

A PRELIMINARY ANALYSIS OF THE SUPPLY AND DEMAND FOR MIDDLE SCHOOL MATHEMATICS AND SCIENCE TEACHERS IN VIRGINIA

J. A. SIGLER

Lynchburg College, Lynchburg, VA 24501-3199

Virginia Colleges and Universities have a major challenge to produce educated elementary and middle school students. The magnitude of this challenge can be measured by studying the number of current teachers in each grade in Virginia and the anticipated retirements and departures from the profession for other reasons. The new licensure requirements have their biggest impact for the preparation of middle school teachers since middle school teachers will no longer be able to receive general middle school certification.

During its organizational meeting, the conference steering committee agreed that some analysis of data upon which to base projections of teacher supply and demand would be useful. The official charge was to examine the number of teachers in the Commonwealth and to project the number of elementary and middle-school science teachers required for the next several years, in light of the new certification requirements.

One might assume that someone in Richmond would have the necessary data and that the project would simply entail tracking it down. That assumption is patently incorrect! First of all, there is very little current data on Virginia. The most recent published data on things as simple as the number of teachers in the Commonwealth is found in the 1996-97 *Superintendent's Annual Report* [1]. Various calls to persons in the Department of Education yielded no comprehensive information. The Virginia Education Association (VEA) had lots of information, but little that was useful for this analysis. Regional and national sources of data, such as the Southern Regional Education Board (SREB), the National Center for Educational Statistics (NCES), and the Eisenhower National Clearinghouse (ENC) were examined. The SREB provided a 1994 report entitled *Educator Supply and Demand in Virginia* [2], which although dated, was useful. The NCES provided some national projections of teacher demand, while the ENC provided some ten-year old data which is marginally useful. Local school systems seem to know least of all what their long-term needs will be. Obviously they have information on the age distribution of teachers and can to some

extent project retirements, but they have little means other than the past for forecasting teacher retention, etc.

Given the paucity of data, where do we begin? First of all, on a national basis, is there an impending shortage of teachers or not? Sources ranging from the US Department of Education [3] to the Wall Street Journal claim a need for as many as two million new teachers in the next decade. Such estimates are based on the aging teacher workforce nationwide as shown in Figure 1, contrasted with projected increases in student enrollment. The National Council of Teachers of Mathematics (NCTM) raises strong concerns about the possible shortage of mathematics teachers [4]. But the Wall Street Journal [5] also reports that the pending shortage is simply another effort by the supporters of education to divert money into education. The shortage is not real because there are millions of teachers in the country who have left teaching but will return and millions of others desperate to teach but unable to do so because of arbitrary and strangling certification requirements.

We will begin this analysis by looking at projections of the numbers of teachers needed provided by the National Center for Education Statistics [6]. Updated in July of 1998, these projections show growth in the number of teachers based upon a commonly accepted statistical model. Figure 2 indicates a projected growth between 1994 and 1998 of approximately 500,000 new teaching positions nationwide. Figure 3 indicates an annual growth rate of 1.3% between 1996-2002 and a smaller growth rate of about 0.9% during the next six years. Figure 4 shows that most of the projected growth occurs in the K-8 grade levels, while high school growth is relatively flat. Figure 5 indicates how the enrollment is expected to change, state by state, during the same period. Notice that Virginia shows a growth in enrollment which is less than seven per cent. Figure 6 indicates one more important factor influencing the number of teachers employed--the student teacher ratio. This ratio has been declining steadily and is projected to continue to decline at the elementary level. Finally, some data reported by the Central Michigan University (Figure 7) indicates projected shortages of teachers by region across the south.

Certification of elementary and middle-school mathematics and science teachers drove the creation of this conference and brought each participant to the conference. Data on certification is more difficult to find. The Eisenhower National Clearinghouse [7] has

published some national (1994) data on certification for middle school math and science teachers. Their data indicates that in states which have had such certification, of the teachers teaching science in grades 7 and 8, 53% were certified in science. Forty five percent of those teaching math were certified. The NCTM estimates that 34% of secondary teachers are teaching mathematics with neither a major nor a minor in the subject. Figure 8 summarizes some preliminary data from a study commissioned by the Virginia Mathematics and Science Coalition [8]. Responses from 280 middle-school mathematics teachers indicate that about 25% have six or fewer hours of college-level mathematics; about 61% have 15 or fewer hours and fewer than 40% have enough hours to complete a major or minor in mathematics.

