 [a]
South Carolina	40	34	35	34	36	n/a	29 [a]	35
Alabama	41	37	29	37 [a]	37	33	38	36
Louisiana	43	38	***37*** [a,b]	39	38 [a]	***35*** [a,b]	39	37
Mississippi	***44*** [b]	***40*** [b]	36	***40*** [b]	***40*** [b]	n/a	***40*** [b]	***38*** [b]

Notes: a. *Tied.*
b. *Lowest rank for year and subject.*

Source: *RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).*

[25] Grissmer, Table A.2, pp. 120-122.

Table 2. Unadjusted Achievement Rankings on the 1990 through 1996 National Assessment of Educational Progress and Achievement and Gains Adjusted for Socioeconomic Status, Tennessee and Selected States

	Achievement Rank		Adjusted Gain Rank	
State	**Unadjusted**[26]	**Adjusted**[27]	**All Tests**[28]	**Math Only**[29]
Maine	***1*** [a]	5	18 [a]	31
North Dakota	***1*** [a]	6	26 [a]	32 [a]
Wyoming	12	15	31	***36*** [b]
Missouri	19	10	33 [a]	30
Virginia	24	14	28 [a]	26
Texas	27	***1***	2	2
West Virginia	30	41	13 [a]	6
Kentucky	31	36	7 [a]	7 [a]
North Carolina	34	23	***1***	***1***
Tennessee	**35**	**35**	**25**	**18** [a]
Georgia	36	13	***36*** [b]	35
Florida	37	29	7 [a]	12
Arkansas	39	37	28 [a]	21
South Carolina	40	28	16 [a]	17
Alabama	41	40	20 [a]	22 [a]
California	42	***44*** [b]	10 [a]	14
Louisiana	43	43	22 [a]	22 [a]
Mississippi	***44*** [b]	42	26 [a]	25

Notes: *a. Tied.*
b. Lowest rank for year and subject.

Source: *RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).*

Other states in the region showed dramatic changes, most notably Texas and Georgia. Texas ranked 27th before the adjustment and first afterward. Georgia ranked just below Tennessee before the adjustment for family characteristics, but while Tennessee's rank remained the same before and after, Georgia moved up from 36th to 13th, indicating that Georgia, like Texas, is demographically different from Tennessee in a way that explains much of the tendency of Georgia students to score low on these tests. Two other states, North Carolina and Florida, ranked close to Tennessee (34th and 37th) before the adjustment for demographic differences, but notably higher after (23rd and 29th). In other words, Tennessee's demographics do not explain Tennessee's lower than average reading and math scores for this period.

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[26] Grissmer, Table A.2, pp. 120-122. Numbers in both bold and italic type indicate highest and lowest ranking states.

[27] Ibid., Table 6.1, pp. 68-69.

[28] Ibid., Table 5.3, pp. 60-61.

[29] Ibid., Table 5.4, pp. 62-63.

In addition to analyzing average achievement levels, RAND analyzed trends over the six-year period. In the case of gains, RAND did not provide "before and after" results based on family characteristics. Having established that fair comparisons require controlling for these characteristics, RAND estimated gains only after doing so. As shown in Table 2, Tennessee ranked 25th for gains when all tests were considered and 18th based only on the math tests. Texas ranked second in gains by both measures, and North Carolina, which ranked just above Tennessee for achievement, ranked first in gains. In contrast, despite Georgia's good showing in achievement based on controlling for family characteristics, that state ranked last in overall gains and second to last in math gains.

Money Matters in Education
—When Spent in Certain Ways

The RAND study clearly supports Tennessee's efforts to reduce class sizes as a cost-effective means of improving student performance. However, it also suggests additional strategies that should lead to further improvement. Having established reliable statistical models to control for family characteristics and demonstrating the significance of their impact, RAND went on to use those methods to explore the effects of differences in state educational policies and characteristics from three cost-related perspectives:

- Total expenditures per pupil as the sole measure of educational resources
- Substituting for total expenditures four, more specific measures of educational resources variables:
    - pupil-teacher ratios
    - teacher salaries
    - teacher-reported resources
    - public pre-kindergarten participation rates
- Substituting two more specific measures for teacher salaries:
    - teacher experience
    - teacher education

In all cases, these variables were averaged over the years of schooling for the students taking each test. For example, the pupil teacher ratio used in the equations for each of the fourth grade tests was the average of the ratios for all of the years in which those students were in school, including the fourth grade. Expenditures per pupil and teacher salaries were averaged in the same way. The pre-kindergarten participation rate was taken from the year in which the students being tested would have been pre-kindergarten age.[30]

Higher Spending Correlates to Better Student Performance

The researchers concluded from the total expenditures per pupil perspective that spending an additional $1,000 per pupil would raise average state scores between one and three percentile points depending on which equation was used to control for demographic differences. When demographic differences were factored out and cost of living adjustments were made, the effect of differences

$1,000

The researchers concluded from the total expenditures per pupil perspective that spending an additional $1,000 per pupil would raise average state scores...

[30] Ibid., pp. 52-53 and Appendix F, "Variable Definitions", pp. 187-196.

across the states in expenditures per student was highly statistically significant (at the 99% level).[31] When the selected components of expenditures were factored in individually, it became evident that certain spending policies were more cost-effective than others. Raising teachers' salaries—at least based on state-level differences in averages—was not one of the cost effective policies.

Table 3. Estimated Effect of Educational Resource Policies on State Average Test Scores[32]

Change in Educational Resource Policy[33]	**Difference in Score** (percentile points)[34]	**Number of Models**[35] **in which Variable is Significant at . . .** 99%	95%	90%
$1,000 *increase* in expenditures per pupil	1.43 to 3.33	all		
One point *increase* in percent of students participating in public pre-kindergarten	0.10 to 0.17	0	1	2
One student *increase* in pupil-teacher ratio *for grades one through four*	-0.65 to -0.88	4	1	0
One student *increase* in pupil-teacher ratio *for grades five through eight*	0.20 to 0.24	0	0	2
$1,000 *increase* in average teacher salary	-0.10 to 0.17	0	0	0
One point *increase* in percent of teachers reporting that they have *some or none* of the resources they need	-0.07 to -0.10	0	0	3
One point *increase* in percent of teachers reporting that they have *most* of the resources they need	-0.07 to -0.10	0	0	0

Source: RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).

In exploring the effects of educational policies, the RAND researchers started with a set of eight variables: average teacher salaries, the pupil-teacher ratio, the percentage of teachers reporting low resources, the percentage reporting medium resources, the percentage of students in pre-kindergarten programs, transportation expenditures per student, the percentage of students in limited English proficiency [LEP] programs, and the percentage of students with individualized learning plans [IEPs or special education]. The latter three variables were not intended to represent policy choices but rather to account for differences across states in those costs.

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[31] Ibid., p. 76 and Table 7.1, p. 77.

[32] Ibid., Table 8.1, p. 89. Standard deviation units converted to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

[33] Values for expenditures per pupil are based on calculating the five socioeconomic status (SES) equations with that as the only resource variable. Values for the other variables are based on including all six in each SES equation.

[34] Percentile points range from one to 99.

[35] Five equations were calculated and three confidence levels were reported.

