

2000 New Teachers

Where Are They Needed Most?





An Issue Paper Prepared by

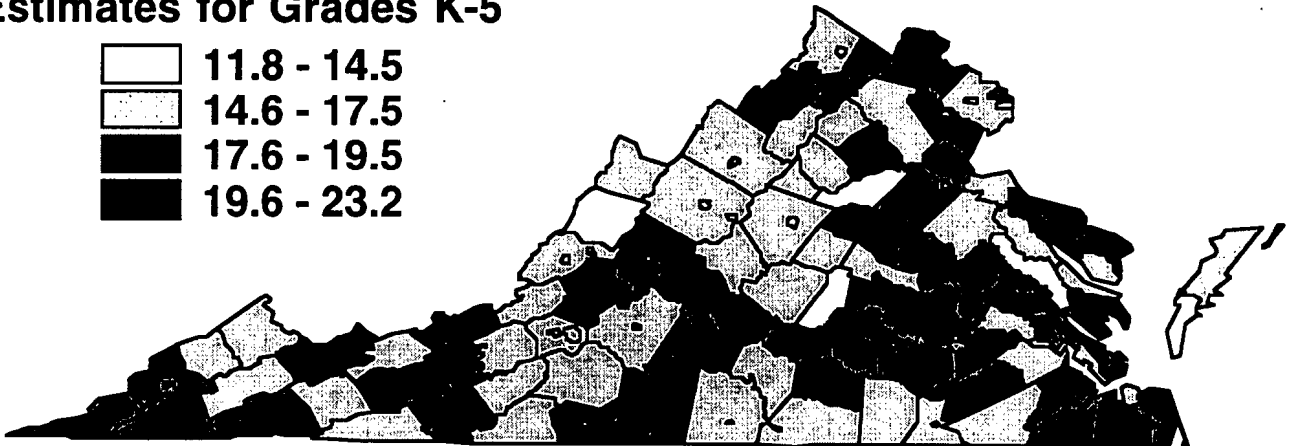
I. David Wheat, Jr.

for the

Thomas Jefferson Institute for Public Policy

Pupil-Teacher Ratio Estimates for Grades K-5

	11.8 - 14.5
	14.6 - 17.5
	17.6 - 19.5
	19.6 - 23.2



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Foreword

This Issue Paper is part of a series of thought provoking essays published by the Thomas Jefferson Institute for Public Policy and distributed to the Executive Branch, General Assembly, media and other leaders in Virginia.

These Issue Papers cover important topics of the day and focus attention on creative and workable alternatives to current public policy issues. The ideas presented in this on-going series are those of the authors and do not necessarily reflect the opinions of the Thomas Jefferson Institute for Public Policy or its Board of Directors.

This particular Issue Paper entitled, “*2000 New Teachers – Where Are They Needed Most?*” is part of four education-oriented essays that will be published over the next few weeks. The author, David Wheat, wrote the much-talked-about study for the Thomas Jefferson Institute, “*Understanding Virginia's Report Card – Why Standardized Test Scores Vary from One Community to Another.*”

Other studies and Issue Papers published by the Thomas Jefferson Institute for Public Policy include:

A Tax Reform Agenda for Virginia
A Brief Review of the Fairfax County Budget for Fiscal Year '98
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Vision 2001: Virginia's Transportation System for the New Millennium
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Compensation of Campus Faculty – How Virginia Compares Within the Region

These studies can be ordered from the Thomas Jefferson Institute for Public Policy. Please call or write this foundation if you would like a copy.

Michael Thompson
Chairman and President
February 1998

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Executive Summary

In January 1998, Virginia Governor Jim Gilmore proposed a budget amendment that would provide state funding for 56 percent of the cost of placing about 2000 additional teachers in public elementary classrooms over a two-year period, beginning with the 1998-99 school year. The Governor's plan would distribute the additional teachers proportionally among all school divisions in the state on the basis of student enrollments. One effect of the Governor's proposal would be to lower pupil/teacher ratios in elementary classrooms below 17 to 1 statewide, compared to the current ratio of about 18 to 1.

