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Introduction

As technological advancements continue driving innovation and automation across much of the global economy, STEM* subjects—including coursework in science, technology, engineering and mathematics—have increasingly become an essential component of educational standards at all levels, from as early as pre-kindergarten up to secondary education and beyond. Local, state and federal policymakers all have emphasized the importance of STEM coursework to America’s students, appropriating hundreds of millions of dollars in recent years to ensure the next generation of workers is equipped with the skills and knowledge to compete in the global workforce.

To maintain a robust STEM-competent workforce, it is critical for states to establish a sustainable pool of qualified teachers who can educate students in STEM subjects at both the primary and secondary levels. Historically, a vast

* Identifying a concrete definition that encompasses every STEM category can be daunting. According to the Standard Occupational Classification System, released by the U.S. Bureau of Labor Statistics in 2010, STEM occupations include nearly 100 subjects under the umbrellas of management; computer and mathematics; architecture and engineering; life, physical and social sciences; education; healthcare occupations; and sales.

number of schools across the nation have experienced more difficulty recruiting and retaining a sufficient number of teachers for STEM classes than for other areas, a trend that has held steady for nearly 20 years.¹ Openings for physics, chemistry and math instructors often are the hardest to fill, leaving schools with few options beyond hiring teachers without proper certification or the background necessary to teach in these areas.² Similar shortages exist for other STEM courses, such as computer science, which are growing in popularity as states and school districts enact new measures to ensure students are exposed to emerging and evolving subject areas.³

For the United States to remain competitive in the global economy, it will be important for states to address these shortages in the years ahead. Not to do so compounds the risks that students will fall behind in many critical skills that are essential to maintaining sustainable economic growth in today’s globalized, automation-driven workforce. This *SLC Regional Resource* examines various initiatives in Southern states to increase the number of qualified primary and secondary teachers equipped with the skills and knowledge to successfully educate students in STEM subjects.

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Importance of STEM

Studies show that students who major in STEM subjects often have access to many of the nation's fastest-growing jobs, with some of the highest starting salaries. A 2016 report from the National Association of Colleges and Employers, a nonprofit organization in Pennsylvania that connects professionals with businesses, found that students completing bachelor's degrees in engineering, computer science, and math and sciences had starting salaries of \$64,891, \$61,321 and \$55,087, respectively, the highest among all job categories.⁴ These numbers mirror a similar report from 2015, by the Collegiate Employment Research Institute at Michigan State University, which found that the top 10 starting salaries for students completing a bachelor's degree program all were in STEM areas: chemical engineering, computer engineering, electrical engineering, software design, mechanical engineering, computer programming, computer science, civil engineering, "all technical" occupations and management information systems. The report found that average starting salaries for these occupations ranged from \$51,690 to \$63,389, compared to \$35,733 for advertising, \$36,235 for public relations, and \$36,327 for psychology, which were at the bottom of degrees examined by the study.⁵

Meanwhile, occupations requiring STEM skills have experienced faster growth than the overall job market during the past several years—a trend that is expected to continue in the future—and have reshaped the workforce and economies of many cities throughout the United States. According to a January 2017 report from the Bureau of Labor Statistics, employment in STEM occupations grew by 10.5 percent between May 2009 and May 2015, compared to 5.2 percent among all other occupations, bringing the total number of national STEM jobs to 8.6 million.⁶

Importantly, the growth in STEM employment supports people from different educational backgrounds and geographic areas, including many in the South. Cities across the Southern region—such as Atlanta, Austin, Dallas, Houston, Huntsville, Raleigh and Durham—all

have benefited from having an educated STEM workforce. A 2015 report from Bloomberg noted that the percentage of STEM workers in Huntsville, Durham, Austin, and Raleigh was 16.7 percent, 13.9 percent, 11.0 percent, and 10.3 percent, respectively, among the highest percentages in the country.⁷ Likewise, a 2013 report from the Metropolitan Policy Program at the Brookings Institution highlighted the benefits that STEM-competent workforces bring to cities throughout the region. Southern cities, particularly, have experienced sizable increases in sub-bachelor's STEM workers, also referred to as the technical STEM workforce.* The Brookings report found that, among the top 10 cities where sub-bachelor's STEM workers have the most jobs available to them, eight were in the South (See Table 1).⁸

As a result of this continuing growth and opportunity, states and schools across the country are crafting innovative strategies to expose students to STEM subjects at the earliest ages. Southern states often have been at the forefront of developments to create a more STEM-competent workforce that can remain competitive in the global economy for many years into the future. From mandating computer science courses for all K-12 students and providing incentives for high school students to excel in STEM subjects, to partnering with the private sector and leveraging companies' expertise in STEM areas, states throughout the South are taking the initiative to ensure students have the skills that are needed to succeed in the 21st century.