The regression equation based on these eight variables accounted for 95% of the variance across states in expenditures per pupil.[36] However, in interpreting the results it is important to consider that each variable included in the equation may to some extent represent the effects of variables that were not included in the equation and that inclusion of additional variables might reduce the impact of those selected. For example, the results of the regression analysis indicate that increasing transportation expenditures by one dollar costs four dollars. That result seems counterintuitive except for the variables that have not been included in the analysis. Most likely, some factor not included in the regression equation affects both transportation costs and other costs similarly so that a one-dollar difference in transportation costs is associated with a three-dollar difference in those other costs.

Table 4. Estimated Marginal Cost per Pupil of Educational Policies and Characteristics[37]

Change in Educational Policy or Characteristic	Cost per Pupil[38]	T-statistic[39]
$1,000 *increase* in average teacher salary	$148.00	12.7
One student *decrease* in pupil-teacher ratio for kindergarten through grade twelve	$196.00	-7.1
One point *decrease* in percent of teachers reporting that they have *some or none* of the resources they need	$5.10	1.8
One point *decrease* in percent of teachers reporting that they have *most* of the resources they need	$5.60	1.5
One point *increase* in percent of students participating in public pre-kindergarten	$12.00	2.7
One dollar *increase* in transportation expenditures per pupil	$4.00	4.2
One point *increase* in percent of students participating in Limited English Proficiency programs	$4.00	0.3
One point *increase* in percent of students with Individualized Educational Programs (special education)	$16.00	1.2

Source: RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).

The RAND researchers combined the results of the achievement equations presented in Table 3 with the results of the expenditure equation presented in Table 4 to analyze the cost-effectiveness of the policies. This was done quite simply by dividing the results for the policy variables from the equation used to predict total expenditures per pupil (Table 4) by the results for those variables from the equations used to predict test scores (Table 3). The results from the expenditure equation produce the marginal cost per pupil associated with the policy, and the results from the achievement equations represent the marginal effect of the policy on test scores. The result is expressed in Table 5 as the cost to raise average state scores by one percentile point. It is shown as a range because of the use of five different statistical models,

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[36] Grissmer., Chapter 8, "Assessing the Cost-effectiveness of Different Resource Utilizations", pp. 87-88.

[37] Ibid., Tables 8.1 and 8.2, p. 89-90.

[38] The marginal cost per student of differences in policy and educational characteristics across states are derived by multiplying the regression coefficients by $1,000. (See Ibid., p. 88.) The baseline cost per pupil (the y-intercept for the regression equation multiplied by $1,000) was $2,750. (See Ibid., Table L.1, p. 256.)

[39] Larger t-statistics indicate narrower confidence intervals and estimates that are more reliable.

representing five methods of controlling for demographic differences across the states, to predict the effects on scores.[40]

Table 5. Estimates of Additional Expenditures per Pupil in Each Resource Category to Raise Average Scores One Percentile Point[41]

Change in Educational Resource Policy	Cost per Pupil
Increase in expenditures per pupil	\$300 to \$700
Decrease in pupil-teacher ratio *for kindergarten through grade twelve*	\$220 to \$300
Decrease in pupil-teacher ratio *for grades one through four*	\$70 to \$90
Increase in average teacher salary	>>\$870
Decrease in percent of teachers reporting that they have *some or none* of the resources they need	\$50 to \$75
Decrease in percent of teachers reporting that they have *most* of the resources they need	\$55 to \$80
Increase in percent of students participating in public pre-kindergarten	\$70 to \$120

Source: RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).

The researchers went further and analyzed the marginal cost of the four most significant variables—the pupil-teacher ratio for grades one through four, the participation rate for pre-kindergarten, and two levels of teaching resources—for three levels of state socioeconomic status. The results imply that expanding pre-kindergarten and lowering pupil-teacher ratios would be most efficient for low socioeconomic states, while providing more teacher resources would be equally effective for all states.[42] The results further imply that these policies would be more effective in low socioeconomic schools and school systems.

[40] Grissmer, pp. 89-90.

[41] Ibid., Table 8.3, p. 90. Costs presented here are expressed in terms of percentile points based on conversion of standard deviation units to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

[42] Ibid., p. 91.

Table 6. Estimate of Additional Expenditures per Pupil to Raise Average Scores by One Percentile Point for States with Different Socioeconomic Status[43]

Change in Educational Resource Policy	State SES*		
	Low	**Medium**	**High**
Decrease in pupil-teacher ratio *for grades one through four*	$45	$130	>>$300
Increase in percent of students participating in public pre-kindergarten	$35	$95	>>$300
Decrease in percent of teachers reporting that they have *some or none* of the resources they need	$30	$30	$30
Decrease in percent of teachers reporting that they have *most* of the resources they need	$40	$40	$40

** Socioeconomic status.*

Source: RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).

Higher State Average Teacher Salaries Show Little Impact

The effect of differences in state average teacher salaries on state-average student test scores was insignificant and in fact was negative in one of the five statistical models.[44] To better understand this effect, the RAND researchers substituted teacher training and experience variables for teacher salaries. The effect of advanced degrees was very small and insignificant in four of the five statistical models. Interestingly, the effect of having higher percentages of teachers with more than two years experience was generally positive, but significant only for those teachers with three to nine years or more than twenty years of experience. The effect of having a higher percentage of teachers with ten to nineteen years of experience was insignificant in all five models.[45]

The RAND researchers give extensive consideration to the implications of the lack of any significant effects of teacher salaries, offering several possible interpretations:

1. The measures are accurate, and increases in teacher salaries have no effect on student test scores. This in turn could be the result of at least two problems: Current teacher compensation systems are ineffective at providing salary increases for higher quality teachers. Salary structures reward training and experience instead of proficiency, yet teachers' verbal ability, test scores and degrees in subjects taught show more consistent relationships with student achievement.

2. The coefficients in the equation are biased downward because of the correlation between teacher salaries and family socioeconomic status variables. The highest correlation between school and family characteristics was between teacher salaries and family characteristics (0.60). If teachers disproportionately teach in schools

[43] Ibid., Table 8.4, p. 91. Costs presented here are expressed in terms of percentile points based on conversion of standard deviation units to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

[44] Ibid., Table 7.2, p. 77.

[45] Ibid., Table 7.3, p. 79.

whose students have family characteristics similar to their own, which they generally do, then they must be considered part of social capital rather than a school effect.

3. The effects of interstate salary differentials may be different from intrastate differentials. The researchers note that teachers tend to teach in their home states and are not as sensitive to salary differentials across states as they are to those within states. They suggest that part of the reason for this phenomenon may be that over two-thirds of teachers are women, and they do not have the same mobility as men in seeking higher paying jobs.
4. The teacher labor market during the period of the analysis was characterized by a surplus across most categories, which means teachers were likely less sensitive to salary differences. As a result, they may have had fewer opportunities from which to select and may have chosen among them based on other differences.[46]

Despite the lack of significance of the teacher characteristics variables in this analysis, the RAND researchers calculated the cost to raise test scores by increasing teacher salaries. This was the most expensive of the policies analyzed, costing more than $870 per pupil to increase student scores by one percentile point.[47] To put this amount in perspective, consider that with the national average pupil teacher ratio at around 17:1, this amount equates to a difference of $14,790 per teacher; however, it is unlikely that the entire difference is attributable to teachers' salaries. As the researchers carefully note, "raising teacher salaries . . . probably implies salary increases for non-teaching professional staff and perhaps even support staff."[48]

Without further analysis, it is impossible to determine exactly what accounts for such a large cost. As indicated in Table 4, increasing average teacher salaries by $1,000 costs $148 per student, which with a pupil teacher ratio of 17:1 translates into $2,516 per teacher. If benefits cost around 25% of salary, then half of that amount must be attributable to increases in other areas that tend to be associated with higher teacher salaries. Clearly, the teacher salary variable only partly represents the cost of teachers and is partly a proxy for other expenses. Regardless, given the lack of significance in the achievement equations, the RAND analysis by itself does not support raising salaries to improve student performance.