Several factors affect projections of math/science teacher supply and demand. First, early retirement incentives--state and local--can substantially alter the demand. What many teachers perceive to be a deteriorating classroom environment requiring more and more attention to fewer and fewer students affects the longevity of classroom teachers. The Standards of Learning and subsequent teacher accountability will have a substantial effect, at this point completely unknown. Beginning teacher salaries do not compete with salaries associated with other careers available to technically qualified graduates. The use of non-certified teachers, particularly if certification requirements are circumvented to allow persons such as retired military to teach without certification, can change the supply of teachers. The implications of strengthened certification requirements in mathematics and science for those desiring to return to teaching after some absence is also an unknown factor.

The SREB report projects teacher needs for the Commonwealth between 1994 and 1998. While much of the study is not germane to our interests, some data is interesting. Figure 9 shows a breakdown by race for Virginia high-school teachers in 1992. At that point 13% of all high school teachers were Black. There were 27 Black physics teachers and 38 Black chemistry teachers statewide in 1992. Figure 10 shows the age distribution of Virginia teachers in 1992, following the statewide early retirement incentive offered in 1991. Notice that it does not show the strong peak at age 50 as found in national data (Figure 1). Figure 11 summarizes the report's projections for teacher supply and demand through 1997. The SREB projected shortages or surpluses in terms of classes, not teachers. So if one assumes five classes per teacher, then a surplus of 20 equates to four teachers. This makes some sense if the classes are concentrated in four or five-class bunches by schools. Otherwise a shortage

of 20 classes statewide might imply a shortage of 20 qualified teachers in 20 different schools. The report concluded that all of the projected shortages were negligible.

Now to rough projections for the need for science and math teachers in the Commonwealth. Physicists would call this is an "order of magnitude calculation." First, according to the 1996-7 *Superintendent's Annual Report*, Virginia has about 48,805 K-7 teachers. If we assume (incorrectly) an even distribution among the eight grades, we calculate that about 12,000 of these are teaching grades 6-7, while the remaining 36,000 are teaching K-5. Using the same assumptions, approximately 6000 of the 31,100 secondary teachers teach eighth grade. So the Commonwealth has approximately 12,000 middle school teachers (7-8) and about 42,000 K-6 teachers. (These data are accurate for 96-97-- current numbers are slightly higher.)

In Lynchburg City Schools and surrounding school districts, approximately 10% of the middle school teaching staff teach mathematics and a like percentage teach science. Applying these percentages statewide leads to the following conclusion: Approximately 1200 persons teach middle school (7-8) mathematics and a like number teach middle school (7-8) science. Another 1200 teach presumably teach sixth-grade mathematics and science.

If we assume (again incorrectly) no attrition and that all currently assigned middle school math/science teachers are certified and teaching in their fields, then growth rates of 15%, as projected nationally by NCES, would require 180 additional middle school math teachers by 2007. Such growth would require 25 additional middle school math teachers per year. Similar numbers apply for middle school science teachers. The same reasoning leads to an estimate of 6300 additional K-5 teachers by 2007, about 900 per year, who meet the new certification requirements in mathematics and science. If we assume that teacher growth parallels student population growth, then seven per cent would be more reasonable. This leads to a much smaller number -- 84 new middle school math teachers by 2007, about 12 per year. Similar numbers apply for science and K-5 teachers.

The SREB report indicates an average attrition for Virginia teachers of about 7% per year. If we assume 7% attrition, then an additional 84 trained middle school mathematics teachers and an additional 84 trained middle science teachers will be needed each year.

Persons in the non-working trained teacher pool will not meet the new certification requirements, although they may have maintained certification. So a conservative estimate leads to numbers from slightly less than 100 to about 115 newly trained 7-8 math teachers each year and a like number of 7-8 science teachers.

An informal telephone poll of schools and departments of education in the Commonwealth, as well as a study of catalog information leads to a conservative (on the high side) estimate that the current statewide production of math-science middle school (7-8) teachers is between ten and twenty total. The number may be much smaller.