STEM Teacher Shortage

The existence and severity of teacher shortages in America have been debated extensively for many years. A widely cited September 2016 report from the Learning Policy Institute—a non-partisan organization that

*The National Science Foundation (NSF) defines *sub-bachelor's STEM workers* as people with a high school education, two-year technical training or a relevant certification who use significant levels of STEM knowledge on the job. The NSF predicted in 2014 that, when these workers are included, there may be as many as 26 million jobs that require significant STEM knowledge. According to the Brookings Institution, one out of every 10 jobs in the United States is classified as a sub-bachelor's STEM occupation.

focuses on improving education policy in the United States—estimated that a total of 64,000 teacher vacancies existed nationally during the 2015-2016 school year, which could increase to more than 110,000 by 2018, if current trends continue.⁹ Echoing these sentiments, mainstream media outlets across the country have offered anecdotal evidence suggesting that schools struggle to recruit and retain enough qualified educators, often forcing them to resort to a host of imperfect solutions, such as increasing class size, canceling courses, and hiring teachers who are uncertified in subjects they are teaching.^{10,11,12}

Others suggest the shortage of teachers is not as severe as many assert and, in fact, has significantly improved in recent years. According to a May 2016 study by the Education Commission of the States in Denver, Colorado, which works with policy leaders to address issues pertaining to education, 83 percent of schools in the 1999-2000 school year had at least one teaching vacancy, compared to only 68 percent in 2011-2012. Similarly, 36 percent of schools in 1999-2000 reported having at

least one subject area that was difficult to staff, whereas only 15 percent reported staffing difficulties in 2011-2012.¹³ The Center for Public Education in Virginia, an initiative of the National School Boards Association that provides data and research for policymakers and educators, reached similar conclusions, noting that the current national supply of teachers is sufficient to meet demand, though certain states and districts have more difficulty than others finding enough qualified educators.¹⁴

While experts and policymakers may disagree on whether an overall shortage of teachers in America's schools exists, there is less disagreement surrounding the lack of qualified STEM educators. At both the primary and secondary levels, vacancies for STEM subjects, primarily math and science, historically have been harder to fill than positions in other subject areas, apart from special education. Annual surveys conducted by the National Center for the Analysis of Longitudinal Data in Education Research (CALDER), associated with the American Institutes for Research in Washington, D.C., indicate that schools have reported difficulty

Table 1

Share of jobs and wages for sub-bachelor's STEM workers (top 10 metropolitan areas, ranked according to percentage of jobs available to sub-bachelor's STEM workers)

Metro Area	Percentage of all jobs available to sub-bachelor's STEM workers	Weighted average annual wage of STEM workers in sub-bachelor's jobs	Weighted average annual wage of non-STEM workers in sub-bachelor's jobs
Baton Rouge, LA	12.6	\$49,764	\$30,171
Birmingham-Hoover, AL	12.5	\$48,034	\$31,522
New Orleans-Metairie-Kenner, LA	12.4	\$51,891	\$31,970
Cape Coral-Fort Myers, FL	12.4	\$47,893	\$29,534
Wichita, KS	12.3	\$48,353	\$29,752
Tulsa, OK	12.3	\$44,851	\$30,498
Knoxville, TN	12.2	\$46,318	\$29,692
Cleveland-Elyria-Mentor, OH	12.1	\$52,164	\$31,453
Palm Beach-Melbourne-Titusville, FL	12.0	\$49,223	\$29,934
Virginia Beach-Norfolk-Newport News, VA-NC*	11.8	\$51,050	\$30,846

*The Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan Statistical Area includes five counties and nine independent cities in Virginia and two counties in North Carolina.