Tennessee's Improving Pupil-Teacher Ratios

Fall	Ratio	Rank
1991	19.4	47th
1992	19.6	48th
1993	18.8	44th
1994	18.6	42nd
1995	16.7	26th
1996	16.5	26th
1997	16.5	28th
1998	15.3	21st

Source: U.S. Department of Education, Digest of Education Statistics (1995 through 1999) and Education Statistics Quarterly, Summer 2000.

Lower Pupil-Teacher Ratios Improve Performance

The RAND researchers evaluated the impact on achievement of two pupil-teacher ratio variables: the ratio for grades one through four and the ratio for grades five through eight. The former was the only variable that was significant in all five achievement equations. The latter was significant in only two models and had the opposite sign one would expect

[46] Ibid., Chapter 9 "Conclusions", pp. 104-108.

[47] Ibid., Table 8.3, p. 90. Costs presented here are expressed in terms of percentile points based on conversion of standard deviation units to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

[48] Ibid., Chapter 8 "Assessing the Cost-effectiveness of Different Resource Utilizations", p. 88.

(i.e., larger pupil teacher ratios predicted higher test scores) in all models. This result appeared to have occurred because of the high correlation between the two pupil-teacher variables. When the researchers substituted the combined ratio for grades one through eight for the two disaggregated variables, the coefficients were negative, as expected, but insignificant in two of the five models.[49]

Having determined that the most significant impact of lowering the pupil-teacher ratio was in grades one though four, the RAND researchers went on to analyze the differences for higher beginning pupil-teacher ratios and for three levels of socioeconomic status. Not surprisingly, the estimated effects were much larger for higher beginning class sizes and lower socioeconomic status. The predicted gains ranged from five to six percentile points for the lowest socioeconomic status states with the highest pupil-teacher ratios to no effects for higher socioeconomic status states.[50]

Table 7. Estimate of Additional Expenditures per Pupil to Raise Average Scores by One Percentile Point for States with Different Socioeconomic Status and Different Initial Pupil-teacher Ratios[51]

Change in Educational Resource Policy	State SES*		
	Low	**Medium**	**High**
Decrease in pupil-teacher ratio for grades one through four *from 26*	$30	$50	$75
Decrease in pupil-teacher ratio for grades one through four *from 23*	$40	$90	$180
Decrease in pupil-teacher ratio for grades one through four *from 20*	$60	>>$300	>>$300
Decrease in pupil-teacher ratio for grades one through four *from 17*	$130	>>$300	>>$300
Increase in percent of students participating in public pre-kindergarten	$35	$95	>>$300
Decrease in percent of teachers reporting that they have *some or none* of the resources they need	$25	$25	$25
Decrease in percent of teachers reporting that they have *most* of the resources they need	$30	$30	$30

** Socioeconomic status.*

Source: RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).

[49] Ibid., Tables 7.2 and 7.3, pp. 77 and 79, and accompanying text.

[50] Ibid., Table 7.4, p. 80, and accompanying text.

[51] Ibid., Table 8.5, p. 92. Costs presented here are expressed in terms of percentile points based on conversion of standard deviation units to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

The researchers went further, analyzing the cost-effectiveness of the three most significant policies in states with different initial pupil-teacher ratios. The estimated cost per pupil of gaining one percentile point by lowering the ratio ranged from as low as $30 in low socioeconomic status states with initial ratios of 26:1 or higher to more than $300 for medium and high status states with initial ratios of 20:1 or less. (Interestingly, the estimated cost of achievement gains by increasing teacher resources was lower in the model that evaluated different initial ratios than in the model that considered only the overall ratio—contrast Table 6 with Table 7.) The policy implications are clear: efforts to increase achievement by lowering class sizes will be most cost-effective at schools with higher beginning class sizes and lower socioeconomic status student populations.

More Teacher Resources Help All Students

Teachers are asked, as part of the data collection process for the National Assessment of Educational Progress, how well they are provided the instructional materials and the resources they need for teaching. The effects of two responses were evaluated: "I get most of the resources I need" and "I get some or none of the resources I need."[52] The percentage reporting the lower level was significant in three of the five achievement models. The percentage reporting the middle level of resources had comparable coefficients, but was insignificant in all models.[53]

Increasing teaching resources appeared to be equally cost-effective regardless of the socioeconomic status of the student population. The estimated cost per pupil to raise average scores by one percentile point by improving teaching resources was $30 if they were currently rated low and $40 if they were currently rated medium.[54] The cost was a bit lower ($25 and $30 per student) in the model that analyzed different initial pupil-teacher ratios.[55]

Public Pre-kindergarten Participation Pays Dividends

The percentage of students participating in public pre-kindergarten programs had a significant effect on achievement in three of the five socioeconomic status models. The results showed gains of one or two percentile points for each ten percentage-point increase in public pre-kindergarten participation.[56] Expanding public pre-kindergarten programs was identified as one of the three most efficient policy choices with a marginal cost of $12 per student for increasing participation one percentage point.[57] The researchers point out that that cost may be overstated because of the disproportionately high percentage of special education students currently participating in public pre-kindergarten.[58]

The cost of increasing average scores one percentile point by investing in public pre-kindergarten was estimated at between $70 and $120 per student.[59] However, the cost of a gain of one percentile point varied widely depending on states' socioeconomic status. The cost

[52] Ibid., Appendix F, "Variable Definitions", p. 193.

[53] Ibid, Table 7.2, p. 77, and accompanying text.

[54] Ibid., Table 8.4, p. 91.

[55] Ibid., Table 8.5, p. 92.

[56] Ibid., Table 7.2, p. 77 and accompanying text.

[57] Ibid., Table 8.2, p. 90.

[58] Ibid., footnote seven, p. 88.

[59] Ibid., Table 8.3, p. 90. Costs presented here are expressed in terms of percentile points based on conversion of standard deviation units to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

in low socioeconomic status states ($35 per student) was just over one-third the cost for states with medium socioeconomic status ($95 per student), which in turn was less than one-third the cost for states with high socioeconomic status student populations (more than $300 per student).[60]

Implications for Tennessee

RAND's analysis indicates that Tennessee is gaining in both math and reading—not just improving scores, but also moving up in the ranks. The RAND researchers based their analysis on math and reading tests given in 1990 through 1996. Reading was tested again in 1998 along with eighth grade writing, and Tennessee's performance was mixed—much better for writing than for reading. In fact, Tennessee's fourth graders lost all of the ground they had gained in reading in terms of state rankings between 1992 and 1996. (Comparisons of selected states are presented in Table 8; comparisons for all states are presented in the appendix.)

RAND's analysis of the cost-effectiveness of various education resource policies indicates that Tennessee is on the right track, but also suggests two specific areas for improvement: teachers' resources and public pre-kindergarten. Because RAND's work offers no real guidance in determining policy in teachers' salaries, no implications are suggested here.

