

CAROLINA context

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THE PROGRAM ON PUBLIC LIFE

is a non-partisan organization devoted to serving the people of North Carolina and the South by informing the public agenda and nurturing leadership.

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DIRECTOR'S NOTE

Over the past year, the Program on Public Life and the UNC-CH School of Education have hosted an ongoing seminar on school improvement. Math and science preparedness was the topic of one session, and several participants raised concerns about North Carolina's supply of math and science teachers. Even more worrisome to some participants was the lack of accessible information about the state's capacity to train math and science teachers and about where trained teachers go after graduation.

In response to these concerns, the Program on Public Life compiled a data-based study of both the supply and demand sides of math and science teacher preparation and placement. We enlisted the help of Trip Stallings, who is pursuing his Ph.D. in Education at UNC-CH. In addition to teaching middle and high school for seven years, Trip spent four years serving as Duke University's teacher licensure coordinator and service-learning facilitator. He has a B.A. in

English and a M.P.P. from Duke University.

Data for the full report, which can be found at www.southnow.org, were compiled from three primary sources: the North Carolina Department of Public Instruction's Licensure and Payroll Databases and survey responses from every university or college in the state with at least one secondary math or science licensure program. With the exception of some projections about teacher turnover in math and science, none of the results in this report are the product of complex statistical analyses. More often than not, they are simply head-counts, from which tentative conclusions have been drawn. Therefore, we report provisional findings and not definitive assertions; in many cases, our findings raise more questions than answers and may be important starting points for further investigation.

— FERREL GUILLORY

Director, Program on Public Life

FINDINGS

- Almost half of all active licensed math and science teachers in North Carolina middle and high schools were either trained out-of-state or in an alternate license program, (e.g., lateral entry).
- Most math and science teachers are hired to replace teachers who leave—not to meet the demand of increasing student enrollment.
- Many school districts employ a high proportion of math and science teachers who are in the early stages of their careers.
- School systems of similar size sometimes employ widely different numbers of licensed math and science teachers.

The Status of North Carolina’s Math/Science Teacher Pipeline

► **NOTE:** In some sections of this report, we consider two subsets of teachers: those trained at in-state, traditional licensure programs (programs that train teachers before they take teaching jobs), and those who either earned licensure out-of-state or through in-state alternate licensure programs (e.g., lateral entry.)

OVERVIEW

There are four main factors to consider when analyzing the math and science teacher pipeline: teacher production, retention, quality, and presence.

The first component of the full study is an estimation of the production of math and science teachers at all of the North Carolina-based institutions of higher education that house middle and high school math and/or science licensure programs. Rather than simply examining the number of candidates who pursued state licensure, the full study also estimates the number of candidates who met the requirements for licensure, regardless of whether they chose to apply for a North Carolina license. By doing so, we can draw conclusions about the

potential size of the math and science corps and estimate how many potential licensees either chose not to pursue licensure in-state or chose not to enter the profession at all.