Source: Brookings Institution, 2013.

filling STEM vacancies for more than 20 years. In 1999-2000, approximately 32 percent of schools reported difficulty filling STEM vacancies, compared to less than 10 percent for traditional subjects. Similar disproportionate trends held throughout the 2000s and continued into the 2011-2012 school year, the last year of CALDER's survey.¹⁵ These findings are consistent with the U.S. Department of Education (DOE) which, in its annual list of teacher shortage areas, identified a lack of teachers in multiple STEM subjects. During the 2016-2017 school year, every Southern state experienced teacher shortages in at least one STEM area. Math, natural sciences, career technologies, computer science, technology and engineering were among the most common subjects experiencing teacher shortages.¹⁶

The lack of qualified teachers is particularly acute in rural school districts. Largely because of geographic isolation, lack of resources to competitively compensate teachers, and insufficient opportunities for professional development and certification, rural schools experience greater difficulty recruiting and retaining qualified educators. Teacher recruitment and retention issues, in turn, lead to further difficulties in meeting student benchmarks for math and science at the elementary, middle school and high school levels.¹⁷

Staffing STEM Vacancies

Like many educators, STEM teachers face challenging environments—relatively low pay coupled with high expectations—that result in high attrition rates. The Alliance for Excellent Education, a Washington, D.C.-based organization focusing on high school reform and student achievement, estimates that teacher attrition costs the United States approximately \$2.2 billion annually, in addition to invaluable losses of institutional knowledge and experience that departing teachers carry with them.¹⁸

Individuals with STEM backgrounds, and students with an interest in teaching STEM subjects, are particularly hard to recruit and retain due to the many other career paths available to them, many of which are more lucrative and do not require the additional coursework

required for teacher certification. Highlighting this dilemma, the Collegiate Employment Research Institute at Michigan State University found that students with bachelor's degrees in elementary education had starting salaries of \$37,480, while those working in middle school and high school had starting salaries of \$36,836 and \$38,055, respectively. These earnings are considerably less when compared to the starting salaries of many high-paying STEM careers, which range from approximately \$50,000 to \$63,000.¹⁹ According to the Education Law Center at Rutgers University, the starting salaries of teachers who begin careers at age 25 are approximately 80 percent of salaries for all other occupations. This trend worsens as teachers advance in their careers: nationally, teachers at age 45 earn about 70 percent of wages for all other occupations.²⁰

Given the disparity in pay, many STEM students have relatively little interest in pursuing teaching careers. A survey by the American Physical Society in Maryland—a nonprofit organization promoting physics education—revealed that 64 percent of computer science majors have no interest in teaching, followed by 59 percent of chemistry majors, 52 percent of physics majors, and 46 percent of math majors.²¹ A similar survey of prospective college students by ACT—a nonprofit primarily known for administering the standardized test of the same name—found that, out of approximately 2.1 million students, only 1,258 expressed an interest in teaching math or science.²²

Multiple solutions have been proposed to address the ongoing shortage of teachers to fill STEM vacancies. School districts could move away from single salary schedules, which assign teachers with similar experiences and education levels the same salary regardless of position or specialization. If prospective STEM teachers have lucrative job prospects in other sectors, higher salaries could, in theory, increase overall interest in teaching, as well as lower attrition rates for those already in the profession. Presently, many U.S. public school districts maintain single salary schedules, with one study estimating that approximately 90 percent of U.S. public school teachers work in districts that utilize them.²³

States also have the option of providing financial incentives for STEM students to pursue careers in education, most notably by offering loan forgiveness or scholarships for those who opt to teach in designated “critical subjects” or high-need geographic areas. Removing certification barriers, which often prevent people from being able to teach in other states without fulfilling additional requirements beforehand, also has shown potential.²⁴

State	Universities
Alabama	University of Alabama–Birmingham
Arkansas	University of Arkansas–Lafayette University of Arkansas–Little Rock
Florida	Florida Institute of Technology Florida International University Florida State University University of Florida
Georgia	Columbus State University Kennesaw State University University of West Georgia
Kentucky	Morehead State University Western Kentucky University
Louisiana	Louisiana State University Louisiana Tech University
Oklahoma	Oklahoma State University
Tennessee	Middle Tennessee State University University of Tennessee–Chattanooga University of Tennessee–Knoxville
Texas	University of Houston University of North Texas University of Texas–Arlington University of Texas–Austin University of Texas–Dallas University of Texas–Brownsville University of Texas–Rio Grande Valley University of Texas–San Antonio University of Texas at Tyler
Virginia	Old Dominion University
West Virginia	West Virginia University

Source: UTeach Institute, University of Texas–Austin, 2017.