Tennessee renewed its efforts to reform education in 1992 with the passage of the Education Improvement Act, which provided for improvements in two of the three policy areas found by RAND to be most cost-effective. The Act required the implementation of a funding formula to support the Basic Education Program, the hallmark of which was reducing class sizes at all grade levels. The new class size limits become effective on July 1, 2001—four years from the date on which the formula was first fully funded.[61] The new formula also explicitly funds classroom equipment, materials and supplies[62] and the Act further requires that $200 be allocated to each teacher to purchase instructional supplies. Half of that amount is to be spent as the teacher sees fit and the other half must be pooled within a school and spent as determined by a committee of teachers in that school.[63]

[60] Ibid., Table 8.4, p. 91. Costs presented here are expressed in terms of percentile points based on conversion of standard deviation units to percentile scores per discussion with author (0.10 standard units equal 3.4 percentile points).

[61] Public Chapter 535, Section 37, Acts of 1992; codified at Tennessee Code Annotated, §49-1-104(a).

[62] Tennessee State Board of Education, *Tennessee Basic Education Program, BEP 2000-2001*, Nashville, TN: 2000. [http://www.state.tn.us/sbe/bep.htm]

[63] Public Chapter 535, Section 3, Acts of 1992; codified at Tennessee Code Annotated, §49-3-359(a).

Table 8. Achievement Scores and Rankings on the 1992 through 1998 Reading and Writing Components of the National Assessment of Educational Progress, Tennessee and Selected States

State	4th Grade Reading[64]						8th Grade 1998			
	1992		1994		1998		Reading[61]		Writing[65]	
National Mean	215		212		215		261		148	
New Hampshire	***228***	***1***	223	3	226	3	n/a		n/a	
Maine	227	2	***228***	***1***	225	5	***273***	***1***	155	3
Connecticut	222	7	222	6	***232***	***1***	272	2	***165***	***1***
Virginia	221	9[a]	213	15[a]	218	15	266	10	153	6
Missouri	220	10[a]	217	11	216	20	263	16	142	26
West Virginia	216	15[a]	213	18	216	22	262	21	144	21
Kentucky	213	20[a]	212	20	218	14	262	19[a]	146	17[a]
Tennessee	**212**	**21[a]**	**213**	**14**	**212**	**26**	**259**	**24**	**148**	**13**
Georgia	212	21[a]	207	25	210	29	257	26	146	20
North Carolina	212	21[a]	214	13	217	18[a]	264	14[a]	150	9[a]
Arkansas	211	26[a]	209	23	209	31	256	28[a]	137	32
South Carolina	210	27	203	30	210	30	255	30[a]	140	30
Florida	208	29	205	28[a]	207	34	253	32[a]	142	27
Alabama	207	30	208	24	211	28	255	30[a]	144	22[a]
Louisiana	204	31	197	34	204	36[a]	252	34	136	33
Mississippi	199	34	202	31	204	36[a]	251	35	134	35
District of Columbia	***188***	***35*** [b]	***179***	***35*** [b]	***182***	***40*** [b]	***236***	***37*** [b]	***126***	***36*** [b]
Number of States	35		35		40		37		36	

Notes: *a. Tied.*
b. Lowest rank for year and subject.

Source: *RAND, "Improving Student Achievement: What State NAEP Test Scores Tell Us" (July 2000).*

The new formula did not, however, provide for the other policy found by RAND to be one of the three most cost-effective: public pre-kindergarten. This may be the next best policy to implement. A more specific analysis of the implications for these policies based on RAND's work follows:

[64] U.S. Department of Education, National Center for Education Statistics, "NAEP 1998 Reading Report Card for the Nations and States", March 1999 [http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=1999500].
[65] U.S. Department of Education, "National Center for Education Statistics, "NAEP 1998 Writing Report Card for the Nation and the States", September 1999 [http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=1999462].

Tennessee's Lower Class Sizes Should Improve Performance

The new law requires class sizes to be reduced by five students at every grade level except fourth, for which the reduction is three. Vocational class sizes were also reduced by three.

Table 9. Class-size Requirements Before and After Passage of the Education Improvement Act

Class	Old Requirements[66]		New Requirements[67]	
	Without Waivers	With Waivers	School-wide Averages	Individual Class Maximums
Kindergarten through Grade Three	25	28	20	25
Grade Four	28	31	25	30
Grades Five and Six	30	33	25	30
Grades Seven through Twelve	35	39	30	35
Vocational	23	25	20	25

Class size requirements do not translate directly into pupil-teacher ratios because the latter includes instructional staff other than classroom teachers, such as music and reading teachers in the elementary grades.[68] Because teachers not identified with a particular class are included in the pupil-teacher ratios, those ratios are generally lower than the class sizes shown here. Nevertheless, if the average change in class size requirements is used as a proxy for the change in the pupil teacher ratio for Tennessee, then the reduction produced by the new requirement would be about 4½ students per teacher based on the average daily membership for the 1999-2000 school year.

Tennessee's pupil-teacher ratio, at 19.6:1, was the fourth highest in the nation in 1992.[69] Lowering the ratio by one student in grades one through four was estimated to produce an achievement gain of about three quarters of a percentile point.[70] If the pupil-teacher ratio in Tennessee were lowered as much as the class sizes must be, then the gain could be as much as three or four percentile points on the tests analyzed by RAND. Based on the study, any future investment in further reducing class size should be focused on the lower grades. One caveat that bears attention is that the cost-effectiveness of reducing pupil-teacher ratios

[66] Rules and Regulations, State of Tennessee, Chapter 0520, Rule 0520-1-3-.03(3). Ten percent waiver granted upon request. [http://www.state.tn.us/sos/rules/0520/0520.htm]

[67] Public Chapter 535, Section 37, Acts of 1992; codified at Tennessee Code Annotated, §49-1-104(a).

[68] For that reason, pupil-teacher ratios should not be interpreted as average class size. U.S. Department of Education , National Center for Education Statistics, "Public School Student, Staff, and Graduate Counts by State: School Year 1998-90", *Education Statistics Quarterly*, Volume 2, Issue 2, NCES 2000-606. Washington, D.C: Summer 2000. [http://nces.ed.gov/pubs2000/quarterly/summer/2feat/q2-6.html]

[69] U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 65, Washington, D.C.: 1995. [http://nces.ed.gov/pubsold/D95/dtab065.html]

[70] Grissmer, Table 7.2 and accompanying text, pp. 77-78.

declines as the ratios decline so that the cost of raising achievement levels even in low socioeconomic states more than doubles when the starting point is 17:1 instead of 20:1.[71]

Teacher Resources Have Improved But More May be Needed

The other issue in the RAND report that corresponds to a change brought about by the Education Improvement Act is the availability of instructional materials and other resources for teaching. Great strides have been made since the implementation of the Basic Education Program, but there is room for improvement. According to a report issued in October by the Educational Testing Service, improvement may be essential to continued efforts to reform education. According to the ETS report, students whose teachers provide hands on learning activities outperform their peers by about 70 percent in math and 40 percent in science.[72]

> ***Availability of Teaching Resources***
>
> *–1998 teacher ratings from NAEP*
>
> **4th Grade Reading Teachers**
>
> - 12% say "I get all I need"
> - 52% say "I get most of what I need"
> - 36% say "I get some of what I need"
>
> **8th Grade Writing Teachers**
>
> - 13% say "I get all I need"
> - 46% say "I get most of what I need"
> - 40% say "I get some of what I need"

Based on the survey of teachers that is part of the National Assessment of Educational Progress, clear conclusions about Tennessee teachers' opinions on the availability of resources for teaching are hard to draw. For example, the percentage of fourth grade teachers whose students took the reading test and who reported that they received all or most of the resources they needed improved from 1992 to 1998, but so did the percentages in most other states. As a result, Tennessee fell in the rankings. The percentage reporting that they received all or most of the resources they needed increased from fifty percent to sixty-four percent between 1992 and 1998, but Tennessee's rank fell from 27th of 35 to 33rd of 40.[73]

While the statistics on the availability of resources seem to convey some good news about instructional materials, Tennessee teachers' responses to questions from the 1996 National Assessment of Educational Progress math and science tests indicate some serious gaps remain in those areas. When those teachers were asked about hands-on activities, the kind considered critical to student learning, their answers indicated that many Tennessee students have limited experiences of that kind. As with the responses to questions about the availability of teaching resources, there have been some improvements, but based on the ETS report, those efforts should continue.