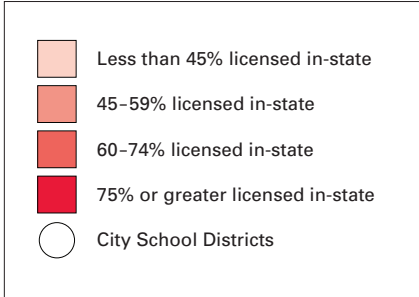
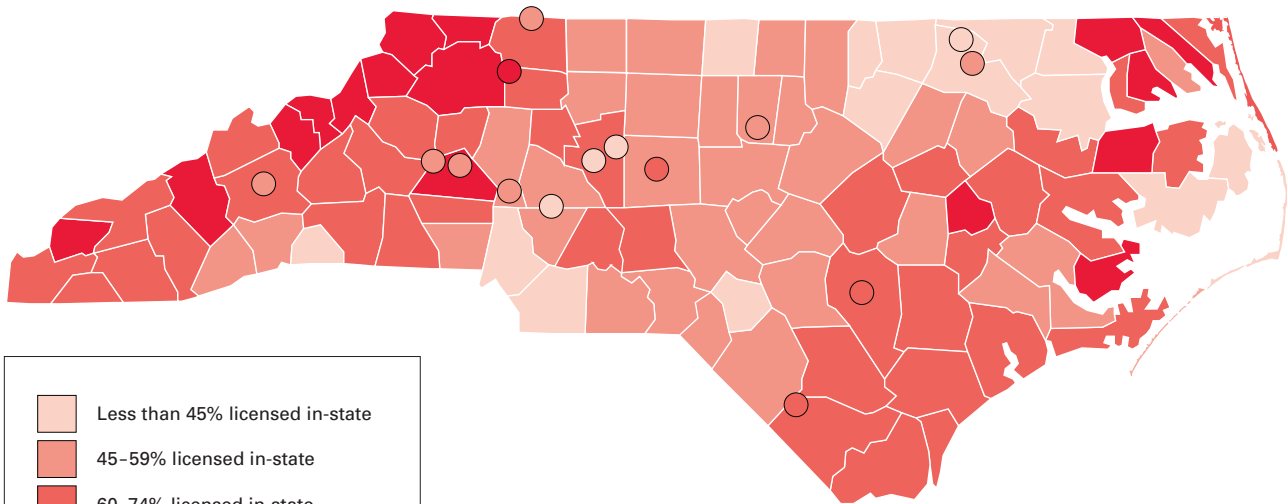
The next part of this study attempts to estimate patterns in math and science teacher retention across the state. The section examines the relationship between years of experience and decisions to leave the math or science classroom, as well as estimates of teacher positions created due to student population growth versus positions created due to turnover.

The third component is an examination of the relative quality of the state’s math and science teachers, statewide and per school district. There is disconcerting evidence that without high-quality math and science instruction, particu-

larly at the secondary level, many young people will choose not to pursue careers in science- and math-related fields. In 2003-2004, around 8% of all North Carolina secondary math and science teachers taught without full credentials—well above the national average of 3.6%. The numbers of such teachers may be higher than that if we were to include credentialed teachers who are teaching out of field. For example, across the nation in 2002, 45% of biology and life science high school students and 30% of high school math students were taught by teachers who did not hold a degree in the field being taught.

The study’s final element considers differences in the presence of licensed math and science teachers across districts. In addition, this section models the degree to which the largest

Map 1
Percentage of North Carolina Middle and High School Math and Science Teachers Licensed in “Traditional” In-State Programs



Note: Statewide proportion of middle and high school math and science teachers trained in traditional in-state programs is 55.8%; all other licensed teachers either trained out-of-state or via in-state alternate licensure programs. Source: N.C. Department of Public Instruction

licensure programs serve each area of the state by estimating where their graduates currently hold teaching positions. Teachers, like many other professionals, tend to migrate toward certain geographic locations (predominantly suburban districts), and away from others (such as inner-city and rural districts and high-needs schools), and they do so for a variety of reasons. They also tend toward certain licensure areas, such as elementary education, and away from other high-need licensure areas, such as mathematics and science. The end result is an imbalance in teacher distribution across disciplines and across regions that is often masked by aggregated state licensure numbers.

Highlights from the full report:

PRODUCTION

■ *Only about one half of all active licensed math and science teachers were trained in “traditional” in-state programs.* Traditional licensure programs at North Carolina colleges and universities—public and private combined—have provided around 56% (about 7,400 out of 13,200) of the state’s licensed math and science classroom teachers; at least 44% of the state’s math and science teachers either received all of their training out-of-state or entered the teaching profession through an alternative licensure program (34%), or are currently enrolled in a lateral entry program (10%), indicating a far greater need for math and science teachers than is currently being met by traditional in-state teacher education programs.

Of those trained in traditional state programs, a large majority also earned degrees from public universities. About 8,600 school employees (teachers and administrators) statewide with traditional math or science licensure earned at least one degree in state. At least 7,500 of their degrees came from public universities; just under 2,000 of their degrees came from private colleges.