Southern Initiatives

States in the South have taken many steps toward ensuring that a steady stream of qualified and well-prepared STEM teachers is flowing into classrooms upon graduation. Both legislatively and in partnership with the private sector, philanthropic organizations and universities, the Southern region often has been at the forefront in preparing students and qualified professionals for careers in teaching STEM subjects.

For instance, UTeach, a nationwide STEM teacher preparation program, originated in the South at the University of Texas–Austin. The program schedules STEM degree coursework concurrently with teaching certifications, which allows interested students to prepare for teaching careers in STEM subjects within the standard four-year bachelor’s degree timeline.²⁵ Although the UTeach curriculum has been adopted at institutions across the country, the South remains predominately represented. Out of the 45 institutions that have adopted the teaching preparation program, 29 (nearly 65 percent) are in Southern states, including Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Oklahoma, Tennessee, Texas, Virginia and West Virginia (See Table 2).²⁶

Southern states also have experimented with other models that encourage greater STEM teacher preparation and retention. For instance, multiple states in the South provide financial incentives for students and professionals interested in pursuing teaching careers in STEM subjects (See Table 3). These include student loan forgiveness and repayment, as well as sizeable college scholarships for prospective teachers.

Other initiatives implemented in recent years include public-private partnerships to leverage corporations’ expertise in STEM areas; summer residency STEM programs for teachers; and utilization of federal and philanthropic grants to support teacher training preparation programs at universities. During the past few years, nearly every state in the Southern region has implemented at least one measure to increase the number of STEM teachers in schools.

STEM Teacher Financial Incentives

ARKANSAS

The state Department of Higher Education administers annual loan repayments to public school educators teaching critical subjects or within geographic areas designated by the department. Known as the State Teacher Education Program (STEP), educators receive loan payments for federal student loans in the amount of \$3,000 for each year of qualification. Minority teachers who qualify for STEP also may receive an additional \$1,000 for each year of teaching in a public school. Educators are eligible for loan repayment for up to three years.²⁷ For the 2016-2017 school year, critical STEM-related subject areas include mathematics for grades 7-12; agriculture science and technology for grades 7-12; and computer science, physics and chemistry for all grade levels.²⁸ During the 2015-2016 school

year, 347 teachers received repayments through STEP, according to the Department of Higher Education.²⁹

MISSISSIPPI

Educators who hold an Alternate Route Teaching License and teach a critical subject area, or in a critical geographic area, are eligible for the Mississippi Teacher Loan Repayment Program (MTLR), administered by the Mississippi Office of Student Financial Aid. Recipients are eligible to receive an annual maximum repayment of \$3,000 toward undergraduate loans, for up to four years. Federal undergraduate student loans qualify for repayment; Perkins Loans and other graduate study loans do not. Due to budget constraints, no new awards will be granted for the 2017-2018 school year. Only educators applying for renewal of the loan repayment program will receive additional funds.³⁰ During the 2015-2016 school year, critical STEM-related

State	Program	Type of Assistance	Applicable STEM Subjects
Arkansas	State Teacher Education Program (STEP)	Loan repayment	Grades 7-12 mathematics; grades 7-12 agriculture science and technology; computer science; physics; chemistry
Mississippi	Mississippi Teacher Loan Repayment Program (MTLR)	Loan repayment	Mathematics; biology; chemistry; physics
North Carolina	North Carolina Teaching Fellows Program	Loan forgiveness	None; legislation proposed during the 2017 legislative session
Oklahoma	Teacher Shortage Employment Incentive Program (TSEIP)	Loan forgiveness	Applies to those who teach math or science in public secondary schools
South Carolina	South Carolina Teacher Loan Program; South Carolina Careers Changers Loan; Program of Alternative Certification for Educators	Loan forgiveness	Secondary and middle school mathematics; secondary and middle school science; career and technology; engineering
Tennessee	Math and Science Teacher Loan Forgiveness Program	Loan forgiveness	Mathematics; science
Texas	Teach for Texas Loan Repayment Assistance Program; Math and Science Scholars Loan Repayment Program	Loan repayment	Mathematics; science; career and technical education; computer science and technology applications
Virginia	Virginia Teaching Scholarship Loan Program	Scholarship	Mathematics; science