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[71] Ibid., Table 8.5, p. 92.

[72] Wenglinsky, Harold, *How Teaching Matters: Bringing the Classroom Back into Discussions of Teacher Quality*, Princeton, NJ: Educational Testing Service, October 2000. [http://www.ets.org/research/pic/teamat.pdf]

[73] From the U.S. Department of Education, National Assessment of Educational Progress, web site [http://nces.ed.gov/nationsreportcard/TABLES/SDTTOOL.HTM] NAEP 1998, 1994, and 1992 National and State Reading Summary Data Tables for Grade 4 Teacher Data (NAEP ID: T041201) Availability of Resources, Teacher Background and Education Question 49.

> ***Use of "Hands On" Activities***
>
> *–1996 teacher ratings from NAEP*
>
> **4th Grade Math Teachers**
>
> - 12% never use rulers—59% use them only once or twice a month
> - 31% never use blocks or shapes—53% use them only once or twice a month
> - 43% never use calculators—39% use them only once or twice a month
>
> **8th Grade Math Teachers**
>
> - 31% never use rulers—49% use them only once or twice a month
> - 73% never use blocks or shapes—25% use them only once or twice a month
> - 23% never use calculators—30% use them only once or twice a month
>
> **8th Grade Science Teachers**
>
> - 14% never do hands-on activities—47% do them only once or twice a month
> - 19% never talk about hands-on activities—46% do so only once or twice a month

Based on figures provided by the Tennessee Department of Education, the amount spent on instructional materials and supplies increased from about $27.66 per student to $57.25 between 1992 and 1999. This approximately $30 increase, based on RAND's estimates could be expected to produce an increase in achievement of about one percentile point. If instructional equipment is included, however, the increase comes closer to $80 (the $30 dollar increase in materials and supplies plus the difference between $22.97 and $73.65 for equipment), which could mean an improvement of as much as 2.5 percentile points.

The figures quoted in the previous paragraph include only expenditures from governmental revenues. They do not include funds raised by students or contributed by parents at individual schools. Those funds are recorded separately in special accounts kept at the schools. However, while they are not included in the figures quoted above, they are included in the figures reported to the U.S. Department of Education. According to the latest available data on their web site Tennessee ranks second in the nation, behind only the District of Columbia, in expenditures for instructional supplies from all sources of funds. According to the data made available for fiscal year 1996-97 on the USDE web site, Tennessee spent $269 per student compared to the national average of $152 per student. However, that figure includes about $166 per student in student activity fund revenue that was reported as having been spent on instructional supplies. The average amount raised by other states and the District of Columbia fom student activities was less than $50 per student. Tennessee ranked 3rd in the nation behind only Iowa and Nebraska. Without student-raised or parent-contributed funds, Tennessee would have spent only $103 per student and ranked 50th in expenditures for instructional supplies.[74]

Tennessee Could Benefit from a Public Pre-kindergarten Program

Early childhood education has been part of the State Board's Master Plan since 1990; however, the state has been able to make little progress toward providing it. According to the Board's analysis, about 45,000 three- and four-year-olds are in need of some kind of formal early childhood education (basically those eligible for Head Start) and 12,000 of those children are not being served.[75] Head Start serves only about 30% of eligible children in Tennessee and the

[74] http://nces.ed.gov/ccd/stfis.html.

[7575] Tennessee State Board of Education, "Master Plan For Tennessee Schools: Preparing For The 21st Century 2000", p. 5. [http://www.state.tn.us/sbe/master.htm] state's early childhood program will only serve an additional 1,200 unless additional funds can be freed up from the Temporary Assistance to Needy Families (TANF) program.[76]

RAND's work indicates that Tennessee stands to gain much by implementing a pre-kindergarten program. Based on the State Board's Early Childhood Policy and the current-year Basic Education Program formula, serving all four-year-olds could cost as much as $300 million. This amount is about $320 per pupil, which based on RAND's results, corresponds to a 3.5 percentage point increase in achievement for states with middle of the range socioeconomic status. It is almost three times the amount that has been found to produce the same amount of improvement in low socioeconomic states, in which the same increase in expenditures for pre-kindergarten could be expected to produce a nine percentile point increase in achievement.

> Pre-K Program
>
> **RAND's work indicates that Tennessee stand to gain much by implementing a pre-kindergarten program.**

Many of the approximately 70,000 four-year-olds[77] in Tennessee are already in pre-kindergarten programs, either Head Start, the new state pilot project, special education or private programs. The RAND analysis clearly indicates that a public pre-kindergarten program targeted at children from lower socioeconomic status families could be a very cost-effective means of improving average test scores. Based on the estimate of $300 million to serve all four-year-olds, serving even one-third of them would cost around $100 million. If that one-third were students from families of lower socioeconomic status, the result could be the 3.5 percentile point increase projected by RAND for low socioeconomic states, making this one of the more cost-effective policy options identified.

Effects of Changes in Education Policy Take Time

Because it requires thirteen years for the typical child to progress through school, the full effects of most changes in education policy are not evident until that amount of time has passed, that is until all students in public schools have had the opportunity to benefit from the new policies throughout their tenure in school. Effects on test scores in the lower grades will show up earlier, and the policy changes can begin to be evaluated then. The RAND researchers acknowledged the time lag, for example, by basing their analysis of fourth grade performance on the percentage participation in pre-kindergarten four years earlier and the average pupil-teacher ratios for kindergarten through fourth grade over the years those students were in those grades.

Tennessee students will not reap the full benefit of the class-size reductions required by the Education Improvement Act until all have experienced only the new, smaller classes throughout their student career. Likewise, the full effect of pre-kindergarten programs requires fourteen years. Nevertheless, given the significant effect on student test scores found by RAND, both policies look like sound investments. And while the full effects may require thirteen or fourteen years, progress can be monitored throughout that time and smaller, but increasing, benefits should be evident within a few years of implementation.

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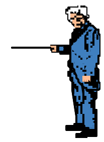
[76] Per direct correspondence with Jan Bushing, Director of Early Childhood Education, Tennessee Department of Education.

[77] An estimate based on the number of kindergarten students in public schools.

