Consortium for Educational Research and Evaluation– North Carolina

North Carolina's STEM High Schools:

An Overview of Current Data

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NORTH CAROLINA'S STEM HIGH SCHOOLS: AN OVERVIEW OF CURRENT DATA

Executive Summary

Introduction and Background

North Carolina's four-year Race to the Top (RttT) grant provides an unprecedented opportunity to further the state's vision for science, technology, engineering, and mathematics (STEM) education and to develop its understanding of what constitutes a successful STEM school. Because the State's RttT-supported STEM initiatives are being introduced into a context in which STEM-focused activity has already been underway for a decade or more, a critical first step for the evaluation of the RttT STEM initiatives is to understand and describe current STEM conditions.

This report describes measures of the STEM high school education landscape for the 2009–10 school year that will serve as a baseline against which the Consortium for Educational Research and Evaluation–North Carolina (CERE–NC) will assess the implementation and impacts of RttT-sponsored STEM activities.

Data and Methods

School-level administrative data for this report (e.g., student demographics, course characteristics, teacher experience and credentials, expenditures, achievement scores, and graduation rates) were obtained from a database maintained by the Carolina Institute for Public Policy (CIPP) and assembled from North Carolina Department of Public Instruction (NCDPI) administrative records.

NCDPI provided evaluators with a list of high schools across the state currently self-identified as STEM schools and associated with three STEM-focused programs: Project Lead the Way Schools, Career and Technical Education Academies, and North Carolina New Schools Project STEM-focused high schools. The sample for this report includes all high schools in North Carolina that serve grades 9 and above and that do not serve lower grades (n = 477). Schools in this report are identified as either non-STEM (n = 358) or STEM (n = 119; Project Lead the Way schools: n = 53; Career and Technical Education academies: n = 69; New Schools Project high schools: n = 24).[1]

Findings

Based on data from the 2009–10 school year, along several different axes—demographic, financial, and academic—North Carolina's STEM schools appear to be similar to their non-STEM school peers in most respects, with notable exceptions in the proportion of lower-income students, minority students, and rural areas served, as well as in the performance of students in STEM schools with a high percentage of minority representation.

[1] There were 27 schools associated with more than one STEM program.

I. Equity of Opportunity

- *Engagement of underrepresented groups*. In 2009–10, North Carolina STEM schools served more black students and more students of poverty than did other high schools, hosted the same proportion of female students, and were much more likely to be located in rural areas.
- *Availability of advanced STEM courses*. In 2009–10, STEM schools offered a proportion of advanced STEM courses similar to the proportion offered by non-STEM high schools.
- *Access to highly qualified teachers and supportive school settings*. In 2009–10, faculty credentials and experience were similar across STEM and non-STEM high schools. Per-pupil expenditures for STEM and non-STEM schools were not statistically different, but school sizes often were larger for STEM schools.

II. Academic Outcomes

- *Student achievement*. Student outcomes for STEM and non-STEM schools in 2009–10 were not notably different overall, and by measures such as ABCs accountability designations appear to have been slightly worse, but outcomes for students in high-minority STEM schools appeared to surpass those of students in similar non-STEM schools.
- *Graduation rates*. The difference in four-year cohort graduation rates in 2009–10 for STEM and non-STEM schools was small but statistically significant.

Next Steps

One of the major guiding goals for the evaluation of the RttT STEM Schools initiative is to evaluate whether the RttT STEM anchor and network schools have expanded the academic opportunities and improved academic outcomes for students in the anchor and affiliated network schools. Over the next three years, CERE–NC will continue to track changes in these measures, identify the degree to which any changes are related to efforts connected to RttT, and apply the evidence to determine progress toward the stated goals of the North Carolina RttT STEM initiative.

Introduction

Student success in the core content areas of science, technology, engineering, and mathematics (STEM) is essential for North Carolina to develop a workforce that can compete in the global economy. In response to this critical need, over the past decade, North Carolina has developed several K–12 initiatives that are designed to inspire and prepare the next generation of scientists, mathematicians, and engineers, including STEM-focused high schools; schools that provide 1-to-1 computer learning environments; and extensive partnerships between high schools, colleges, and universities. These initiatives and others were developed with the expectation that they would result in: more engagement of groups that historically have been underrepresented in STEM areas (e.g., females, minorities, students from low-income families); an increase in access to teachers who are highly qualified to teach STEM content and supportive school settings statewide; provision of and increased enrollment in advanced STEM courses; increased student achievement in math and science courses; increased graduation rates; and an increase in the number of students who are well-prepared for post-secondary STEM opportunities.

North Carolina's receipt of a four-year Race to the Top (RttT) grant from the United States Department of Education in 2010 provides an unprecedented opportunity to further the state's vision for STEM education and to develop its understanding of what constitutes a successful STEM school. The state's RttT proposal recognized the ongoing need for increased student enrollment in STEM subjects, as well as for additional resources for strengthening STEM instruction statewide. The RttT STEM schools initiative will support two major activities in North Carolina:

- Establishment of four STEM anchor schools (STEM-focused high schools that will serve as regional leaders in STEM education), each of which will be focused on a major area relevant to North Carolina economic development (health and life sciences, biotechnology and agriscience, energy and sustainability, and aerospace); and

- Support for and growth of a broad network of STEM schools across the state, with the anchor schools serving as centers for professional development for principals and teachers in these networked schools. The anchor schools will support the network by providing instructional coaches, residencies for principals and teachers, peer school reviews, project-based learning curriculum development based on the Grand Challenges of Engineering curriculum, and models for innovative technology use and for collaboration and partnership with business and other STEM partners.

North Carolina's RttT proposal also included a commitment to evaluate the initiatives outlined in the proposal. This evaluation will take place over the full term of the grant (2010–2014) and is designed to determine the impact of each initiative on STEM-specific goals (outlined below) as well as on more general student outcome goals set by the state in its application. The evaluation is being conducted by the Consortium for Educational Research and Evaluation–North Carolina (CERE–NC), a partnership of the SERVE Center at the University of North Carolina at Greensboro, the Carolina Institute for Public Policy at the University of North Carolina at Chapel Hill, and the Friday Institute for Educational Innovation at North Carolina State University.

Background and Purpose

Overview of Current STEM Activities in North Carolina

The North Carolina Department of Public Instruction (NCDPI) provided CERE–NC with a list of 131 high schools across the state currently identified as STEM schools (see Appendix A). These schools are classified into the following categories: Project Lead the Way schools, Career and Technical Education academies, and North Carolina New Schools Project STEM-focused high schools.

- Project Lead the Way (PLTW) is an "activities-, projects-, and problem-based" STEM curriculum developed for both elementary and secondary students. It is designed to serve students from diverse backgrounds, not just students who are taking advanced courses or who already have an interest in STEM subjects. Classroom equipment—software and kits for hands-on activities—along with required teacher training are the significant costs associated with the program. The curriculum, delivered through PLTW's Virtual Academy, is provided free of charge to schools that register with PLTW. Approximately 14,000 North Carolina students participate in PLTW (http://ncpltw.pratt.duke.edu/).