Source: SLC research of state departments of education.

subject areas included mathematics, biology, chemistry and physics.³¹ The Mississippi Institutions of Higher Learning confirmed that 161 participants took advantage of MTLR during the 2016 fiscal year.³²

NORTH CAROLINA

During the 2017 legislative session, legislators introduced Senate Bill 252, which would allow new teachers to receive up to \$8,250 each year in loan forgiveness grants for teaching any STEM subject or special education in a public school.³³ If passed, the legislation would revive the North Carolina Teaching Fellows Program, discontinued in 2015. Under the bill, loan forgiveness is provided to qualified teachers who teach two years for each year loans are received. For those who also opt to teach in a low-performing school, only one year of teaching is needed for each year a loan is received. Legislators are calling for annual appropriations of approximately \$6 million to award up to 160 teachers per year.³⁴ As of this writing, the bill is working its way through Senate committees.

OKLAHOMA

The Teacher Shortage Employment Incentive Program (TSEIP) was created by Senate Bill 1393, passed and signed into law by the governor in 2000. The program was designed to produce more math and science teachers in Oklahoma's public secondary schools by forgiving a portion of teachers' college loans. To qualify for forgiveness, certified teachers must teach in the areas of math or science for five consecutive years at a public secondary school. The total incentive distributed to qualified individuals for loan forgiveness is based on the amount appropriated toward the program in the annual state budget and, thus, varies each year. However, the total amount of payments to one teacher may not exceed the average cost of three years of tuition and fees for an undergraduate resident at institutions offering teacher education programs. Eligible student loans for TSEIP include Stafford Student Loans, Perkins Loans, privately funded loans issued through institutions of higher education, Consolidation Loan Program loans, and loans made pursuant to the federal Supplemental Loans for Students program.³⁵

According to the Oklahoma State Regents for Higher Education, 61 students participated in TSEIP during the 2016-2017 school year.³⁶

SOUTH CAROLINA

The *South Carolina Educational Improvement Act of 1984*, initially passed to encourage qualified students to enter the teaching profession, led to the formation of three distinct loan programs that incentivize careers in teaching: the South Carolina Teachers Loan Program, South Carolina Career Changers Loan Program and the Program of Alternative Certification for Educators (PACE).³⁷ Administered by South Carolina Student Loan, a nonprofit, state-designated education lender, the Teachers Loan Program was established to encourage interested and qualified students to enter the teaching profession in a critical subject area, while the Career Changers Loan Program was designed to assist individuals interested in changing careers with obtaining certification in critical subject areas.³⁸ Meanwhile, prospective teachers also may apply for a loan to participate in PACE, which confers a teaching certificate after three years of study within a critical subject area. To qualify for the PACE program, candidates must already hold at least a bachelor's degree that aligns with one of the designated subject areas; pass a subject-specific teacher certification assessment; undergo a background check; and be employed as a full- or part-time teacher of a qualifying subject area in a South Carolina public school.³⁹

Award amounts for each loan program vary. For the Teachers Loan Program, freshmen and sophomore students can borrow up to \$2,500 per year, while upper class undergraduate and graduate students can borrow up to \$5,000 per year, up to a maximum of \$20,000. Meanwhile, participants qualifying for the Career Changers Loan Program may receive \$15,000 per year for up to four years – \$60,000 maximum – and PACE participants can borrow approximately \$750 per year for a maximum of \$5,000.⁴⁰

Students who participate in the Teachers Loan Program may have loans forgiven for teaching in a critical subject

or critical geographic area. For the 2017-2018 school year, there are 50 critical subject areas, including secondary and middle school mathematics, secondary and middle school science, career and technology,* and engineering.⁴¹ Designated critical subject and geographic areas are determined annually by the state Department of Education. Loans for the programs are forgiven at a rate of 20 percent, or \$3,000, whichever is greater, for every full year of teaching in one of the state's public schools. If a recipient decides to teach in both a critical subject area and critical geographic area, loans are forgiven at a rate of 33.3 percent, or \$5,000, for every year full year of teaching.⁴² During the 2015-2016 school year, 1,126 students participated in the Teachers Loan Program and another 46 students received reimbursement from the Career Changers Loan Program.⁴³