Recent research supports the conventional wisdom that students' academic achievement improves in classrooms where teachers have fewer students to teach. Thus, the Governor's proposal should have a positive impact on student performance. However, the magnitude of that impact will be diluted by a *proportional* distribution approach that causes some of the additional teachers to be assigned to school divisions where pupil-teacher ratios are already low.

An alternative distribution method is the *targeted* approach. It would target about half of the school divisions--those having the highest elementary pupil-teacher ratios--and fund enough teaching positions in those school divisions to lower their average class size to 17.5 students. It is estimated that the targeted approach would require about 500 fewer teachers, cost \$21.5 million less, and raise statewide student performance 15 percent higher than the proportional approach.

Thus, on the basis of efficiency alone, the targeted distribution of new teachers is preferable. However, there are legitimate equity considerations that lend support to the proportional plan or to some compromise version of it. Making tradeoffs between efficiency and equity is inevitable in the process of making public policy. The goal of this issue paper is to clarify the magnitude of this particular tradeoff for those interested in education policy making in Virginia, including those executive and legislative officials currently involved in that process.

Governor Gilmore's Plan

During Virginia's 1997 gubernatorial campaign, candidate Gilmore pledged to put 4000 additional public school teachers in elementary schools across the state. His goal was to raise student achievement by reducing class size and enabling more individualized instruction for students with deficiencies in reading skills. Soon after taking office in January 1998, Governor Gilmore announced the first half of his plan to make good on his campaign commitment.

For the upcoming biennium, the new Governor proposed an executive amendment to the budget submitted in December by his predecessor, George Allen, who had recommended adding 1000 new elementary teachers across the Commonwealth. Governor Gilmore's proposed budget amendment doubled that number, and he expressed hope that the additional 2000 teachers needed to complete his campaign pledge could be funded in the next biennial budget.

Governor Gilmore's budget amendment provides funding for the teachers in two stages--about 500 in the school year beginning in the fall of 1998 and the remaining 1500 during the following school year. By the second year, total annual costs for the 2000 teachers would approximate \$82.6 million, of which the state share would be 56 percent, or about \$46.4 million.¹

Under the Governor's plan, each of the 137 school divisions would receive funding for additional elementary teachers on a proportional basis, according to student enrollments. Since there is such wide variation in student populations, 48 school divisions would gain funding for fewer than five additional teachers, Fairfax County and Virginia Beach would be eligible for 238 and 133 new teachers, respectively, and the rest would receive funding for something in between. The table below summarizes the distribution that would result from the Governor's proposed budget amendment.²

Number of School Divisions	Number of Teachers to be Added to a School Division							
	2-4	5-9	10-19	20-29	30-39	40-49	50-99	100+
	48	45	23	6	4	2	7	2

Note the first two data columns of the table. Two-thirds of the school divisions (93) would gain fewer than 10 teachers under the proportional distribution method contained in the budget amendment. Even the 238 additional teachers for Fairfax County (included, along with Virginia Beach, in the far right data column) would have to be spread over 134 elementary schools.

The question raised by the data in the table is this: Would the 2000 teachers be spread so thin over all the schools by the proportional distribution method that the benefits would be insignificant?

We will begin to answer that question by first considering the effect of the Governor's plan on pupil-teacher ratios in elementary classrooms across the state. It is estimated that the statewide, weighted-average pupil-teacher ratio in grades K-5 was close to 18 to 1 in 1996.³ If 2000 additional teachers had been in K-5 classrooms in 1996,

the pupil-teacher ratio would have been a little less than 17 to 1.⁴

An Alternative Method for Distributing the Teachers

A statewide reduction from 18 down to 17 elementary students per classroom teacher could be achieved by adding about 2000 elementary teachers to Virginia's public schools, regardless of how those teachers were distributed among the school divisions and individual schools. However, there is reason to believe that the *student performance gains* from adding that many teachers *would* depend on the distribution method.