- Career and Technical Education academies (CTE) offer students the opportunity to enroll in a program that is focused on a specific curricular area or theme. Enrolled students take a sequence of courses and receive specialized training in a particular career pathway. CTE academies aim to integrate academic and technical skills that prepare students for postsecondary education, training, and productive entry into the workforce. Currently, over 21,000 students are enrolled in CTE academies across the state (http://www.dpi.state.nc.us/docs/cte/briefing/academies.pdf).

- The North Carolina New Schools Project (NCNSP) sponsors STEM-focused secondary schools that are often located on community college campuses or in small-school academies located on the campuses of larger, traditional high schools. NCNSP STEM high schools are typically very small, usually with no more than 100 students per grade. The NCNSP STEM curriculum emphasizes connections between the fields of mathematics and science, integrates appropriate technology tools, and utilizes the engineering design process. These high schools also focus on implementing NCNSP's core Design Principles for innovative high schools; these principles include promoting college readiness, implementing rigorous and engaging instruction, facilitating personalized learning for students, and demonstrating shared leadership. Almost 3,000 North Carolina students attend NCNSP high schools focused on STEM (http://newschoolsproject.org/our-schools/school-models/stem).

Overview of the Evaluation of the RttT STEM Schools Initiative

CERE–NC's four-year evaluation of the RttT STEM schools initiative will include a descriptive study and documentation of the implementation of this initiative and related outcomes for students, teachers, schools, and school networks. The evaluation will utilize a mixed-methods approach, which will include a comparative analysis of extant quantitative data at the beginning and conclusion of the RttT grant period, coupled with qualitative and survey data analyses throughout the evaluation period. Quantitative data will consist of student and school staff surveys and data provided by the Department of Public Instruction and the University of North Carolina General Administration (UNC–GA) that has been compiled by one of the CERE–NC partners. Qualitative data will consist of observations of professional development, site visits to STEM schools, and interviews with providers. The goals of the evaluation of the RttT STEM Schools initiative are to:

- Provide a descriptive study and documentation of the implementation of the initiative to assess the fidelity with which the state meets the terms of its agreement with the United States Department of Education;

- Provide a formative evaluation for all RttT activities performed in order to develop the STEM schools network during the RttT period;

- Evaluate the initiative's outcomes for students, teachers, schools, and the proposed school network, with a particular focus on increases in the availability of and student participation in STEM learning opportunities; and

- Evaluate the sustainability and scalability of the initiative and provide recommendations about the continuation and expansion of this initiative to other schools and districts.

Purpose of this Report

As noted above, North Carolina's RttT-supported STEM initiatives are being introduced into a context in which STEM-focused activity already has been underway for a decade or more. A critical first step of the evaluation of RttT-supported STEM activities is to understand and describe current STEM conditions in order to meet one of the four evaluation goals described above—the evaluation of whether the RttT STEM Schools Initiative has been successful in expanding STEM opportunities and contributing positively to student outcomes. This report provides measures of the current STEM high school education landscape that will serve as baselines against which to estimate specific impacts of RttT-sponsored STEM activities.

Data, Sample, Measures, and Analyses

Data

Data for this report were obtained from a database assembled and managed by one of the CERE–NC partners, the Carolina Institute for Public Policy (CIPP). Teacher, student, and school-level data at CIPP were obtained from NCDPI, UNC–GA, and several other sources. CIPP houses an immense amount of linked student, teacher, classroom, school, and school district data from the 2004-05 school year through the present for all data sets.

School Sample

The sample for this report includes all high schools in North Carolina that serve grades 9 and above and do not serve lower grades (n = 477). Schools that serve grades 6–12, or a subset of middle and high school grades, were excluded; because the study used school-level data, it was important to have a consistent grade span across all compared schools. Schools in this report are identified as either STEM (n = 119) or non-STEM (n = 358). Sub-totals for the high schools categorized as STEM schools are:

- Project Lead the Way schools: n = 53
- Career and Technical Education academies: n = 69
- New Schools Project high schools: n = 24

The actual total number of STEM schools included on the list provided by NCDPI is 131[2]; however, in addition to removal of schools serving lower grades, several other schools were removed due to lack of data (e.g., some schools are new and do not yet have students). There are 462 non-STEM high schools in the full state count, but 104 of these schools include grades before grade 9 and therefore were dropped from the comparison sample for this report.

Measures

The RttT Evaluation Team has identified several measures that will serve as indicators of the key STEM student outcomes outlined above. They include:

Equity of Opportunity

- *Changes in the engagement of groups typically underrepresented in STEM fields*. School-level demographic measures include: student ethnicity, gender, and free- and reduced-price lunch eligibility; and school location.
- *Changes in availability of advanced STEM courses.* School-level measures include proportions of math and science course sections designated as "advanced."

[2] There were 27 schools associated with more than one STEM program.

- *Changes in student access to highly qualified teachers and supportive school settings.* School-level measures include teacher credentials and experience per-pupil expenditures, and school size.

Academic Outcomes

- *Changes in student achievement in math and science courses.* School-level measures include: average End-of-Course scores for math and science; and End-of-Course composite scores by poverty rate, minority population, and age of school.

- *Changes in graduation rates.* School-level measures include freshman cohort four-year graduation rate.

This report uses these measures to compare current high schools identified as having a STEM-based focus to non-STEM high schools. Future reports will report on changes in these measures that occur after the implementation of RttT in North Carolina.

Analyses

For many of the tables below (Tables 3, 4, 8, 12, and 13), the unit of analysis is the school, which allows for computations based on simple averages of the values of interest. For example, calculations for Table 3 (*Proportion of Schools by Size, 2009–10*) is based on a simple count of schools that fall into each school size category.

Because calculations of averages in the remaining tables (Tables 1, 2, 5, 6, 7, 9, 10, 11, 14, and 15) often involve school-level data that were generated from data collected at other levels (such as student-level or teacher-level), averages for these tables have been weighted to reflect variations in population sizes across schools. Notes on weights used are included with each of these tables.

Findings

I. Equity of Opportunity

Engagement of Underrepresented Groups

> *Finding: In 2009–10, North Carolina STEM schools served more black students and more students of poverty than did other high schools, hosted the same proportion of female students, and were much more likely to be located in rural areas.*

The following tables provide a comparison of student, teacher, and school demographics for STEM and non-STEM high schools for the 2009–10 school year. In general, these data reveal promising trends in terms of students served while also raising questions about the resources available to STEM schools.