■ *In-state colleges produce enough teachers to meet demand due to student population growth, but not due to teacher turnover.* Most math and science teachers are hired to replace

Table 1
Total College and University “Touches,” All Active Teachers Trained In-State in Traditional Licensure Programs

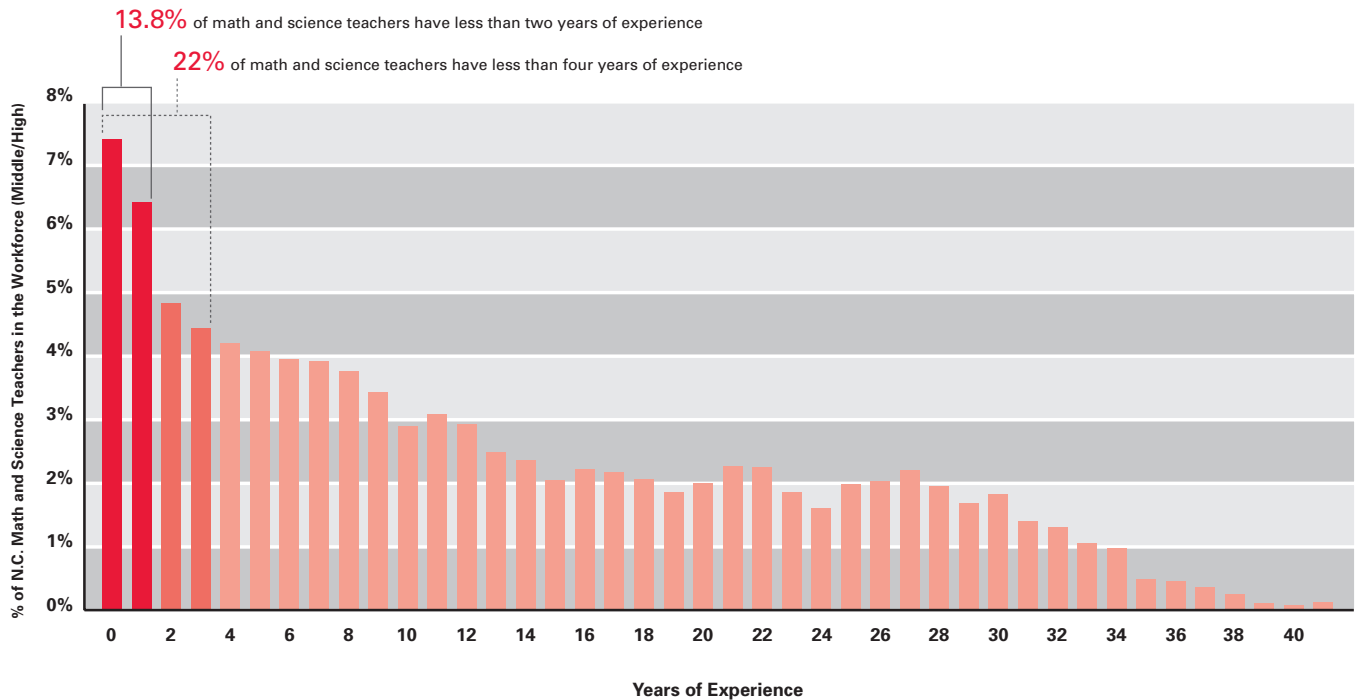
NORTH CAROLINA COLLEGES AND UNIVERSITIES WITH ACTIVE LICENSURE PROGRAMS			
PUBLIC	TOTAL “TOUCHES”	PRIVATE	TOTAL “TOUCHES”
Appalachian State University	1457	Barton College	172
East Carolina University	1184	Bennett College	21
Elizabeth City State University	118	Campbell University	258
Fayetteville State University	295	Catawba College	63
N.C. A&T State University	168	Duke University	57
N.C. Central University	159	Elon University	169
N.C. State University	814	Gardner-Webb University	265
University of North Carolina - Asheville	90	Greensboro College	40
University of North Carolina - Chapel Hill	597	High Point University	99
University of North Carolina - Charlotte	605	Johnson C. Smith University	9
University of North Carolina - Greensboro	531	Lenoir-Rhyne College	143
University of North Carolina - Pembroke	389	Livingstone College	17
University of North Carolina - Wilmington	424	Mars Hill College	130
Western Carolina University	620	Meredith College	150
Winston-Salem State University	60	Methodist College	46
Total Public “Touches”	7511	North Carolina Wesleyan College	38
		Pfeiffer University	71
		Queens College	20
		Salem College	13
		Shaw University	18
		Wake Forest University	110
		Warren Wilson College	14
		Wingate University	54
		Total Private “Touches”	1977
<hr/>			
Total “Touches”			
Total Public			7511
Total Private			1977
In-state-trained teachers whose college and university connection is unknown			393
Total			9881

FINDINGS: ❶ The majority of in-state trained math and science teachers who completed traditional programs (c. 75–80%) also earned degrees in public universities. ❷ The impact of Regional Alternative Licensing Centers (RALC) licensure on math and science teacher totals is limited (21 RALC-only; another 41 in conjunction with an NC college or university).