One alternative method for distributing the teachers might be called the *targeted* approach, as opposed to the Governor's *proportional* approach. The targeted method would aim to distribute the teachers to those school divisions where the greatest impact on student achievement could be expected.

Comparing the Two Methods: Targeted vs. Proportional

Implicit in the targeted method is the assumption that student performance improvements due to reducing class size tend to level off at some point, and that the greatest gains in student performance can be achieved by reducing exceptionally large class sizes down to some "optimal" size.⁵

A recent analysis of school division data in Virginia identified pupil-teacher ratios at the elementary grade level as having a statistically significant impact on students' standardized test results. Test scores were higher in school divisions where pupil-teacher ratios were lower.⁶ In order to determine whether some pupil-teacher ratio "threshold" could be identified, the data were analyzed again for this issue paper. The school divisions were repeatedly separated and analyzed in two groups, those with elementary pupil-teacher ratios above and

below several possible thresholds.

In simplest terms, the results indicated that students' test scores could be improved significantly by reducing K-5 class sizes down to 17.5 students, but that there was no statistically significant impact on test scores below that 17.5-student level.⁷

This indicates that hiring additional teachers in school divisions already having relatively low pupil-teacher ratios may not produce much improvement in student performance. On the other hand, this analysis suggests that school divisions with average class sizes above 17 in grades K-2 and above 18 in grades 3-5 could raise their test scores by adding more teachers.

Currently, there are 61 school divisions with pupil-teacher ratios in grades K-5 in excess of 17.5 to 1. And, even though the Governor's proportional plan would reduce the statewide weighted average class size in K-5 to 17, there would still be 25 school divisions above the 17.5 level.

Applying the statistical methods utilized in the earlier study of standardized test scores in Virginia, it is estimated that the number of students scoring above the national average on standardized tests would increase by about 6700 if the Governor's proportional distribution method were implemented. Virtually all of the improvement--nearly 90 percent--would be expected in those 61 school divisions currently above the 17.5 threshold.⁸

On the other hand, the *targeted distribution method* could be expected to have a *greater impact on test scores, and with fewer teachers*. It is estimated that only 1500 additional teachers would be needed in about half of the state's school divisions to bring their average elementary class size down to 17.5. Furthermore, by targeting the teachers to those schools currently having large class sizes, the number of students scoring above the national average on standardized tests would increase by about 7700.⁹

Thus, the targeted distribution method would require about 500 fewer teachers, cost \$21.5 million less, and raise statewide student performance 15 percent higher than the proportional distribution method.

Compromise Approach

One compromise approach would use the targeted method for about 1500 teachers, while distributing 500 teachers proportionally, based on student enrollments. The cost of the compromise approach would be a little less than the Governor's proportional distribution method, and would raise statewide student performance 22 percent more.¹⁰

The table below summarizes the costs and benefits of the three distribution methods. The distribution of teachers to each division under the proportional, targeted, and compromise methods is contained in the Attachment.

	Distribution Method		
	Proportional	Targeted	Compromise
Number of Teachers	2012	1502	2000
% of School Divisions	100%	46%	100%
Total Cost	\$82.6 million	\$61.1 million	\$82.0 million
State Share	\$46.4 million	\$37.8 million	\$48.5 million
Local Share	\$36.2 million	\$23.3 million	\$33.5 million
Student Performance Index*	6700	7700	8200
Cost Per Unit of Increase in Student Performance Index	\$12,330	\$7,940	\$10,000

*Additional students scoring above national average on standardized tests

Conclusion

The benefits expected from the Governor's proportional plan would indeed be significant, although greater impact on student performance could be achieved at less cost under either the targeted or compromise distribution methods.

On purely *efficiency* grounds, the targeted distribution method is clearly preferable to both the proportional and compromise methods for allocating additional teachers. Its estimated unit cost of student performance gains is, by far, the lowest of the three methods.

The public policy process, however, must consider questions of *equity* in addition to efficiency. And, certainly, an equity argument can be made for a proportional distribution to all school divisions in the Commonwealth based on student enrollments.