As noted above, one commonly shared goal of STEM-focused education programs is to increase minority representation in STEM fields. There is evidence that this goal is being met when we compare the representation of black students in STEM high schools (39% of the student populations) and non-STEM high schools (24%; Table 1). The same outcome is not evident for Hispanic students, the state's next-largest minority group.

Table 1
Proportions of Students by Ethnicity, 2009–10

	STEM schools		**Non-STEM schools**		**State overall**	
	Mean	Range	Mean	Range	Mean	Range
Asian	3%	0%–16%	2%	0%–28%	2%	0%–28%
Black	39%	0%–96%	24%	0%–97%	31%	0%–97%
Hispanic	9%	0%–39%	8%	0%–47%	8%	0%–47%
Multiracial	3%	0%–12%	3%	0%–9%	3%	0%–12%
American Indian	1%	0%–18%	2%	0%–82%	2%	0%–82%
White	45%	1%–98%	61%	1%–98%	55%	1%–98%

Note: Across-schools means estimated by weighting per-school ethnicity proportions; weighting is by total number of students in each school.

Another commonly shared goal of many STEM programs is to encourage females—currently underrepresented in STEM-related fields—to participate in advanced mathematics and science courses. As indicated in Table 2, on average, female representation in North Carolina STEM schools is equivalent to female representation in non-STEM schools. At first glance, these figures might suggest that STEM schools are failing to meet the gender goal, but if typical female representation in STEM-related courses is low, then these balanced figures offer encouraging early evidence that STEM schools may be overcoming typical underrepresentation of females at the secondary level. It should be noted, however, that female representation varies considerably across STEM schools: Some STEM schools enroll low proportions of female students (East Wake School of Engineering, 22%; Southern Durham School of Engineering, 26%; Olympic High-Math, Engineering, Technology, and Science, 30%), while others enroll high proportions (Durham City of Medicine Academy, 80%; JF Webb High School of Health and Life Sciences, 77%; Howard Health and Life Sciences, 75%).

Table 2
Student Gender Proportions, STEM and Non-STEM Schools, 2009–10

	STEM schools	**Non-STEM schools**
	Mean	Mean
Female	49%	49%
Male	51%	51%

Note: Across-schools means estimated by weighting per-school gender proportions; weighting is by total number of students in each school.

STEM schools also share a common goal of targeting students from lower-income backgrounds. Table 3 indicates that, while many STEM schools serve small- to moderate-sized populations of students from lower-income backgrounds, there is currently a higher proportion of STEM schools (30%) than non-STEM schools (24%) with large populations of students eligible for free or reduced-price lunch.

Table 3
Schools by Proportion of Students Eligible for Free or Reduced-Price Lunch, 2009–10

School Classification	**STEM schools (*n*=119)**	**Non-STEM schools (*n*=358)**	**State overall (*n*=477)**
Low-Poverty	28%	24%	25%
Middle Quartiles	42%	51%	49%
High-Poverty	**30%**	**24%**	26%

Note: High-poverty = top quartile of schools, as ranked by proportion of students applying for free and reduced-price lunch. Low-poverty = bottom quartile of schools, as ranked by proportion of students applying for free and reduced-price lunch.

One way to reach lower-income and minority students in North Carolina is to locate schools in areas where higher proportions of these students live—typically, rural areas of the state. Table 4 reveals that STEM schools are much more often located in rural areas than are non-STEM schools. Though not as heavily represented as non-STEM schools, a large number of STEM schools also are located in cities, another locale with higher proportions of these students.

Table 4
Proportion of Schools by Location, 2009–10

	STEM schools (*n*=119)	**Non-STEM schools (*n*=358)**	**State overall (*n*=477)**
Rural	**38%**	**17%**	22%
Town	11%	9%	9%
Suburb	10%	17%	15%
City	**41%**	57%	53%

Note: Rural = schools located in fringe, distant, or remote rural areas; Town = schools located in fringe, distant, or remote town areas; Suburb = schools located in small, mid-sized, or large suburbs; City = schools located in small, mid-sized, or large cities.

Availability of Advanced STEM Courses

Finding: In 2009–10, STEM schools offered a proportion of advanced STEM courses similar to the proportion offered by non-STEM high schools.

Interestingly, STEM schools and non-STEM schools offered approximately the same proportion of advanced-level math and science courses in the 2009–10 school year (Table 5). These data suggest that overall, STEM schools may not yet be meeting their goal of providing their students with increased access to advanced math and science courses.

Table 5
Proportion of Math and Science Course Sections Designated as Advanced, 2009–10

	STEM schools		**Non-STEM schools**	
	Mean	Range	Mean	Range
Advanced Algebra 1	0%	0%–10%	1%	0%–57%
Advanced Algebra 2	34%	0%–100%	32%	0%–100%
Advanced Biology	33%	0%–100%	32%	0%–100%
Advanced Chemistry	57%	0%–100%	54%	0%–100%

Notes: The proportion of advanced courses represents the number of courses for a given subject offered at an *advanced* level, divided by the *total* number of courses for a given subject offered. This table provides the average proportion of advanced math and science courses in STEM and non-STEM high schools. Across-schools means estimated by weighting per-school advance course section proportions; weighting is by total number of course sections offered at each school.

Access to Highly Qualified Teachers and Supportive School Settings

> *Finding: In 2009–10, faculty credentials and experience were similar across STEM and non-STEM high schools. Per-pupil expenditures for STEM and non-STEM schools were not statistically different, but school sizes often were larger for STEM schools.*

The comparison of instructional staff across STEM and non-STEM school conducted for this report suggests the need for more in-depth investigation. For example, data on teacher credentials and experience (Table 6) indicate no real differences in average teacher background across STEM and non-STEM schools. Of particular interest may be the wide ranges in the proportions of advanced-credential holders and teachers with experience across all STEM schools. While such ranges may be expected across traditional high schools, the advanced curricula in STEM schools suggest the need for more experienced or more highly-credentialed teachers, yet there are instances of STEM high schools in which no more than 6% of the teachers hold advanced degrees, as well as schools in which no teachers hold National Board licensure. These wide ranges—and whether any relationships can be drawn between them and STEM student outcomes—may warrant additional inquiry.

Table 6
Proportion of Teachers by Credentials and Experience, 2009–10

	STEM schools		**Non-STEM schools**		**State overall**	
	Mean	Range	Mean	Range	Mean	Range
Teachers with an Advanced Degrees (Master's or Higher)	33%	**6%–71%**	32%	0%–100%	32%	0%–100%
National Board Certified Teachers	11%	**0%–33%**	12%	0%–100%	12%	0%–100%
Teachers with Three Years or Less Experience	20%	**0%–65%**	18%	0%–100%	19%	0%–100%

Note: Across-schools means estimated by weighting per-school credentials and experience proportions; weighting is by total number of teachers in each school.

Appendix B includes more detailed information about these distributions.