Given the current situation, even the most modest projected increase presents a real challenge. How do we encourage the "best and brightest" of our mathematics and science students to pass up the monetary rewards of research or college teaching or management to pursue careers teaching our young people? Or how do we encourage those in the next tier, who have the ability but perhaps not the confidence, to pursue mathematics or science education? Perhaps the answers to those questions will provide the substance of a future conference. ■

References

- [1] *The Superintendent's Annual report, 1996-97*, Virginia Department of Education, Richmond, VA
- [2] *Educator Supply and Demand in Virginia: Report on Phase One*, The Southern Regional Education Board, June 1994.
- [3] *A Back to School Special Report on the Baby Boom Echo: America's Schools are Overcrowded and Wearing Out*, U. S. Department of Education, September 1998, [Http://inet.ed.gov/pubs/bbecho/fig10.html](http://inet.ed.gov/pubs/bbecho/fig10.html)
- [4] *Teacher Shortage*, NCTM News Bulletin, December 1997.
- [5] C. E. Feistritzer, "The Truth Behind the Teacher Shortage", *The Wall Street Journal*, January 28, 1998.
- [6] Projections of Education Statistics to 2008, National Center for Education Statistics, July 1998, [Http://nces.ed.gov/pubs98/pj2008/](http://nces.ed.gov/pubs98/pj2008/)
- [7] State Science and Mathematics Indicators, The Eisenhower National Clearinghouse for Mathematics and Science Education, [Http://carson.enc.org/reform/journals/ENC2158/](http://carson.enc.org/reform/journals/ENC2158/)
- [8] *Preparing Middle School Mathematics and Science Teachers: A Challenge for Virginia*, Virginia Mathematics and Science Coalition, White Paper, May 1999.

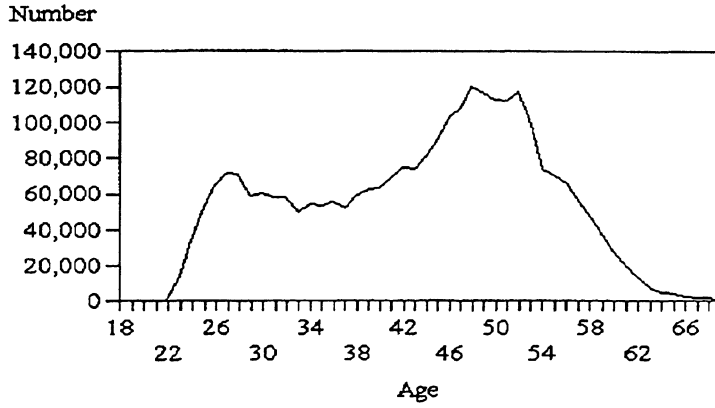


Figure 1. Estimated age distribution of full-time equivalent public school teachers: 1998-99.

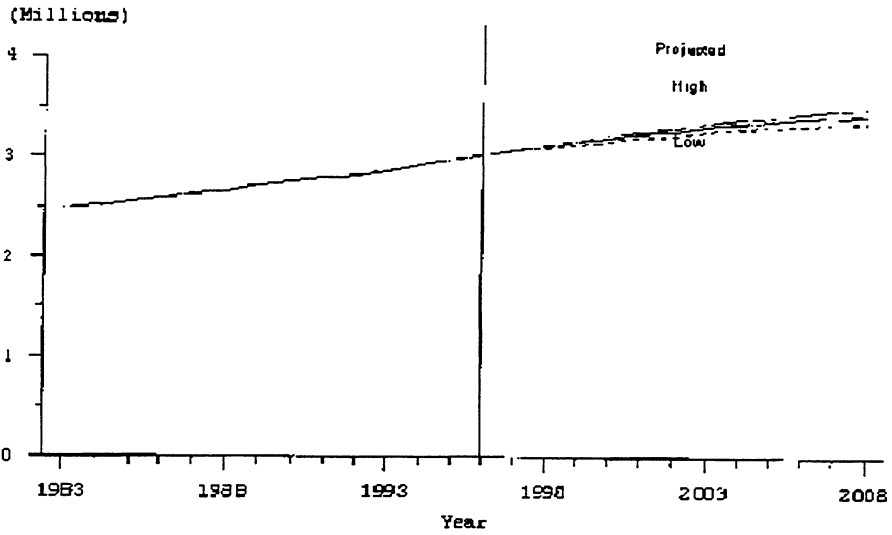


Figure 2. Elementary and Secondary classroom teachers, with alternative projections: Fall 1983 to Fall 2008.