A NOTE ABOUT TOUCHES: The state currently tracks information about institutions from which license-holders have degrees, but it does not track information about institutions at which license-holders completed their licensure work. Thus, a teacher may have graduated from Fayetteville State University with a bachelor’s degree in math and from Duke University with a master’s degree in statistics but have earned his high school math licensure at the University of North Carolina-Greensboro. In the licensure database, only his degrees from FSU and Duke would be listed; there would be no indication of his work at UNC-G.

The data in this table and in some sections of the full report were generated by counting “touches.” That is, every time a college with a math or science licensure program is mentioned in a teacher’s record, that school is given credit for “touching” or potentially influencing a teacher and her or his decision to teach math or science. The resulting number is therefore not a true count of college and university production but instead only an approximation (and an over-estimate in almost all cases). Thus, when we report that 1,457 of the math and science teachers teaching in 2005-2006 were “touched” by Appalachian State University, we are saying that 1,457 math and science teachers have at least one degree from ASU. The actual proportion of those teachers who earned their licensure at ASU is smaller but unknown. While this solution to the problem is acceptable for the back-of-the-envelope estimates presented in this report, more accurate and meaningful assessments of college and university teacher production will require more accurate records.

Graph 1
Distribution of Teachers by Experience, 2005–2006



teachers who leave the profession, the classroom, or the state—not to meet the demand of increasing student enrollment. In 2005, just over 500 math and science licensure candidates completed in-state licensure programs. Our estimate for the demand for N.C. math and science teachers is around 1,200 new teachers a year. Therefore, the state’s colleges and universities are not producing as many teachers as are needed to meet the annual demand.

It is inaccurate to conclude, however, that the only reason for the shortage is that the state is not producing “enough” teachers. A high teacher turnover rate and decisions to teach in other states contribute to the shortage. For example, not all of the over 500 candidates who completed licensure programs in-state in 2005 chose to teach in North Carolina. Also, several colleges support many active teachers still enrolled in lateral entry programs.

RETENTION

■ *Math and science teachers leave the classroom at a very high rate during their first two years of teaching, and they continue to leave at a lower but steady rate in succeeding years. Based on 2004–2005 and 2005–2006 figures, math and science teachers leave the classroom rapidly after the first two years of teaching. A steady but lesser share of each cohort of teachers continues to leave the classroom over the next 12 years of their careers. In 2005–06, 7.4% of the secondary-school teaching workforce had no experience, and 6.4% had only one year of experience.*

■ *For every 10 math and science teachers hired, more than 7 are hired to fill vacancies and slightly more than 2 are hired to meet growth in the student population. It is difficult to estimate the total annual number of math and science teachers newly hired by*

the state. We can, however, make approximations. Conservatively, we estimate that North Carolina districts made about 1,200 new hires in 2005–2006. The secondary student population has grown by about 2.5% per year over the past 10 years. At the current teacher-student ratio, this rate of enrollment growth suggests that fewer than 300 of the state’s estimated 1,200 vacancies last year were new positions. As a result, the majority of the more than 900 zero-experience teachers hired for the 2005–2006 school year were hired to replace departing experienced teachers, not to meet demand created by growth in the student population. There always will—and should—be vacancies due to turnover; the question for the state is whether the current rate of turnover is acceptable, especially given the current production rate of in-state math and science teacher preparation programs.

■ *Some of the retention problem is a result of teachers moving among districts in the state, not just of the state losing teachers due to retirement and career changes.* Estimates for this report suggest that the statewide annual leaving rate for math and science teachers is probably around 7%. However, in a 2005 study, the Department of Public Instruction reported an average annual teacher leaving rate for all disciplines of about 12% per district. One reason why our statewide estimate is lower than the average reported leaving rate is because our statewide rate does not include teachers who stay in-state and in-profession but who move between districts. In 2004–2005, nearly 20% of all teachers who left their positions did so to take jobs in another district in the state.