STEM-focused school programs often include components that require specialized and sometimes expensive equipment or human resources, but Table 7 suggests that, across many expenditure categories for the 2009–10 school year, STEM-focused high schools in North Carolina appeared to spend less per-pupil than did their non-STEM counterparts. These differences, though minor, are particularly evident for expenditures on regular instruction and instructional support. It is important to bear in mind, however, that none of the differences is statistically significant[3] and, at least in the case of the regular instruction expenses, might be explainable by differences in the experience levels and credentials of the teaching populations (Table 6). While a report of this nature is not designed to examine these differences in greater detail, they, like the credentials and experience discrepancies noted above, may benefit from further analysis.

Table 7
Per-Pupil Expenditures, 2009–10

	STEM schools	**Non-STEM schools**	**State overall**
	Mean	Mean	Mean
Total per-pupil expenditures	$8,008	$8,144	$8,103
Spending on regular instruction	$3,877	$4,020	$3,977
Spending on professional development	$57	$55	$56
Spending on instructional support	$316	$354	$343

Note: Across-schools means estimated by weighting per-school expenditures means; weighting is by total number of students in each school.

Finally, STEM high schools in North Carolina tend to be larger than other high schools (Table 8), with nearly 50% hosting student populations of 1,000 or more. This finding may be puzzling for some readers who tend to equate STEM schools with smaller schools, but as noted in the Background and Purpose section, the definition of a STEM school used for this report includes STEM programs that are embedded in larger school settings.

Table 8
Proportion of Schools by Size, 2009–10

	STEM schools (*n*=119)	**Non-STEM schools (*n*=358)**	**State overall (*n*=477)**
Small (500 or less)	30%	35%	34%
Medium (501 - 1000)	21%	34%	30%
Large (1001 - 2000)	**39%**	29%	31%
Extra-Large (2001 or more)	**9%**	2%	4%

[3] Two-tailed, unpaired *t*-tests indicated no statistically significant differences for total per pupil spending (t = .48; p = .63), regular instruction spending (t = .95; p = .34), PD spending (t = .18; p = .86), or instructional support spending (t = 1.19; p = .23).

II. Academic Outcomes

The final series of tables provides a baseline overview of academic outcomes for the 2009–10 school year for STEM and non-STEM high schools.

Student Achievement

> *Finding: Student outcomes for STEM and non-STEM schools in 2009–10 were not notably different overall, and by measures such as ABC accountability designations, they may have been slightly worse, but outcomes for students in high-minority STEM schools appear to surpass those of students in similar non-STEM schools.*

Each year, as part of North Carolina's ABCs accountability program, schools receive designations based on their performance on the state's End-of-Grade and End-of-Course tests. These ABC designations are awarded based on standards in two areas: (1) performance (typically, the proportion of students testing at or above grade level), and (2) growth (the extent to which testing data indicate that students have learned as much as or more than they were expected to learn in one year).

Student achievement data for the 2009–10 school year (Table 9) indicate little difference in mean scores on math and science End-of-Course (EOC) exams, regardless of school type. Mean score ranges across schools show that the lowest scoring STEM schools scored better than the lowest scoring non-STEM schools, but the highest scoring STEM schools scored lower than the highest scoring non-STEM schools.

Table 9
Mean Scores, Math and Science End-of-Course Exams, 2009–10

	STEM schools		**Non-STEM schools**	
	Mean	Range	Mean	Range
Algebra 1	151.56	138.73–162.42	151.64	137.56–165.36
Algebra 2	153.20	141.57–160.14	153.96	132.00–168.27
Biology	153.04	144.84–160.90	153.39	138.48–167.67
Geometry	153.87	139.00-164.90	154.57	135.00-167.69
Physical Science	152.99	142.25-163.80	153.52	135.00-167.86

Note: Across-schools means estimated by weighting per-school means; weighting is by total number of students in each school.

On the other hand, Tables 10 and 11, which compare schools with the highest and lowest proportion of poor and minority students, offer hope that STEM schools may be beginning to fulfill their promise of raising the performance of underprivileged and minority students. One way to look at overall student achievement in a group of schools is to use the performance composite, which measures the proportion of students who pass the End-of-Course exams. In 2009–10, STEM schools with high proportions of students in poverty performed only marginally better on average on the performance composite than did non-STEM schools with similar populations, but the lowest composite score for a high-poverty STEM school far exceeded the lowest score for a high-poverty non-STEM school (Table 10). Perhaps more notable is the difference in composite performance levels for STEM schools with high concentrations of minority students (Table 11). These schools performed almost 5 percentage points better than did their non-STEM high-minority peers. Because the data are limited to one year only, neither outcome necessarily indicates a trend or a conclusive difference, but both indicate the need to continue tracking these measures throughout the Race to the Top implementation period.

Table 10
Mean End-of-Course Performance Composite Scores by Poverty Rate, 2009–10

		STEM schools	**Non-STEM schools**	**State overall**
Low-poverty schools	*n*	33	87	120
	Mean	88.33	84.17	87.21
	SD	12.37	10.87	11.26
	Range	49.1–98.8	31.1–100.0	31.1–100.0
High-poverty schools	*n*	36	87	123
	Mean	72.05	69.51	70.53
	SD	12.41	17.17	15.88
	Range	43.0–93.6	10.8–97.2	10.8–97.2

Note: Across-school sub-groups means estimated by weighting per-school means; weighting is by total number of students in each school.

Table 11
Mean End-of-Course Performance Composite Scores by Minority Population, 2009–10

		STEM schools	**Non-STEM schools**	**State overall**
Low-minority schools	*n*	16	103	119
	Mean	88.97	84.17	84.97
	SD	4.72	9.47	9.04
	Range	79.9–97.0	39.0–99.4	39.0–99.4
High-minority schools	*n*	51	68	119
	Mean	73.11	68.19	70.91
	SD	12.65	17.96	15.99
	Range	43.0–94.3	10.8–100.0	10.8–69.6

Note: Across-school sub-groups means estimated by weighting per-school means; weighting is by total number of students in each school.

Table 12 indicates the proportion of STEM and non-STEM high schools that experienced either no growth, expected growth, or high growth, based on differences in predicted and actual changes in End-of-Course scores over a three-year period.[4] Overall, the proportions of schools exhibiting expected or high growth is similar for STEM (80%) and non-STEM (81%) schools; but it should be noted that there was a slightly higher proportion of non-STEM schools in 2009–10 that were classified as high growth (51%) compared to STEM schools (46%).

Table 12
School Representation by North Carolina ABCs Growth Category, 2009–10

	STEM schools	**Non-STEM schools**	**State overall**
No Growth	20%	18%	19%
Expected Growth	34%	30%	31%
High Growth	46%	51%	50%

Table 13 shows that, relative to non-STEM high schools, a higher proportion of STEM high schools received lower designations on the state's ABCs accountability program in 2009–10. A higher proportion of STEM high schools (26% versus 19%) were labeled as either *Priority* schools or *No Recognition* schools. A greater proportion of non-STEM schools (51% versus 44%) earned designations of *School of Distinction* or higher.