Appendices



Appendix 1: National Assessment of Education Progress—Unadjusted Achievement Rankings and Achievement and Gains Adjusted for Socioeconomic Status, 1990 through 1996

Appendix 2: National Assessment of Education Progress—Grade 8 Math, 1990, 1992 and 1996

Appendix 3: National Assessment of Educational Progress—Grade 4 Math, 1992 and 1996

Appendix 4: National Assessment of Education Progress—Grade 4 Reading Composite, 192, 1994 and 1998

Appendix 5: National Assessment of Education Progress—Grade 8 Reading Composite, 1998

Appendix 6: National Assessment of Education Progress—Grade 8 Writing, 1998

Appendix 7: Teachers, students and pupil-teacher ratios in public elementary schools, by state: Fall 1991 to Fall 1998

Appendix 1: National Assessment of Educational Progress—Unadjusted Achievement Rankings and Achievement and Gains Adjusted for Socioeconomic Status, 1990 through 1996

State	Achievement Rank		Adjusted Gain Rank	
	Unadjusted	Adjusted	All Tests	Math Only
Alabama	41	40	20[a]	22[a]
Arizona	33	20	20[a]	18[a]
Arkansas	39	37	28[a]	21
California	42	44[b]	10[a]	13[a]
Colorado	20	22	15	7[a]
Connecticut	10	11	7[a]	7[a]
Delaware	32	33	28[a]	34
Florida	37	29	7[a]	12
Georgia	36	13	36[a]	35
Idaho	14	25	n/a	n/a
Indiana	16	7	4[a]	4
Iowa	3	4	24	29
Kentucky	31	36	7[a]	7[a]
Louisiana	43	43	22[a]	22[a]
Maine	1[a]	5	18[a]	31
Maryland	29	32	6	5
Massachusetts	9	17	32	28
Michigan	22	18	3	3
Minnesota	7	16	4[a]	7[a]
Mississippi	44[b]	42	26[a]	25
Missouri	19	10	33[a]	30
Montana	5	3	n/a	n/a
Nebraska	8	9	10[a]	18[a]
New Hampshire	4	21	n/a	n/a
New Jersey	11	8	18[a]	13[a]
New Mexico	38	27	22[a]	24
New York	28	31	12	15[a]
North Carolina	34	23	1	1
North Dakota	1[a]	6	26[a]	32
Ohio	25	26	n/a	n/a
Oklahoma	23	12	n/a	n/a
Oregon	17	30	n/a	n/a
Pennsylvania	18	19	33[a]	27

Appendix 1: continued

State	Achievement Rank		Adjusted Gain Rank	
	Unadjusted	Adjusted	All Tests	Math Only
Rhode Island	26	39	16[a]	7[a]
South Carolina	40	28	16[a]	17
Tennessee	**35**	**35**	**25**	**18[a]**
Texas	27	1	2	2
Utah	15	34	35	32
Vermont	13	38	n/a	n/a
Virginia	24	14	28[a]	26
Washington	21	24	n/a	n/a
West Virginia	30	41	13[a]	6
Wisconsin	6	2	13[a]	15[a]
Wyoming	12	15	31	36[b]

a = tied with another state
b = ranked last
Source: RAND, "*Improving Student Achievement: What State NAEP Test Scores Tell Us"* (July 2000).

Appendix 2: National Assessment of Educational Progress— Grade 8 Math, 1990, 1992 and 1996*

	1990		1992		1996	
	Average Scale Score	Rank**	Average Scale Score	Rank**	Average Scale Score	Rank**
Nation	263		268		272	
Northeast Region	270	1	270	2	278	1
Southeast Region	255	4	261	4	266	4
Central Region	266	2	275	1	277	2
West Region	261	3	268	3	269	3
Alabama	253	27	252	33	257	38
Alaska					278	*10*
Arizona	260	*17*	265	*18*	268	*25*
Arkansas	256	*22*	256	32	262	*34*
California	256	*22*	261	*23*	263	*31*
Colorado	267	*10*	272	11	276	*13*
Connecticut	270	9	274	8	280	8
Delaware	261	*14*	263	21	267	*27*
District of Columbia	**231**	**31**	**235**	**36**	**233**	**41**
Florida	255	26	260	*25*	264	30
Georgia	259	19	259	27	263	*31*
Hawaii	251	28	257	31	262	*34*
Indiana	267	*10*	270	13	276	*13*
Iowa	278	3	**283**	***1***	**284**	***1***
Kentucky	257	21	262	22	267	*27*
Louisiana	246	30	250	34	252	39
Maine			279	4	**284**	***1***
Maryland	261	*14*	265	*18*	270	*20*
Massachusetts			273	10	278	*10*
Michigan	264	*12*	267	15	273	*18*
Minnesota	275	*5*	282	3	**284**	***1***
Mississippi			247	35	250	40
Missouri			271	12	273	*18*
Montana	**281**	***1***			283	*5*
Nebraska	276	4	278	*5*	283	*5*
New Mexico	256	*22*	260	*25*	262	*34*
New York	261	*14*	266	*16*	270	*20*
North Carolina	250	29	258	30	268	*25*
North Dakota	**281**	***1***	**283**	***1***	**284**	***1***
Oregon	271	8			276	*13*

Appendix 2: continued

	1990		1992		1996	
	Average Score Scale	**Rank****	**Average Score Scale**	**Rank****	**Average Score Scale**	**Rank**
Rhode Island	260	*17*	266	*16*	269	24
South Carolina			261	*23*	261	37
Tennessee			259	27	263	*31*
Texas	258	20	264	20	270	*20*
Utah			274	8	277	12
Vermont					279	9
Virginia	264	*12*	268	14	270	*20*
Washington					276	*13*
West Virginia	256	*22*	259	27	265	29
Wisconsin	275	*5*	278	*5*	283	*5*
Wyoming	272	7	275	7	275	17

** Includes only states that participated in 1996. Bold indicates highest and lowest rank.*
*** Italics indicate a tie.*
Source: U. S. Department of Education, National Center for Education Statistics.

Appendix 3: National Assessment of Educational Progress—Grade 4 Math, 1992 and 1996*

	1992		1996	
	Average Scale Score	**Rank****	**Average Scale Score**	**Rank****
Nation	220		224	
Northeast Region	224	2	228	2
Southeast Region	212	4	218	4
Central Region	224	1	231	1
West Region	219	3	220	3
Alabama	208	*34*	212	40
Alaska			224	*20*
Arizona	215	23	218	*31*
Arkansas	210	33	216	*33*
California	208	*34*	209	*41*
Colorado	221	*14*	226	*13*
Connecticut	227	*7*	**232**	***1***
Delaware	218	*18*	215	*36*
District of Columbia	**193**	**38**	**187**	**44**
Florida	214	*27*	216	*33*
Georgia	216	22	216	*33*
Hawaii	214	*27*	215	*36*
Indiana	221	*14*	229	*6*
Iowa	230	*2*	229	*6*
Kentucky	215	23	220	*28*
Louisiana	204	36	209	*41*
Maine	**232**	**1**	**232**	***1***
Maryland	217	21	221	*27*
Massachusetts	227	*7*	229	*6*
Michigan	220	17	226	*13*
Minnesota	229	*3*	**232**	***1***
Mississippi	202	37	208	43
Missouri	222	13	225	*16*
Montana			228	10
Nebraska	228	*6*	225	*16*
Nevada			218	*31*
New Jersey	227	*7*	227	*11*
New Mexico	213	*29*	214	38
New York	218	*18*	223	*23*
North Carolina	213	*29*	224	*20*
North Dakota	229	*3*	231	*4*
Oregon			224	*20*
Pennsylvania	224	*11*	226	*13*

Appendix 3: continued

Rhode Island	215	23	220	*28*
South Carolina	213	*29*	213	39
Tennessee	211	32	219	30
Texas	218	*18*	229	*6*
Utah	224	*11*	227	*11*
Vermont			225	*16*
Virginia	221	*14*	223	*23*
Washington			225	*16*
West Virginia	215	23	223	*23*
Wisconsin	229	*3*	231	*4*
Wyoming	225	10	223	*23*

** Includes only states that participated in 1996. Bold indicates highest and lowest rank.*
*** Italics indicate a tie.*
Source: U. S. Department of Education, National Center for Education Statistics.