QUALITY

■ *Most of the state’s licensed math and science teachers are designated as highly qualified; however, middle school science li-*

cence holders lag behind other math and science teachers in earning the highly qualified designation. More than 88% of the licenses held by licensed math and science classroom teachers also were held by teachers who were designated “highly qualified” for those areas of licensure under the stipulations of the federal No Child Left Behind Act. The rate was highest for high school math and science teachers (about 94%). However, in 2005–2006, more than 1,000 (nearly 22%) of the 4,750 middle school science license holders were not designated “highly qualified.”

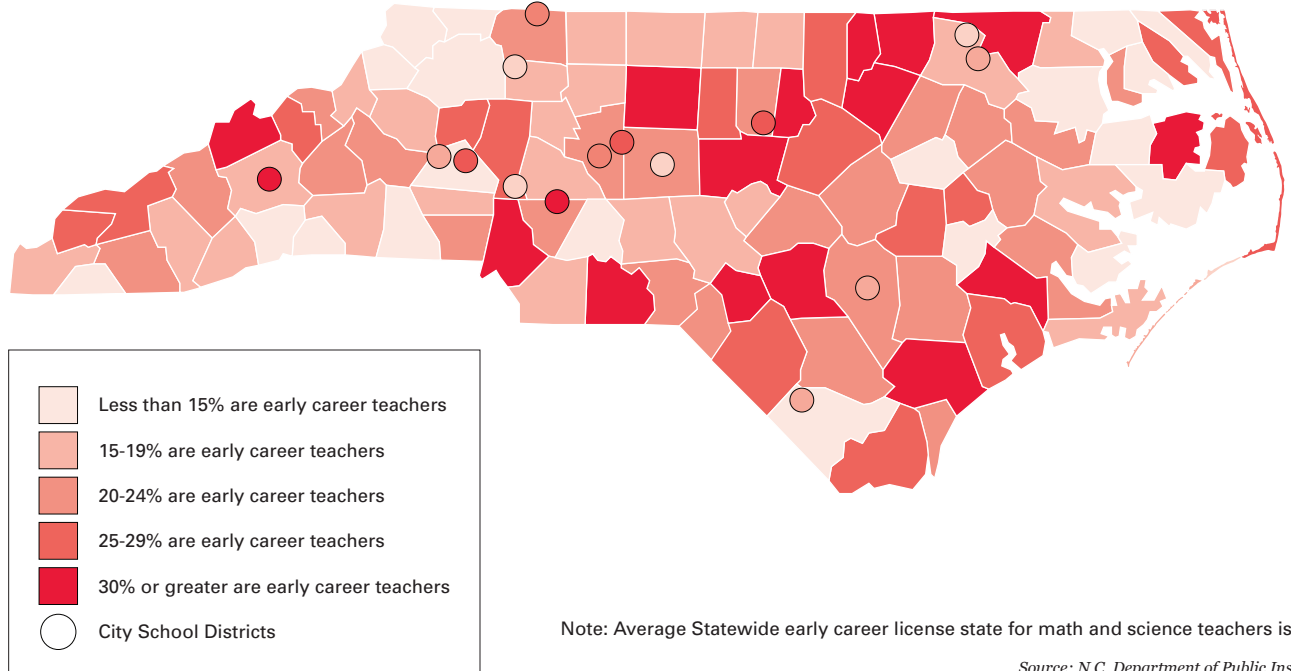
■ *In 40 school districts, one-fourth of the math and/or science teachers are teachers with 0 to 3 years of experience (“early career teachers”); in 11 of these districts, early career teachers make up one-third or more of the licensed math and science teacher corps.* Though a definite pattern is not discernable, it is interesting to note that of the 16 largest districts (districts with more than 10,000

students), 10 employed a higher-than-average number of early career math and science teachers (led by Guilford County at above 33%). By contrast, of the 14 smallest districts (districts with fewer than 1,000 students), only 4 employed a higher-than-average number of early career math and science teachers (in fact, Camden and Gates Counties employed no math and science teachers with fewer than 4 years of experience). On the other hand, the teaching workforces of three small districts—Hoke, Jones, and Vance Counties—were composed of at least 40% early career teachers.