Table 13
School Representation by North Carolina ABCs Accountability Designation, 2009–10

	STEM schools	**Non-STEM schools**	**State overall**
Low Performing (less than 50% of their students' scores at or above grade level)	**0%**	1%	0%
Priority (50% to 60% of students at grade level)	**8%**	3%	5%
No Recognition (at least 60% of their students' scores at or above grade level)	**18%**	16%	17%
School of Progress (had at least 60% of their students' scores at or above grade level)	30%	28%	29%
School of Distinction (had at least 80% of their students' scores at or above grade level)	33%	**37%**	36%
School of Excellence (had at least 90% of their students' scores at or above grade level and did not make Annual Yearly Progress [AYP])	3%	**3%**	3%
Honor School of Excellence (had at least 90% of their students' scores at or above grade level and made AYP)	8%	**11%**	11%

Relative to other high schools in North Carolina, most STEM schools have been in operation for only a short amount of time, raising the question of whether the achievement outcomes for STEM schools reported above are not yet accurate measures of their true potential, due to the relative newness of the schools. As yet, there is not a large enough number of STEM schools with histories of more than 10 years to allow for a meaningful assessment of the validity of this

[4] If a school had only one previous year of data available, then the expectation for change is generated from that year's assessment only.

explanation, but disaggregation of 2009–10 achievement outcomes by school age (Table 14) offer little indication that the age of a STEM school has more bearing on the achievement scores of its students than does the age of a non-STEM school. End-of-Course composite scores for newer STEM schools (0 to 6 years old) lag more than 5 points behind scores for similarly aged non-STEM schools, and while those differences essentially disappear in later years, achievement scores for older STEM schools do not appear to surpass those for older non-STEM schools.

Table 14
Mean End-of-Course Performance Composite Scores by Number of Years School Has Been Open, 2009–10

	STEM schools		**Non-STEM schools**	
	Mean	Range	Mean	Range
0–3 years	78.92	57.70–88.60	84.13	26.00–100.00
4–6 years	82.61	63.60–96.10	87.84	75.50–99.40
7–10 year	83.30	74.40–98.80	85.05	67.20–100.00
10 years or more	78.47	43.00–97.00	78.74	10.80–97.70

Note: Across-school sub-groups means estimated by weighting per-school means; weighting is by total number of students in each school.

Graduation Rates

Finding: The difference in four-year cohort graduation rates in 2009–10 for STEM and non-STEM schools was small but statistically significant.

With a statewide emphasis on career and college preparation, increasing graduation rates for North Carolina students is a top priority for every high school in the state. Table 15 (following page) shows that, for the 2009–10 school year, the overall STEM school on-time graduation rate trailed the overall graduation rate of non-STEM schools[5], though the difference was small. It is important to note, however, that these are overall rates that do not take into consideration any of the differences in student populations in these schools (like those noted above in Tables 1 and 3). In addition, no STEM school graduated fewer than 50% of its students on time, while rates at some non-STEM high schools fell well below that level.

[5] A two-tailed, unpaired *t*-test indicated a significant difference in four-year cohort graduation rate between STEM and Non-STEM schools ($t = 2.25$; $p < .05$).

Table 15
Freshman Cohort Four-Year Graduation Rate, 2009–10[6]

	STEM schools	**Non-STEM schools**	**State overall**
n	110	304	414
Mean	77%	80%	79%
Range	51%–100%	24%–100%	24%–100%

Note: Across-schools rate estimated by weighting per-school rates; weighting is by total number of students in each school.

[6] These rates are higher than widely-reported state cohort four-year graduation rates (74.2% in 2009–10) because the sample of high schools for this report was limited to only those schools with grades no lower than grade 9.

Next Steps

Based on data from the 2009–10 school year, along several different axes—demographic, financial, and academic—North Carolina's STEM schools appeared to be similar to their non-STEM school peers in most respects, with notable exceptions in the proportion of lower-income students, minority students, and rural areas served, as well as in the performance of students in high-minority STEM schools .

As noted at the beginning of this document, one of the four major guiding goals for the evaluation of the RttT STEM Schools initiative is to evaluate whether the RttT STEM anchor and network schools have expanded the academic opportunities and improved academic outcomes for students in the anchor and affiliated network schools. Over the next three years, CERE–NC will continue to track changes in these measures, identify the degree to which any changes are related to efforts connected to RttT, and use this evidence to determine progress toward the stated goals of the North Carolina RttT STEM initiative. The data in this report suggest several lines of questions for future reports that may help to shed more light on the impact of STEM schooling:

- The role of teacher credentials and/or experience in student outcomes in STEM schools;
- Links between spending patterns, per-pupil expenditure, and student outcomes;
- Evidence of longer-term trends for STEM schools, across all data categories; and
- Further investigation of the nature and types of course offerings in individual STEM programs.

This report is limited in several ways, not the least of which are (1) its reliance on standard data categories and outcomes that may not fully represent the goals of all STEM education programs, and (2) its focus on only those high schools identified by NCDPI as having a STEM focus. In addition to continuing the lines of inquiry pursued in this preliminary report, North Carolina should consider ways in which the state can better and more accurately measure the progress of its STEM programs.

CERE–NC looks forward to continuing its investigation of the impacts of RttT-supported initiatives on STEM schooling outcomes in North Carolina.

Appendix A. STEM Schools Identified by the North Carolina Department of Public Instruction

LEA/ school code	School system	School name	Program name	PLTW	CTE	NSP
040700	ANSON	Anson New Technology HS		X		X
111700	ASHEVILLE CITY	School of Inquiry & Life Sciences at Ashville			X	
060302	AVERY	Avery HS	STEM Acad		X	X
080311	BERTIE	Bertie Early College of Agriscience & Biotechnology			X	
080700	BERTIE	Bertie STEM HS				X
100348	BRUNSWICK	West Brunswick HS		X		
132304	KANNAPOLIS CITY	A.L. Brown HS	Cabarrus Health Sciences Acad	X	X	
140305	CALDWELL	Career Center Middle College		X		
160313	CARTERET	East Carteret HS		X		
160314	CARTERET	Croatan HS		X		
160344	CARTERET	West Carteret HS		X		
180340	CATAWBA	Fred T Foard HS		X		
681308	CHAPEL HILL CARRBORO	Chapel Hill HS	Acad of Information Tech		X	
000001	CHARLOTTE MECK	CPPCC North Campus	Automotive& Motorsports Acad		X	
600302	CHARLOTTE MECK	Ardrey Kell HS		X		
600312	CHARLOTTE MECK	William Amos Hough HS		X		
600361	CHARLOTTE MECK	Butler HS		X		
600364	CHARLOTTE MECK	Military & Global Leadership	Davis Acad	X		
600376	CHARLOTTE MECK	E.E. Waddell HS		X		
600377	CHARLOTTE MECK	East Mecklenburg HS	Acad of Engineering	X	X	
600405	CHARLOTTE MECK	Harding University HS		X		
600415	CHARLOTTE MECK	Hopewell HS	Acad of Engineering MotorSports	X	X	
600426	CHARLOTTE MECK	Independence HS		X		
600445	CHARLOTTE MECK	Mallard Creek HS	Acad of Engineering MotorSports	X	X	
600457	CHARLOTTE MECK	Rocky River HS		X		
600466	CHARLOTTE MECK	Myers Park HS		X		
600480	CHARLOTTE MECK	North Mecklenburg HS		X		
600496	CHARLOTTE MECK	Phillip O. Berry School	Acad of Biotech & Medical Science, Information Tech & Engineering Motorsports	X	X	
600508	CHARLOTTE MECK	Providence HS		X		
600535	CHARLOTTE MECK	South Mecklenburg HS		X		
600576	CHARLOTTE MECK	West Charlotte HS		X		