Appendix 4: National Assessment of Educational Progress—Grade 4 Reading Composite, 1992, 1994 and 1998*

	1992		1994		1998	
	Average Scale Score	Rank**	**Average Scale Score**	**Rank****	**Average Scale Score**	**Rank****
Nation	215		212		215	
Northeast Region	220		212		225	
Southeast Region	211		208		210	
Central Region	218		218		220	
West Region	212		212		210	
Alabama	207	30	208	24	211	28
Arizona	209	28	206	26	207	33
Arkansas	211	*26*	209	23	209	31
California	202	33	197	33	202	38
Colorado	217	*14*	213	17	222	10
Connecticut	222	7	222	6	**232**	**1**
Delaware	213	*20*	206	27	212	27
District of Columbia	**188**	**35**	**179**	**35**	**182**	**40**
Florida	208	29	205	*28*	207	34
Georgia	212	*21*	207	25	210	29
Hawaii	203	32	201	32	200	39
Iowa	225	4	223	*4*	223	7
Kansas					222	*8*
Kentucky	213	*20*	212	20	218	14
Louisiana	204	31	197	34	204	*36*
Maine	227	2	**228**	**1**	225	5
Maryland	211	*26*	210	22	215	23
Massachusetts	226	3	223	*4*	225	4
Michigan	216	*15*			217	17
Minnesota	221	*9*	218	10	222	*8*
Mississippi	199	34	202	31	204	*36*
Missouri	220	*10*	217	11	216	20
Montana			222	7	226	2
Nevada					208	32
New Hampshire	**228**	**1**	223	3	226	3
New Mexico	211	*26*	205	*28*	206	35
New York	215	17	212	21	216	21
North Carolina	212	*21*	214	13	217	*18*
Oklahoma	220	*10*			220	11
Oregon					214	25

Appendix 4: continued

	1992		1994		1996	
	Average Score Scale	**Rank****	**Average Score Scale**	**Rank****	**Average Score Scale**	**Rank****
Rhode Island	217	*14*	220	9	218	13
South Carolina	210	27	203	30	210	30
Tennessee	212	*21*	213	14	212	26
Texas	213	*20*	212	19	217	16
Utah	220	*10*	217	12	215	24
Virginia	221	*9*	213	*15*	218	15
Washington			213	*15*	217	*18*
West Virginia	216	*15*	213	18	216	22
Wisconsin	224	5	224	2	224	6
Wyoming	223	6	221	8	219	12

** Includes only states that participated in 1998. Bold indicates highest and lowest rank.*
*** Italics indicate a tie.*
Source: U. S. Department of Education, National Center for Education Statistics.
http://nces.ed.gov/nationsreportcard/reading/reading.asp

Appendix 5: National Assessment of Educational Progress— Grade 8 Reading Composite, 1998*

	Average Scale Score	Rank**
Nation	261	
Northeast Region	267	1
Southeast Region	258	3
Central Region	266	2
West Region	257	4
Alabama	255	*30*
Arizona	261	23
Arkansas	256	*28*
California	253	*32*
Colorado	264	*14*
Connecticut	272	2
Delaware	256	*28*
District of Columbia	**236**	**37**
Florida	253	*32*
Georgia	257	26
Hawaii	250	36
Kansas	268	5
Kentucky	262	*19*
Louisiana	252	34
Maine	**273**	**1**
Maryland	262	17
Massachusetts	269	4
Minnesota	267	6
Mississippi	251	35
Missouri	263	16
Montana	270	3
Nevada	257	27
New Mexico	258	25
New York	266	*7*
North Carolina	264	*14*
Oklahoma	265	*11*
Oregon	266	9
Rhode Island	262	22
South Carolina	255	*30*
Tennessee	259	24
Texas	262	18
Utah	265	13
Virginia	266	10
Washington	265	*11*
West Virginia	262	21
Wisconsin	266	*7*
Wyoming	262	*19*

** Bold indicates highest and lowest rank.*

*** Italics indicate a tie.*

Source: U. S. Department of Education, National Center for Education Statistics.

http://nces.ed.gov/nationsreportcard/reading/reading.asp

Appendix 6: National Assessment of Educational Progress—Grade 8 Writing, 1998*

	Average Scale Score	Rank**
Nation	148	
Northeast Region	153	1
Southeast Region	143	4
Central Region	153	1
West Region	145	3
Alabama	144	*22*
Arizona	143	24
Arkansas	137	32
California	141	28
Colorado	151	8
Connecticut	**165**	**1**
Delaware	144	*22*
District of Columbia	**126**	**36**
Florida	142	27
Georgia	146	20
Hawaii	135	34
Kentucky	146	*17*
Louisiana	136	33
Maine	155	3
Maryland	147	16
Massachusetts	155	2
Minnesota	148	12
Mississippi	134	35
Missouri	142	26
Montana	150	*9*
Nevada	140	31
New Mexico	141	29
New York	146	*17*
North Carolina	150	*9*
Oklahoma	152	7
Oregon	149	11
Rhode Island	148	15
South Carolina	140	30
Tennessee	148	13
Texas	154	4
Utah	143	25
Virginia	153	6
Washington	148	14
West Virginia	144	21
Wisconsin	153	5
Wyoming	146	19

** Bold indicates highest and lowest rank.*
*** Italics indicate a tie.*
Source: U. S. Department of Education, National Center for Education Statistics.
http://nces.ed.gov/nationsreportcard/writing/writing.asp

Appendix 7: Teachers, students, and pupil-teacher ratios in public elementary and secondary schools, by state: Fall 1991 to Fall 1998