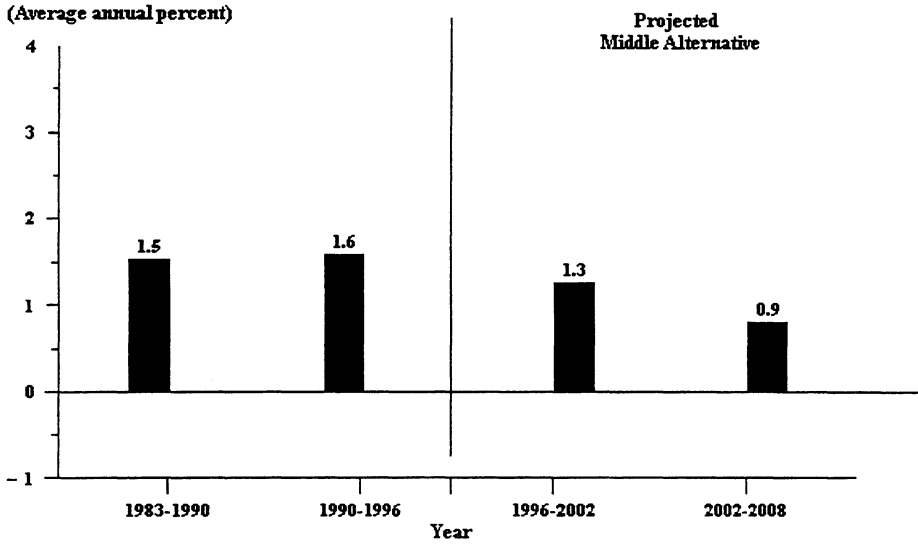


Figure 3. Average annual growth rates for classroom teachers.

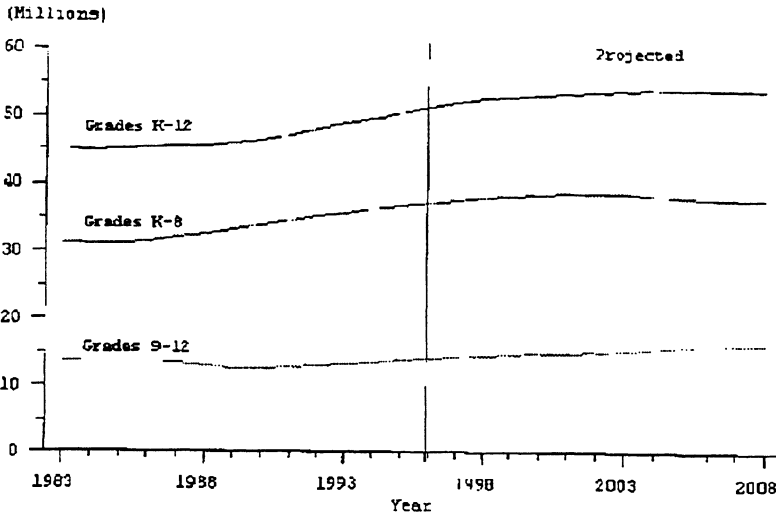


Figure 4. Enrollment in elementary and secondary schools, by grade level, with projections: Fall 1983 to Fall 2008.

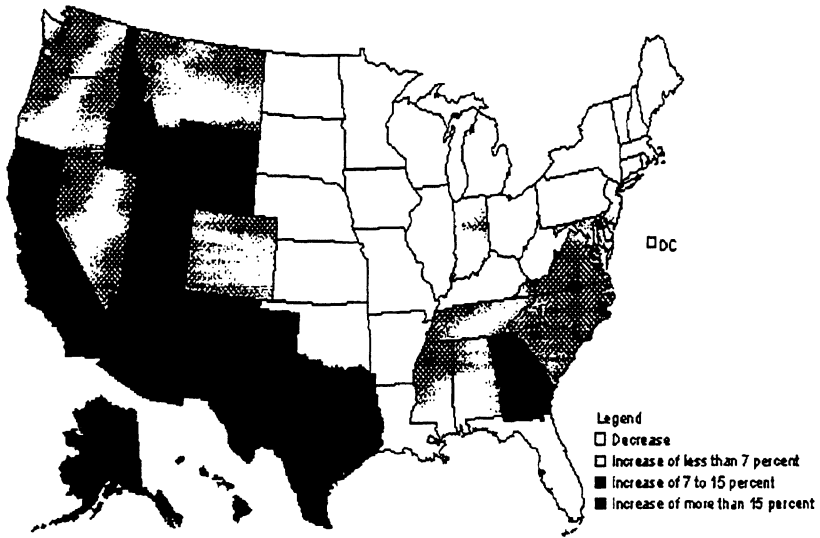


Figure 5. Percent change in grades K-8 enrollment in public schools, by state: Fall 1996 to Fall 2008.