PRESENCE

■ *School systems of similar size sometimes employ widely different numbers of licensed math and science teachers.* On average, North Carolina school districts employed about 21 teachers per 1,000 secondary students. Actual district employment ratios ranged from as few as 11 licensed teachers per 1,000 secondary

Map 2
Percentage of Early Career Licensed Math and Science Teachers Working in Each District



students (Yadkin County) to as high as 35 licensed teachers per 1,000 secondary students (Hyde County).

■ Many of our active and licensed math and science teachers (more than 2,000, or roughly 13%) are not working in middle or high school classrooms. More than 1,600 (about 11% of all) active teachers with middle or high school math and/or science licenses were teaching in elementary schools during the 2005–2006 school year. Nearly 400 more (about 2.5% of all licensed and active) were working in central administration offices. Therefore, one possible reason for a math and science teacher shortage is because thousands of eligible teachers are working in some other capacity within school systems. To be sure, many of the elementary teachers likely hold elementary licenses as well as math and/or science licenses, but according to NC DPI research (2005), math and science positions have been consistently much harder to fill than have been elementary positions.

LIMITATIONS OF THE DATA

This issue of Carolina Context is pulled from a larger report, *Examining the Pipeline: An Analysis of Math and Science Teacher Preparation in North Carolina*, that can be found on the Program web site, www.southnow.org. This analysis presents as many questions as it does answers.

The state currently tracks information about institutions from which license-holders have degrees, but it does not contain information about institutions at which license-holders completed their licensure work. This is an important distinction. A teacher may have graduated from Fayetteville State University with a bachelor’s degree in math and from Duke University with a master’s degree in statistics but earned his high school math licensure at the University of North Carolina-Greensboro. In the licensure database, only his degrees from FSU and Duke would be listed; there would be no indication of his work at UNC-G.

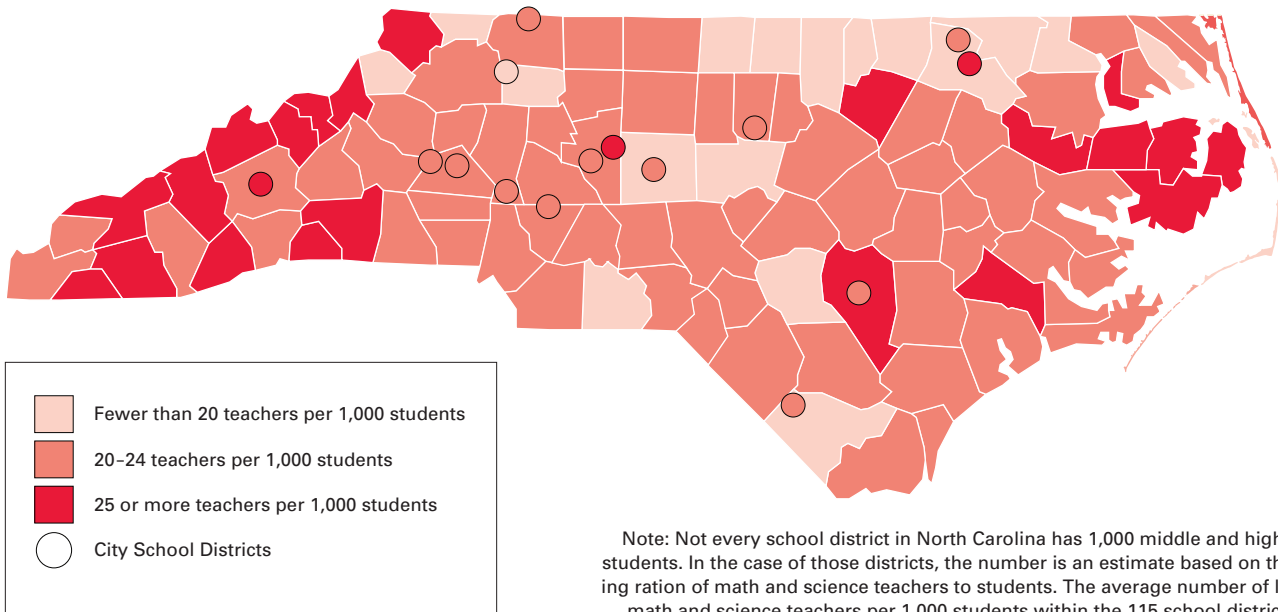
The effects of these missing data are two-

fold: first, it is difficult to assess accurately how many North Carolina based teachers an institution has produced; and second, it reduces the state’s ability to draw connections between teacher quality and teacher training.