TENNESSEE

The Math and Science Teacher Loan Forgiveness Program was established by chapter 977 of the 104th General Assembly Public Acts (2006).⁴⁴ Administered by the Tennessee Student Assistance Corporation (TSAC), the program offers financial assistance to public school teachers interested in obtaining an advanced degree or an additional certification to teach math or science. At present, teachers attending one of 42 in-state teacher preparation programs are eligible to participate in the program and can borrow up to \$2,000 each year for up to five years, given that “satisfactory academic progress” is maintained throughout the program of study.⁴⁵ Upon completion, teachers who receive a TSAC loan must agree to continue teaching at a public school for two years for each year funding is received.⁴⁶ The corporation is responsible for disbursing its loans to eligible institutions, which subsequently credit participants' accounts. According to TSAC, there were two participants in the loan forgiveness program during the 2016-2017 school year, down from a high of 25 in 2009-2010.⁴⁷

* Career and technical education applies to courses that specialize in skilled trades, applied sciences, technology and career preparation.

TEXAS

The Teach for Texas Loan Repayment Assistance Program is a consolidation of two previous programs created by the Texas Legislature: Teach for Texas Conditional Grant Program, created in 2000, and Teach for Texas Alternative Certification Conditional Grant Program, created in 2002. To receive repayment through the program, applicants must be certified teachers in a subject area facing shortages, as designated by the Texas Education Agency (TEA), at the preschool, primary or secondary level in one of Texas's public schools.⁴⁸ Though teachers in other subject areas may qualify for the program, a formula used by TEA prioritizes applicants teaching critical shortage areas or in critical geographic areas. In fiscal year 2017, certified teachers received an award up to \$2,500 annually for teaching in one of the following areas: ESL, mathematics, special education, science, career and technical education, and computer science/technology applications.⁴⁹ According to the Texas Higher Education Coordinating Board, 1,033 students participated in the program during the 2016 school year.⁵⁰

More recently, Texas began offering teachers the opportunity to participate in the Math and Science Scholars Loan Repayment Program, designed to encourage high-performing educators who majored in math or science to pursue teaching careers in Texas public schools. To qualify for the program – which began with the 2016-2017 school year and is administered by the Texas Higher Education Coordinating Board – teachers must have completed an undergraduate or graduate program with a 3.5 GPA or higher, and must be certified to teach math or science in a public school. Applicants must agree to teach for eight years, the first four of which must be in public schools that receive federal funds under Title 1. To date, a total of \$2,575,000 has been appropriated by the state to provide repayment for teachers participating in the program, though individual reimbursements have not been reported.^{51,52}

VIRGINIA

Students preparing to teach in a designated critical subject area may qualify for the Virginia Teaching Scholarship Loan Program, administered by the state Department of Education. Full-time students who qualify for the loan program may receive a scholarship up to \$10,000 annually. Participants must be nominated by the institution where an education degree is being completed and maintain at least a 2.7 GPA in the program of study. Participants also must meet one of the following conditions: (1) be enrolled in a program leading to certification in a critical shortage area; (2) be a male student in an elementary or middle school certification program; (3) be a minority teacher candidate in any teaching area; or (4) be enrolled in a career or technical education teaching certification program.⁵³

Upon graduation, recipients must teach in a public school for the same number years for which the scholarship was received to avoid any obligation of loan repayments. During the 2016-2017 school year, critical STEM areas consist of career and technical education and grades 6-12 mathematics, in addition to several other non-STEM fields, including health and physical education, foreign languages, special education, history and social sciences.⁵⁴ Shortage areas are determined annually by the Supply and Demand Report for School Personnel, a web-based data collection survey from the state Department of Education that is used to determine the number of unfilled positions throughout the state.^{55,56} According to the Virginia Department of Education, 74 students participated in the scholarship loan program during the 2016-2017 school year.⁵⁷

Public and Private Sector STEM Initiatives

ARKANSAS

In December 2016, Governor Asa Hutchinson announced a unique public-private partnership with Microsoft to support statewide STEM education, the first such partnership in the country.⁵⁸ According to the terms of the memorandum of understanding,⁵⁹ Microsoft will work with the state Department of Education to bolster the Technology Education and

Literacy in Schools (TEALS) initiative, a program that pairs computer science professionals with computer science teachers who teach such courses at the secondary level.⁶⁰