LEA/ school code	School system	School name	Program name	PLTW	CTE	NSP
600579	CHARLOTTE MECK	West Mecklenburg HS		X		
600592	CHARLOTTE MECK	Vance HS	Acad of Engineering MotorSports	X	X	
600690	CHARLOTTE MECK	Garinger HS	Math & Science	X	X	
600694	CHARLOTTE MECK	Olympic HS	Math, Engineering, Tech & Science	X	X	
600697	CHARLOTTE MECK	Olympic HS	Biotech, Health & Public Services	X	X	
600698	CHARLOTTE MECK	Garinger HS	New Tech	X	X	
000002	CRAVEN	Craven Eastern Applied Science & Technology (EAST) Early College HS			X	
260318	CUMBERLAND	Jack Britt HS	Integrated Systems Tech		X	
260322	CUMBERLAND	Douglas Byrd HS	Green/Sustain Energy		X	
260325	CUMBERLAND	Cape Fear HS	Agriculture & Natural Sciences		X	
260357	CUMBERLAND	Gray's Creek HS	Information Tech		X	
260408	CUMBERLAND	Pine Forest HS	Information Tech		X	
260455	CUMBERLAND	Westover HS	Engineering Technologies; Health Sciences	X	X	
260700	CUMBERLAND	Howard Health & Life Sciences HS				X
280304	DARE	Cape Hatteras Secondary School of Coastal Studies			X	
000003	DAVIDSON	Technology Center	Oracle Acad		X	
290308	DAVIDSON	Central HS	Acad of Medical Science		X	
290324	DAVIDSON	East HS	Acad of Medical Science		X	
290336	DAVIDSON	Ledford HS	Acad of Medical Science & Biotech Acad		X	
290348	DAVIDSON	North Davidson HS	Acad of Preengineering & Medical Science	X		
290365	DAVIDSON	South HS	Acad of Medical Science		X	
290388	DAVIDSON	West HS	Acad of Medical Science		X	
310338	DUPLIN	Duplin Early College HS	AgriScience			X
310344	DUPLIN	East Duplin HS	Agribusiness Acad; Computer Information Tech		X	
310364	DUPLIN	North Duplin Jr./Sr. HS	Computer Information Tech		X	
310392	DUPLIN	WallaceRose Hill HS	Agribusiness Acad; Computer Information Tech		X	
320317	DURHAM	City of Medicine	Medicine Acad		X	
320356	DURHAM	Northern HS		X		
320365	DURHAM	Riverside HS		X		
320368	DURHAM	Southern HS	Southern School of Engineering	X	X	
320700	DURHAM	Southern School of Engineering				X
320701	DURHAM	Hillside New Tech HS				X
330328	EDGECOMBE	North Edgecombe High	Allied Health Sciences Acad		X	
330350	EDGECOMBE	Southwest HS	Allied Health Sciences Acad; Electronics Acad; Computer		X	

LEA/ school code	School system	School name	Program name	PLTW	CTE	NSP
			Engineering Tech Acad			
330358	EDGECOMBE	Tarboro HS	Allied Health Sciences Acad		X	
360418	GASTON	Highl& School of Tech	Business, Legal & Information Sciences; Manufacturing/Engineering/Graphics Tech; Health Sciences & Dental Acad		X	
390700	GRANVILLE	J.F. Webb School of Health & Life Sciences				X
390704	GRANVILLE	South Granville School of Health & Life Sciences			X	
410355	GUILFORD	James B. Dudley HS		X		
410407	GUILFORD	The Academy at High Point Central	Business & IT Acad; Medical Acad		X	
410545	GUILFORD	The Academy at Smith High	Medical Acad		X	
470312	HOKE	Hoke HS	Agriculture, Construction & Engineering; Tech, Art, & Business		X	
490320	IREDELLSTATESVILLE	Collaborative College for Technology & Leadership			X	
510399	JOHNSTON	Smithfield Selma HS		X		
530343	LEE	Southern Lee HS	Acad of Science, Tech, Engineering & Mathematics		X	
540315	LENOIR	Kinston HS		X		
540324	LENOIR	North Lenoir HS		X		
540336	LENOIR	South Lenoir HS		X		
640346	NASHROCKY MOUNT	Nash Central HS	Health Sciences Acad		X	
640350	NASHROCKY MOUNT	Northern Nash HS	Health Sciences Acad; (Networking)		X	
640361	NASHROCKY MOUNT	Rocky Mount HS	Health Sciences Acad; Acad of Information Tech		X	
640364	NASHROCKY MOUNT	Southern Nash High	Health Sciences Acad; AcgriScience Acad		X	
650326	NEW HANOVER	Emsley A. Laney HS	CISCO Acad (networking)		X	
650327	NEW HANOVER	Eugene Ashley High	CISCO Acad (networking)		X	
650342	NEW HANOVER	John T. Hoggard HS	CISCO Acad (networking)		X	
650352	NEW HANOVER	New Hanover HS	CISCO Acad (networking)		X	
182700	NEWTON CONOVER CITY	NewtonConover Health Science HS	The Newton School			X
660700	NORTHAMPTON	Northampton County HS West/STEM				X
670324	ONSLOW	Jacksonville High	Information Tech & Engineering Acad; Health Sciences	X	X	
670333	ONSLOW	Northside HS	21st Century (Information Tech)		X	
670340	ONSLOW	Richl&s HS	Engineering	X	X	
670352	ONSLOW	Swansboro HS	Health Sciences; Engineering	X	X	
670364	ONSLOW	White Oak HS	Tech; Health Sciences	X	X	
680332	ORANGE	Orange HS		X		