Furthermore, the proportional method is an indirect way of rewarding retroactively those school divisions that have taken the initiative--and absorbed all the costs--of reducing class sizes much lower than required under current Standards of Quality pupil-teacher ratio regulations.

The compromise approach suggested here reflects one way to seek a balance between efficiency and equity on this issue. It achieves all the benefits of the targeted approach for the 61 school divisions with the greatest need for class size reductions. Yet, like the proportional approach, it would distribute some teachers to all other school divisions based on relative student enrollments.

And, while not quite as expensive as the Governor's budget amendment, the compromise approach is, nevertheless, consistent with his goal of adding 2000 elementary teachers to Virginia classrooms over the next two years. Moreover, once all school divisions are at or below the 17.5 threshold, that paves the way for his second installment of 2000 teachers to be distributed proportionally without major efficiency drawbacks.

Next Week

In next week's issue paper, I will suggest another way to address the equity issue in the broader context of current tax policy questions and the Commonwealth's role in public education.

About the Author

I. David Wheat, Jr. is a strategic planning consultant and the author of *Understanding Virginia's Report Card: Why Standardized Test Scores Vary from One Community to Another*, published in 1997 by the Thomas Jefferson Institute for Public Policy.*

He is president of Wheat Resources, Inc., a consulting firm established in 1981 that specializes in helping clients organize and analyze data they use in making strategic decisions. He received his Master's Degree in Public Policy from Harvard University's Kennedy School of Government in 1972, and then served three years as a White House staff assistant specializing in economic and energy issues. Later, at the University of Houston, he served as Director of Federal Relations and designed and taught a graduate course on public policy implementation.

His education policy consulting work is enhanced by several years of nationally recognized classroom instruction experience in Virginia public schools, as well as by service on the Governor's Commission on Champion Schools, where he participated in the upgrading of the history and social science Standards of Learning for Virginia's students. He also teaches political science at Virginia Western Community College.

*Copies available from the author (540-966-5939) or the Jefferson Institute (703-690-9447).

Distribution of Teachers Under Proportional Method (2012), Targeted Method (1502), and Compromise Method (2000)