	Fall 1991				Fall 1998				Fall 1991 to Fall 1998 Change in					
	Teachers	Students*	Pupil-teacher ratio	Rank	Teachers	Students*	Pupil-teacher ratio	Rank	Teachers	Rank	Students*	Rank	Pupil-teacher ratio	Rank
United States	2,432,243	42,046,878	17.3		2,826,146	46,534,687	16.5		16.2%		10.7%		-4.6%	
Alabama	40,480	722,004	17.8	38	47,753	747,970	15.7	25	18.0%	12	3.6%	37	-11.8%	3
Alaska	7,118	118,680	16.7	23	8,118	135,373	16.7	37	14.0%	27	14.1%	12	0.0%	43
Arizona	33,978	656,980	19.3	46	42,352	848,262	20.0	47	24.6%	5	29.1%	2	3.6%	48
Arkansas	25,785	438,518	17.0	30	27,953	452,256	16.2	32	8.4%	39	3.1%	40	-4.7%	26
California	224,000	5,107,145	22.8	50	281,686	5,925,964	21.0	50	25.8%	4	16.0%	6	-7.9%	13
Colorado	33,093	593,030	17.9	40	39,434	699,135	17.7	41	19.2%	9	17.9%	5	-1.1%	39
Connecticut	34,383	481,050	14.0	5	38,772	544,698	14.0	7	12.8%	28	13.2%	15	0.0%	44
Delaware	6,095	102,196	16.8	25	7,074	113,262	16.0	29	16.1%	17	10.8%	16	-4.8%	25
District of Columbia	6,346	80,618	12.7	**1**	5,187	71,889	13.9	*5*	-18.3%	**51**	-10.8%	**51**	9.4%	**51**
Florida	109,939	1,932,131	17.6	37	126,796	2,337,633	18.4	44	15.3%	21	21.0%	3	4.5%	49
Georgia	63,816	1,177,569	18.5	41	88,658	1,401,291	15.8	27	38.9%	2	19.0%	4	-14.6%	2
Hawaii	9,451	174,747	18.5	42	10,639	188,069	17.7	42	12.6%	30	7.6%	29	-4.3%	27
Idaho	11,626	225,680	19.4	48	13,426	244,722	18.2	43	15.5%	20	8.4%	24	-6.2%	19
Illinois	110,153	1,848,166	16.8	27	121,758	2,011,530	16.5	35	10.5%	34	8.8%	21	-1.8%	36
Indiana	54,509	956,988	17.6	36	58,084	988,094	17.0	40	6.6%	40	3.3%	39	-3.4%	30
Iowa	31,395	491,363	15.7	18	32,822	498,214	15.2	*18*	4.5%	44	1.4%	43	-3.2%	32
Kansas	29,324	445,390	15.2	10	32,003	472,353	14.8	17	9.1%	36	6.1%	33	-2.6%	34
Kentucky	37,571	646,024	17.2	32	40,803	655,687	16.1	30	8.6%	37	1.5%	42	-6.4%	16
Louisiana	46,170	794,128	17.2	33	49,124	768,734	15.6	24	6.4%	42	-3.2%	48	-9.3%	8
Maine	15,416	216,400	14.0	4	15,890	210,503	13.2	2	3.1%	47	-2.7%	46	-5.7%	22
Maryland	43,616	736,238	16.9	29	49,840	841,671	16.9	38	14.3%	25	14.3%	11	0.0%	45
Massachusetts	55,963	846,155	15.1	9	69,752	962,317	13.8	*3*	24.6%	6	13.7%	14	-8.6%	10
Michigan	82,967	1,593,561	19.2	45	93,220	1,720,266	18.5	45	12.4%	31	8.0%	28	-3.6%	29

Appendix 7: continued

	Fall 1991				Fall 1998				Fall 1991 to Fall 1998 Change in					
	Teachers	Students*	Pupil-teacher ratio	Rank	Teachers	Students*	Pupil-teacher ratio	Rank	Teachers	Rank	Students*	Rank	Pupil-teacher ratio	Rank
Minnesota	44,903	773,571	17.2	31	50,565	855,119	16.9	39	12.6%	29	10.5%	18	-1.7%	37
Mississippi	28,111	504,127	17.9	39	31,140	502,379	16.1	31	10.8%	32	-0.3%	45	-10.1%	5
Missouri	52,643	842,965	16.0	22	62,222	912,445	14.7	16	18.2%	11	8.2%	25	-8.1%	12
Montana	9,883	155,779	15.8	21	10,221	159,988	15.7	26	3.4%	45	2.7%	41	-0.6%	41
Nebraska	19,069	279,552	14.7	7	20,310	291,140	14.3	*11*	6.5%	41	4.1%	36	-2.7%	33
Nevada	11,409	211,810	18.6	43	16,415	311,061	18.9	46	43.9%	**1**	46.9%	**1**	1.6%	47
New Hampshire	11,464	177,138	15.5	14	13,290	204,713	15.4	22	15.9%	18	15.6%	7	-0.6%	40
New Jersey	80,515	1,109,796	13.8	3	92,264	1,268,996	13.8	*3*	14.6%	23	14.3%	9	0.0%	46
New Mexico	17,498	308,667	17.6	35	19,981	328,753	16.5	36	14.2%	26	6.5%	32	-6.3%	18
New York	171,914	2,643,993	15.4	13	197,253	2,877,143	14.6	15	14.7%	22	8.8%	22	-5.2%	23
North Carolina	65,326	1,097,598	16.8	24	79,531	1,254,821	15.8	28	21.7%	8	14.3%	10	-6.0%	20
North Dakota	7,733	118,376	15.3	12	7,974	114,597	14.4	*13*	3.1%	46	-3.2%	47	-5.9%	21
Ohio	103,372	1,783,767	17.3	34	113,986	1,842,559	16.2	33	10.3%	35	3.3%	38	-6.4%	17
Oklahoma	37,650	588,263	15.6	16	40,886	628,492	15.4	23	8.6%	38	6.8%	31	-1.3%	38
Oregon	26,745	498,614	18.6	44	27,152	542,809	20.0	48	1.5%	49	8.9%	20	7.5%	50
Pennsylvania	100,475	1,692,797	16.8	26	111,065	1,816,414	16.4	34	10.5%	33	7.3%	30	-2.4%	35
Rhode Island	9,709	142,144	14.6	6	11,124	154,785	13.9	*5*	14.6%	24	8.9%	19	-4.8%	24
South Carolina	37,115	627,470	16.9	28	43,689	664,592	15.2	*18*	17.7%	13	5.9%	34	-10.1%	4
South Dakota	8,868	131,576	14.8	8	9,273	132,495	14.3	*11*	4.6%	43	0.7%	44	-3.4%	31
Tennessee	**43,062**	**833,651**	**19.4**	**47**	**59,258**	**905,442**	**15.3**	**21**	**37.6%**	**3**	**8.6%**	**23**	**-21.1%**	**1**
Texas	219,192	3,464,371	15.8	20	259,739	3,945,367	15.2	*18*	18.5%	10	13.9%	13	-3.8%	28
Utah	18,305	456,430	24.9	**51**	21,501	481,176	22.4	51	17.5%	15	5.4%	35	-10.0%	6
Vermont	7,031	97,137	13.8	2	8,221	105,120	12.8	**1**	16.9%	16	8.2%	26	-7.2%	14
Virginia	64,537	1,016,204	15.7	17	79,393	1,124,022	14.2	*8*	23.0%	7	10.6%	17	-9.6%	7
Washington	42,931	869,327	20.2	49	49,671	998,053	20.1	49	15.7%	19	14.8%	8	-0.5%	42

Appendix 7: continued

	Fall 1991				Fall 1998				Fall 1991 to Fall 1998 Change in					
	Teachers	Students*	Pupil-teacher ratio	Rank	Teachers	Students*	Pupil-teacher ratio	Rank	Teachers	Rank	Students*	Rank	Pupil-teacher ratio	Rank
West Virginia	20,997	320,249	15.3	11	20,989	297,530	14.2	*8*	0.0%	50	-7.1%	50	-7.2%	15
Wisconsin	52,028	814,671	15.7	19	61,176	879,542	14.4	*13*	17.6%	14	8.0%	27	-8.3%	11
Wyoming	6,564	102,074	15.6	15	6,713	95,241	14.2	*8*	2.3%	48	-6.7%	49	-9.0%	9

** Student counts are fall enrollment for 1991 and fall membership for 1998.*

Source: U.S. Department of Education, National Center for Education Statistics, Common Core of Data surveys.

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