LEA/ school code	School system	School name	Program name	PLTW	CTE	NSP
740309	PITT	Ayden Grifton HS	Health Sciences Acad		X	
740333	PITT	D.H. Conley HS	Health Sciences Acad		X	
740344	PITT	Farmville Central HS	Health Sciences Acad		X	
740366	PITT	J.H. Rose HS	Health Sciences Acad		X	
740374	PITT	North Pitt HS	Health Sciences Acad		X	
740388	PITT	South Central HS	Health Sciences Acad		X	
830700	SCOTLAND	Scotl& HS of Health Sciences	Health Sciences		X	X
830703	SCOTLAND	Scotl& HS of Business, Marketing & Finance			X	
830705	SCOTLAND	Scotl& HS of Math, Science & Technology			X	
860354	SURRY	Surry Early College HS of Design				X
900316	UNION	Forest Hills HS	STEM Acad	X	X	
900336	UNION	Monroe HS	Engineering	X		
900366	UNION	Central Academy of Technology & Arts	Information Tech, Engineering, Medical Science	X	X	
910364	VANCE	Southern HS	Acad of Information Tech	X	X	
910370	VANCE	Northern HS	Acad of Information Tech	X		
920316	WAKE	Apex HS	Acad of Information Tech		X	
920318	WAKE	Athens Drive HS	Medical Science Acad		X	
920412	WAKE	Enloe HS	Medical & Bioscience Acad		X	
920466	WAKE	Knightdale HS	Acad of Environmental Studies		X	
920562	WAKE	Southeast Raleigh HS	Acad of Engineering	X	X	
920582	WAKE	North Carolina State University STEM Early College HS			X	
920583	WAKE	Wake Early College Health Sciences				X
920700	WAKE	East Wake School of Health Sciences				X
920701	WAKE	East Wake School of Integrated Technology				X
920703	WAKE	East Wake School of Engineering Systems		X		
930700	WARREN	Warren New Tech				X
960324	WAYNE	C.B. Aycock HS	Engineering Acad (PLTW)	X	X	
960335	WAYNE	Goldsboro HS	Wayne School Of Engineering			X
960386	WAYNE	Spring Creek HS	CTE Acad		X	
422700	WELDON CITY	Weldon STEM Academy				X
980318	WILSON	Beddington HS	Engineering, Industrial, Emerging Tech; Math, Science, & Health Sciences		X	
980336	WILSON	Fike HS	Engineering, Industrial, Emerging Tech; Math, Science, & Health		X	

LEA/ school code	School system	School name	Program name	PLTW	CTE	NSP
			Sciences			
340330	FORSYTH	Carver HS	Jacket Integrated Acad			X
340700	FORSYTH	School of Computer Technology Atkins	School of Tech at Atkins	X	X	
340701	FORSYTH	School of Biotechnology at Atkins	School of Biotech at Atkins	X	X	
340702	FORSYTH	School of PreEngineering Atkins	School of Preengineering at Atkins	X	X	

Note. PLTW=Project Lead the Way; CTE=Career and Technology Education; NSP=New Schools Project. X = School identified itself in this category.

Appendix B. Distributions of Teachers by School Type, Credentials, and Experience

Figures B1 through B3 (following pages) provide a visual representation of the distributions of teachers by advanced degree, National Board Certification, and experience (as reported in Table 7). STEM and non-STEM schools exhibit similar distributions with regard to the average proportion of teachers with advanced degrees and teachers with three or less years of experience. The only notable difference is in teachers with National Board Certification (NBC). There is a higher proportion of non-STEM schools with higher average proportions of NBC teachers than there are STEM schools; specifically, there are some non-STEM schools with more than 40% of NBC teachers, whereas STEM schools have no more than 33% NBC teachers within their schools.

Figure B1
Distribution of Teachers with Advanced Degrees (Master's or Higher): STEM and Non-STEM Schools

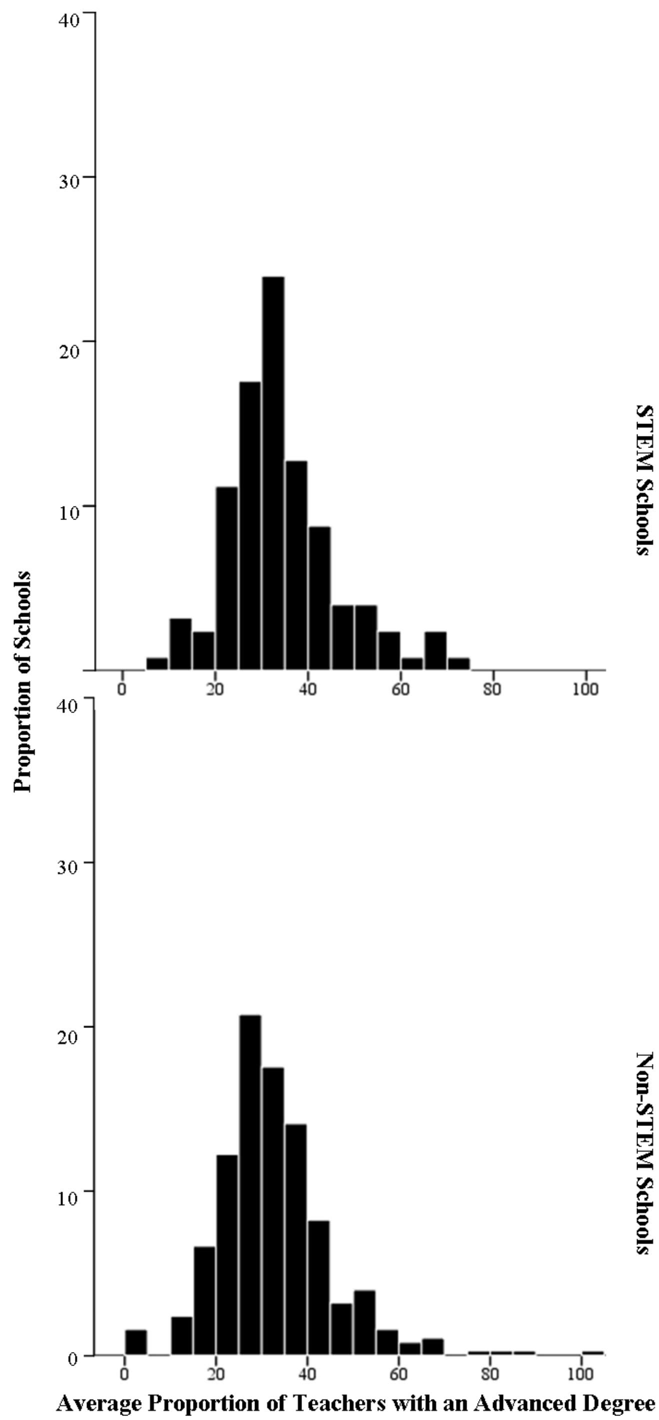


Figure B2
Distribution of Teachers with National Board Certification: STEM and Non-STEM Schools