division	estK-5 p/t	proportional	targeted	comp.	division	estK-5 p/t	proportional	targeted	comp.	division	estK-5 p/t	proportional	targeted	comp.	division	estK-5 p/t	proportional	targeted	comp.
Richmond City	23.2	52	190	190	Washington	18.3	12	8	8	Caroline	17.3	7	0	4	Page	16.4	7	0	4
Powhatan	21.4	7	14	14	Amelia	18.2	3	2	2	Essex	17.3	3	0	2	Franklin	16.3	12	0	7
Prince William	21.1	85	221	221	Gloucester	18.2	12	7	7	Lancaster	17.3	3	0	2	Grayson	16.3	5	0	3
Tazewell	21.0	12	33	33	Hampton	18.2	43	25	25	Norfolk	17.3	67	0	40	Middlesex	16.3	3	0	2
York	21.0	19	48	48	Scott	18.2	7	4	4	Fairfax~	17.2	242	0	144	Montgomery	16.3	18	0	11
Manassas Park	20.8	4	8	8	Westmoreland	18.2	4	2	2	Greensville^	17.2	5	0	3	Nelson	16.3	4	0	2
Botetourt	20.5	9	17	17	Campbell	18.1	13	7	7	Rockingham	17.2	19	0	11	Staunton	16.2	5	0	3
Portsmouth	20.4	37	74	74	Carroll	18.1	8	3	3	Bedford+	17.1	19	0	11	Salem	16.1	7	0	4
Chesterfield	20.3	89	188	188	Louisa	18.1	8	4	4	Manassas	17.1	12	0	7	Bristol	16.0	5	0	3
New Kent	20.3	5	8	8	Poquoson	18.1	4	2	2	Frederick	17.0	17	0	10	Falls Church	16.0	3	0	2
Chesapeake	20.2	64	130	130	Pulaski	18.1	9	4	4	Smyth	17.0	9	0	5	Russell	16.0	7	0	4
Prince George	20.1	9	20	20	Culpeper	18.0	11	4	4	Halifax	16.9	13	0	8	Rappahannock	15.9	3	0	2
Lunenburg	19.9	4	7	7	Northumberland	18.0	3	1	1	Mecklenburg	16.9	9	0	5	Alleghany High.#	15.6	6	0	4
Amherst	19.6	8	14	14	King William	17.9	4	1	1	Bland	16.8	3	0	2	Harrisonburg	15.4	7	0	4
Appomattox	19.6	4	7	7	Richmond	17.9	2	1	1	Fredericksburg	16.8	5	0	3	Surry	15.4	3	0	2
Prince Edward	19.3	5	7	7	Arlington	17.8	39	8	8	Newport News	16.8	55	0	33	Colonial Heights	15.3	5	0	3
Isle of Wight	19.3	9	12	12	Giles	17.8	4	1	1	Roanoke	16.8	24	0	14	Goochland	15.2	4	0	2
Hanover	19.2	27	34	34	Nottoway	17.8	5	1	1	Roanoke City	16.8	28	0	17	Buchanan	14.6	7	0	4
Mathews	19.2	3	3	3	Williamsburg*	17.8	15	4	4	Buckingham	16.7	5	0	3	Fluvanna	14.6	5	0	3
Lynchburg	19.1	19	21	21	Danville	17.7	15	3	3	Norton	16.7	2	0	1	Waynesboro	14.6	5	0	3
Stafford	19.0	34	35	35	Hopewell	17.7	7	1	1	Brunswick	16.7	5	0	3	Colonial Beach	14.4	2	0	1
Galax	18.9	3	2	2	Loudoun	17.7	48	7	7	Charles City	16.7	2	0	1	Cumberland	14.4	3	0	2
Dinwiddie	18.8	8	7	7	Pittsylvania	17.7	16	3	3	Patrick	16.7	5	0	3	Radford	14.4	3	0	2
Virginia Beach	18.8	133	144	144	Sussex	17.7	3	1	1	Southampton	16.7	5	0	3	Northampton	14.2	4	0	2
Wise	18.8	11	13	13	Clarke	17.6	4	1	1	Albemarle	16.6	23	0	14	Alexandria	14.1	21	0	12
Wythe	18.8	8	8	8	Franklin City	17.6	4	1	1	Dickenson	16.6	5	0	3	Charlottesville	13.6	8	0	5
Warren	18.7	8	8	8	Lee	17.6	8	1	1	King George	16.6	5	0	3	Martinsville	13.6	5	0	3
Petersburg	18.6	12	11	11	Rockbridge	17.6	5	1	1	West Point	16.6	2	0	1	Orange	13.5	7	0	4
Spotsylvania	18.5	32	22	22	Accomack	17.5	10	0	6	Floyd	16.5	4	0	2	Covington	13.1	2	0	1
Henry	18.4	15	12	12	Madison	17.5	4	0	2	Buena Vista	16.4	3	0	2	Bath	13.0	2	0	1
Henrico	18.3	74	45	45	Charlotte	17.4	4	0	2	Craig	16.4	2	0	1	King and Queen	12.5	3	0	2
Shenandoah	18.3	9	6	6	Greene	17.4	5	0	3	Fauquier	16.4	17	0	10	Winchester	12.4	5	0	3
Suffolk	18.3	21	12	12	Augusta	17.3	19	0	11	Highland	16.4	2	0	1	Lexington	11.8	2	0	1
										Statewide	18.0	2012	1502	2000					

*includes James City County. ~includes Fairfax City. ^includes Emporia. +includes Bedford City. #includes Clifton Forge.

First data column contains estimated pupil-teacher ratio in grades K-5 in 1996.

Second and third data columns contain number of additional teachers under the proportional and targeted methods, respectively.