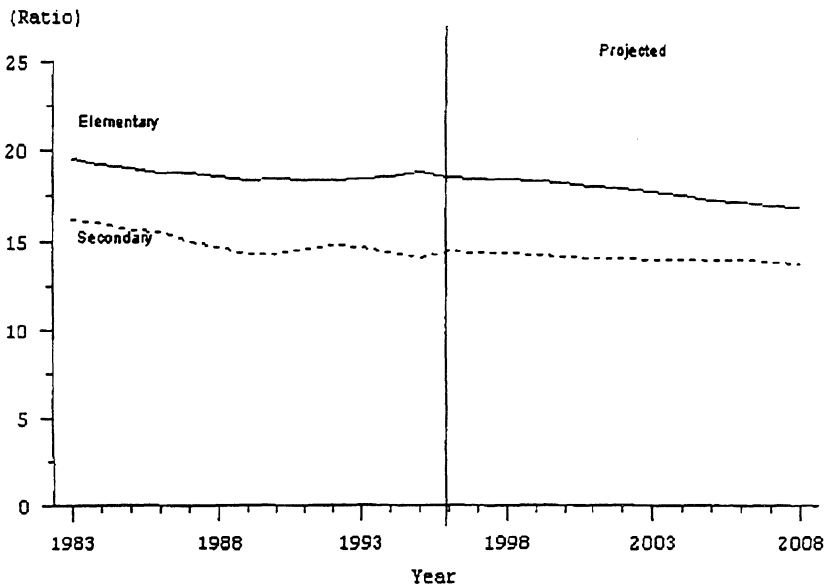


Figure 6. Pupil-teacher ratios, by organizational level, with middle alternative projections: Fall 1983 to Fall 2008.

	South Central	Southeast	Middle Atlantic
Biology	3.77	3.68	3.27
Chemistry	4.07	3.96	3.62
Computer Science	3.73	3.83	3.42
Earth Science	3.78	3.57	3.42
General	3.70	3.62	3.20
Mathematics	4.24	4.87	3.50
Physics	4.08	3.96	4.00

Key: >4.20=considerable shortage, >3.40=some shortage, >2.60= balanced, >1.80= some surplus

Figure 7. Relative Demand for Science-Mathematics Teachers (1995 data from Central Michigan University).

Subject taught	Majored in subject matter taught	Minored in subject matter taught	Teaching out-of-field of initial preparation (did not initially minor or major in discipline currently taught)
Science	31% (Major in science or science education)	13% (Minor in science or science education)	56%
Mathematics	20% (Major in math or math education)	13% (Minor in math or math education)	67%

Figure 8. Initial Preparation of Current Middle School Teachers (Virginia Mathematics and Science Coalition White Paper, May 1999).

Subject Area	Black	All	Percent Black
All High School	3060	22781	13
Foreign Language	107*	1916	6
Physics	27	384	7
Chemistry	38	549	7
Earth Science	92	815	11
Mathematics	397	3349	12
Biology	115	973	12
Social Studies	334	2899	12
English/Language Arts	489	4234	12
Other Science	42	282	15
Physical Science	150	815	18
Health Physical Education	458	2599	18
Special Education	1515	8223	18
Principal Elementary and Middle	450	2156	21
Principal Other and Secondary	211	1075	20
*These are persons who teach at least one class in the listed subject.			

Figure 9. Race/Ethnicity and High School Teaching, Virginia 1992 (Report from Southern Regional Educational Board).

		Age in Years					
Year	Race		20-29	30-39	40-49	50	Total*
1988	All	Number	9,961	25,517	21,990	12,256	70,581
		%	14	36	31	17	100
1992	All	Number	10,741	21,707	30,152	12,332	76,296
		%	14	28	40	16	100
1992	White	Number	9,740	25,343	25,188	9,791	63,523
		%	15	28	40	14	100
1992	Black	Number	833	3,798	4,675	2,422	11,914
		%	7	32	39	20	100

*Does not total exactly because there are missing cases for age category in every year.

Figure 10. Age of Virginia Educator Workforce by Race 1988 and 1992 (Report from Southern Regional Educational Board).

Assignment Area	Year	Projected Number of Classes Needed	Projected Surplus or Shortage of Classes
Early Childhood			
Pre-K and K	1995	4,726	4
Grades 1-3	1997	12,041	
Grades 4-7	1998	12,721	6
Elementary and Middle			
Science	1997	4,215	0
Social Studies	2000	4,111	2
High School			
Foreign Language	1996	8,872	-21
	1997	9,031	7
English Language Arts	1996	19,245	-48
	1997	19,881	17
Mathematics	1996	14,538	-36
	1997	15,018	13
Physics	1996	992	-2
	1997	1,010	
Chemistry	1996	2,084	-5
	1997	2,122	2
Social Studies	1996	13,109	-33
	1997	13,542	11

Figure 11. Projected Supply and Demand for Educators in Virginia (Report from Southern Regional Educational Board).