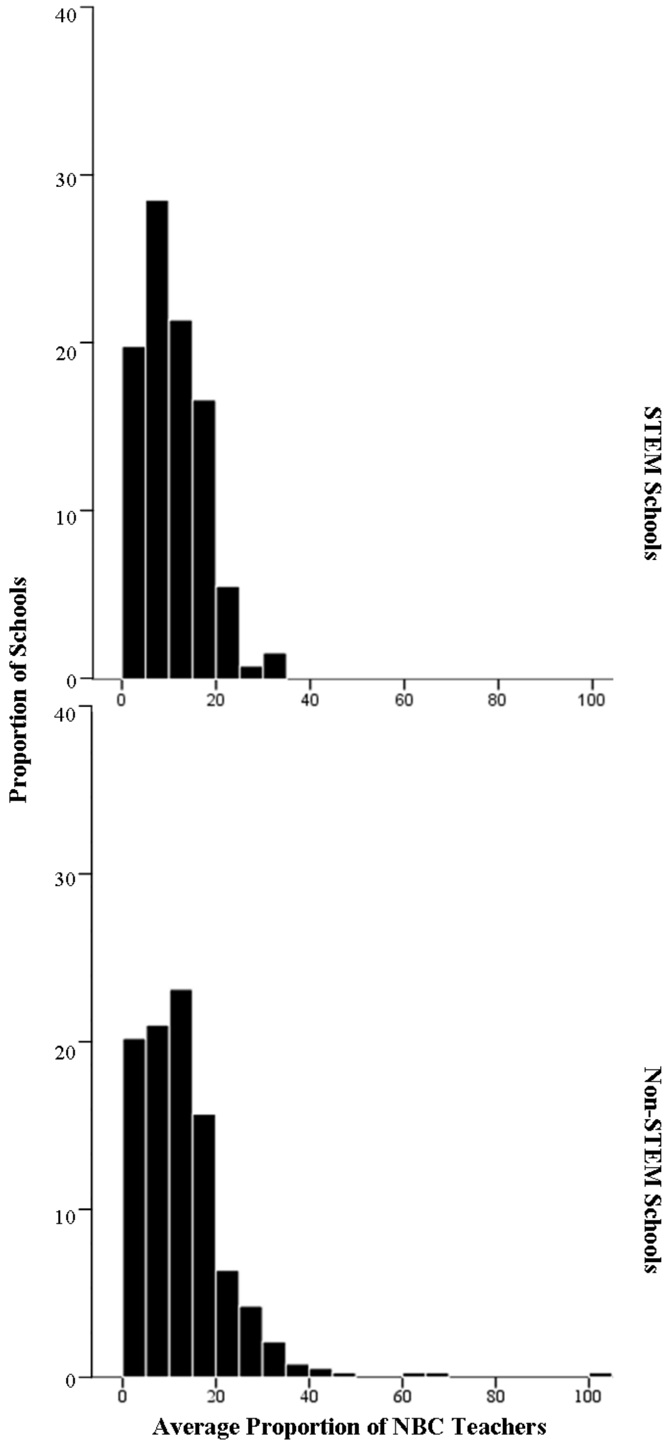
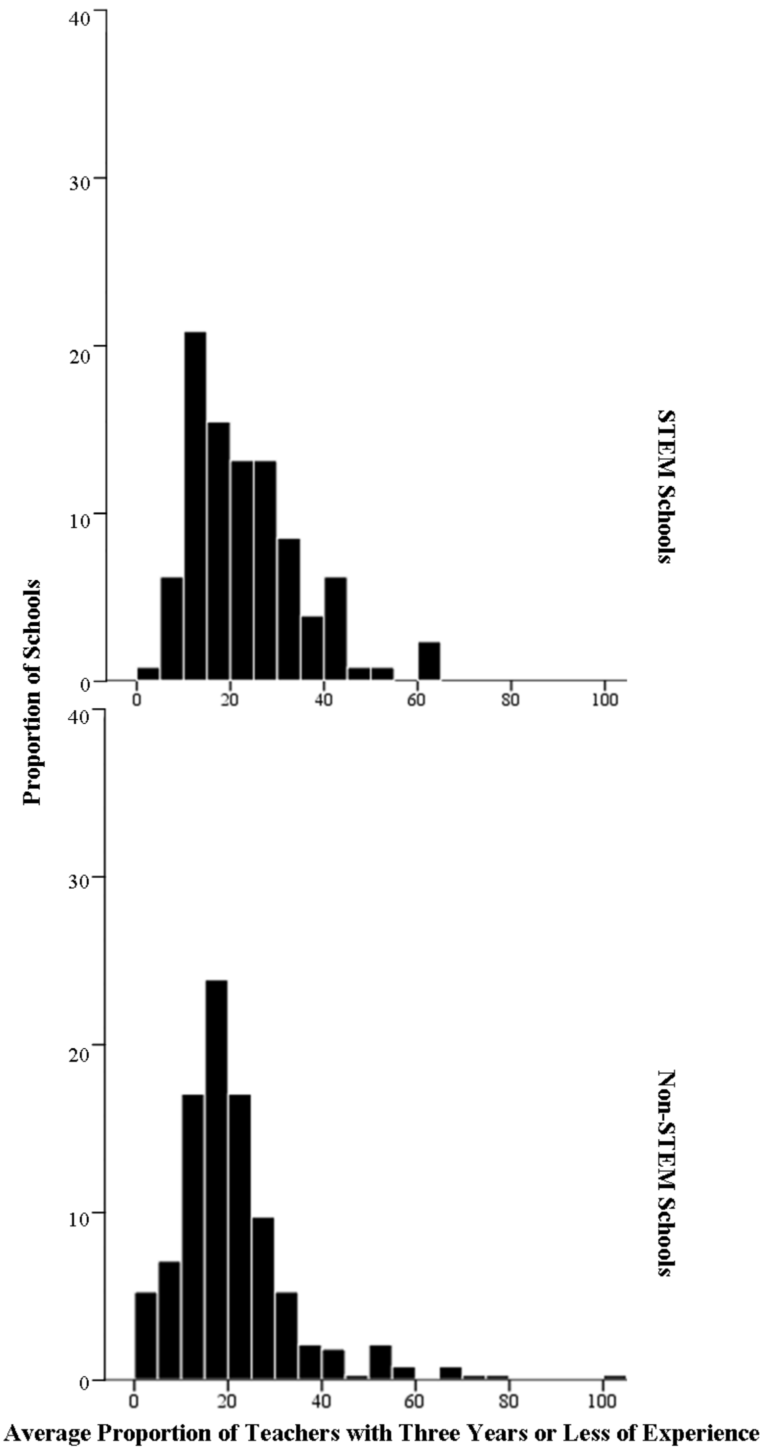


Figure B3

Distribution of Teachers with Three or Less Years of Experience: STEM and Non-STEM Schools



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