Fourth data column contains a compromise method: targeted approach for divisions with ratios above 17.5 (1502 teachers) and proportional distribution of 498 teachers to the remainder of the school divisions.

Endnotes

¹ To be precise, the total number of new teachers is estimated to be 2012 (509 in the first year and an additional 1503 in the second year). The state's share of the cost varies from one school division to another, according to a composite index that is intended to reflect each locality's "ability to pay." The state share ranges from a high of 75-80 percent in some localities to a low of 20 percent in others. Superintendent's Memo No. 15 (January 29, 1998), Department of Education, Attachment D.

² Attachment D, Superintendent's Memo No. 15.

³ Most school divisions in Virginia have adopted an elementary school program that includes grades K-5, and have moved 6th graders to the "middle school." Pupil-teacher ratio data, however, continue to be reported on the basis of grades K-6. The published estimate of the pupils per teacher in grades K-6 for 1996 was 18.7 (Superintendent's Annual Report, Department of Education, 1995-96). Removing the 6th grade data from that estimate would probably reduce the number of pupils per teacher in the remaining grades (K-5) close to 18, given the state requirement for lower pupil-teacher ratios in the 1st grade.

⁴ Assuming 18 pupils per teacher and estimating the K-5 average daily membership (ADM) to be 517,389 in 1996, then the estimated number of classroom teachers in grades K-5 would have been about 28,744 in that year. Adding 2012 to that number would equal 30,756 teachers. Dividing the K-5 ADM by the total number of teachers equals 16.8 pupils per teacher. Source : Superintendent's Annual Report, 1995-96.

⁵ What is "optimal" depends on the grade level and the subjects being taught. My own experience is based on having taught 6th, 7th, 8th, and 12th graders in public schools, as well as both undergraduates and graduate students at the college level. In middle school grades, the optimal threshold seemed to be about 18 students per class, while it was about 22 for a class of high school seniors. A college class of 40 students is usually no more difficult to teach than one of 20 (except for the burden of grading that many additional writing assignments). My wife's experience as a 1st grade teacher suggests that the maximum size for a 1st grade class size is 16 or 17 pupils. R.F. Ferguson provides evidence in his study of the effects of class size on test scores in Texas schools, where he identified a threshold of 18 for elementary grade classes. Class sizes above 18 had proportionally lower test scores, while classes smaller than 18 did not produce higher scores. "Paying for Public Education: New Evidence on How and Why Money Matters," *Harvard Journal on Legislation* (1991), p. 477.

⁶ *Understanding Virginia's Report Card: Why Standardized Test Scores Vary from One Community to Another*, I. David Wheat, Jr. (Thomas Jefferson Institute for Public Policy, 1997), page 20.

⁷ I kept lowering the experimental threshold by .5 pupils per teacher until I reached the lowest pupil-teacher ratio that was still statistically significant above the threshold, and that proved to be 17.5 pupils per teacher in grades K-5. [For the technically oriented reader: The "t value" for the pupil-teacher ratio regression coefficient was negative 2.038 (probability of chance occurrence being .044) when only those school divisions with elementary pupil-teacher ratios exceeding 17.5 to 1 were analyzed. When those school divisions with elementary pupil-teacher ratios equal to or below 17.5 to 1 were analyzed, the "t value" for the regression coefficient was negative 0.415 (probability level: .685).] Any reader (technically oriented or not) is invited to contact the author (540-966-5939) for further explanation of these results.

⁸ See *Understanding Virginia's Report Card*, p. 21. The regression coefficient derived for the threshold was -.718 for ratios above 17.5. Rather than assume no benefits at all at ratios below 17.5, I reduced the estimated impact by 75% for ratios between 17.5 and 15.5, and by 88% for ratios below 15.5.

⁹ *Ibid.* Sixty-one school divisions would gain 1502 teachers; and the remainder would get none.

¹⁰ *Ibid.* Approximately 8200 additional students would score above the national average on standardized tests with the pupil-teacher ratios that would be achieved by the compromise method.