In addition, available data do not allow us to compare the demand for math and science teachers for the past several years across local education agencies (LEAs), nor do they allow us to compare accurately the number of math and/or science teachers who leave the profession to the number of new math and/or science hires. Finally, our data did not indicate how many unlicensed teachers are teaching math and/or science in North Carolina.

We realize that the UNC General Administration, the Department of Public Instruction, and others are actively considering these data shortcomings. Our goal in this report is to offer an initial analysis of what is available and to inform the policy discussions over improving math and science teacher education. ■

Map 3
Number of licensed math and science teachers per 1,000 students



Source: N.C. Department of Public Instruction

Table 2

Total Math and Science Licenses Held, by License Level, 2005–2006

Total # of Math and Science Licenses Held by NC Teachers	20875	
Teachers Who Received At Least One License, of Any Level, from a Traditional In-State Program	57.3%	11958
Teachers Who Received Their Licenses from Out-of-State Institutions or Through Alternate Programs	42.7%	8917
Total # of Bachelor’s-Level Licenses in Math and Science	17837	
Teachers Who Received At Least One License, of Any Level, from a Traditional In-State Program	55.8%	9952
Teachers Who Received Their Licenses from Out-of-State Institutions or Through Alternate Programs	44.2%	7885
Total # of Master’s-Level Licenses in Math and Science	2944	
Teachers Who Received At Least One License, of Any Level, from a Traditional In-State Program	66.4%	1955
Teachers Who Received Their Licenses from Out-of-State Institutions or Through Alternate Programs	33.6%	989
Total # of 6th-Year-Level Licenses in Math and Science	59	
Teachers Who Received At Least One License, of Any Level, from a Traditional In-State Program	67.8%	40
Teachers Who Received Their Licenses from Out-of-State Institutions or Through Alternate Programs	32.2%	19
Total # of Doctoral-Level Licenses in Math and Science	35	
Teachers Who Received At Least One License, of Any Level, from a Traditional In-State Program	31.4%	11
Teachers Who Received Their Licenses from Out-of-State Institutions or Through Alternate Programs	68.6%	24

Note: Totals reflect all math and science licenses held by people currently employed by NC public schools; a teacher can hold more than one license.

Table 3

Where Active Math and Science Teachers Were Working in North Carolina, 2005–06

15,304	school employees held a math or science license for middle or high school
8,609	of these employees were licensed through traditional in-state licensure programs
1,340	of these employees were enrolled in lateral entry programs
5,355	of these employees were licensed through other licensure programs
13,276	licensees were teaching in middle or high schools (86.7%)
1,646	licensees were teaching in elementary schools (10.8%)
382	licensees were working in central offices (2.5%)

FINDING: There are a sizeable number of public school employees who are licensed to teach math or science but who are currently working in other capacities (e.g., elementary education or central office work).

Work in Progress

The UNC Program on Public Life remains in the process of building a website (www.southnow.org) that serves to provide policy makers, faculty, students and citizens with data and analysis on electoral trends and issues in North Carolina and the South.

This issue of Carolina Context summarizes the research conducted by Trip Stallings, a PhD student at UNC-Chapel Hill. You can find a link

to the full report, as well as a pdf version of this white paper, on the southnow.org home page.

If you would like to receive a paper copy, please let us know by emailing our colleague Kendra Cotton at kendradc@unc.edu.

In addition to Carolina Context, the website contains archives of our other publications, NC DataNet and SouthNow.

We have in process the following projects: **NC DataNet** - 1) a data profile of the 2007-08 General Assembly; 2) an analysis of the 2006

judicial elections; and 3) an analysis of trends in the 2006 Congressional elections

SouthNow - A report on the state of entrepreneurship in the Southern states.

Carolina Context - 1) a white paper on workforce training in bio-manufacturing and “sector-based economic development strategies; and 2) the results of two working roundtables on issues affecting coastal communities.