Additionally, following the passage of House Bill 1183 in 2015 – requiring all public schools and charter schools to offer computer science courses to high school students – the state Department of Education began providing state-funded professional development for teachers to learn methods of instruction in computer programming, an initiative that continues as additional schools request funds for professional development.⁶¹ Arkansas also offers several other benefits for those interested in teaching computer science at schools in the state, including funding for online training subscriptions for every teacher; education certificates for computer science professionals; and computer science certifications for existing teachers.⁶²

FLORIDA

At the beginning of 2015, Governor Rick Scott announced \$1 million in proposed funding to create a paid summer residency program for STEM teachers, in which teachers partner with high-tech companies throughout the state to learn about the latest innovations in STEM occupations, knowledge that then can be used upon returning to the classrooms.⁶³ As of December 2015, 52 companies with operations in Florida had agreed to host teachers for the residency program.⁶⁴

GEORGIA

In 2014, Georgia became the first Southern state – and the fifth nationally, after Michigan, Ohio, Indiana, and New Jersey – selected to participate in a national teaching fellowship program sponsored by the Woodrow Wilson National Fellowship Foundation. The fellowship, with the support of Governor Nathan Deal, is designed to allow undergraduate students, recent graduates and professionals with a background in STEM subjects to earn a teaching certificate in their respective fields. Those selected for the fellowship

receive \$30,000 to attend a one-year master's teaching program at selected universities throughout the state.⁶⁵ In return, there must be an agreement to teach at a high-poverty school for at least three years. The first class of 36 fellows began in 2015, attending year-long programs at Kennesaw State University, Columbus State University and Piedmont College, followed by a second class in 2016 consisting of 60 fellows, which expanded to programs at Georgia State University and Mercer University.^{66,67}

KENTUCKY

In July 2015, educators from 22 eastern Kentucky school districts began an initiative aimed at building more effective STEM-based programs for primary and secondary students across eastern Kentucky. Morehead State University, in partnership with other higher education institutions, governments and the private sector—including the Appalachian Regional Commission, Kentucky Council on Postsecondary Education, University of Pikeville, Kentucky Department for Local Government and Touchstone Energy Cooperatives—began providing teachers in high-unemployment, high-poverty counties with training and certification. The first wave included 64 teachers from 22 high-need areas participating in a three-year program designed to prepare them for teaching STEM subjects throughout the region. For the first phase of the program, approximately \$100,000 in funding was invested via the Appalachian Regional Commission, a regional economic development agency consisting of federal, state and local governments.⁶⁸

LOUISIANA

In February 2016, the National Math and Science Initiative, a nonprofit organization based in Dallas, Texas, announced a \$13 million grant from Exxon-Mobil to support its College Readiness Program in Louisiana. The grant was awarded primarily to provide more extensive training for teachers and additional support for those working across the state in the areas of math, science and English.^{69,70}

Similarly, in December 2014, Louisiana Tech University received a \$1.45 million grant from the National Math and Science Initiative and the Howard Hughes Medical Institute to support STEM teacher preparation. The grant, only one of five awarded in the United States, has been used to produce more effective secondary school math and science teachers graduating from teacher preparation programs at the university.⁷¹

MISSISSIPPI

In July 2016, Jackson State University (JSU) was given a \$3.7 million grant from the National Science Foundation for its Science, Technology, Engineering and Mathematics Scholars Teacher Academy Resident System, or “STEM STARS,” designed to address the critical shortage of STEM teachers in high-need school districts. Under the STEM STARS program, JSU, in conjunction with Xavier University of Louisiana and the University of Arkansas–Pine Bluff, will prepare approximately 120 teachers to become STEM educators by gaining clinical, mentored experience and familiarity with local school districts. The partnership among the three universities will focus on science and mathematics education at the middle school and high school levels.⁷²

Similarly, in November 2016, the National Science Foundation granted \$900,000 to Mississippi State University (MSU) to support public schools with enhancing middle school teaching and learning skills in STEM subjects. With the grant, MSU will work with middle school teachers, community colleges and industry partners to develop a more robust STEM curriculum throughout the school year. The grant money will be used to expand materials available for teaching, increase technology in the classroom and provide support for new curriculum development. More than 70 teachers are expected to be involved in the program.⁷³

TENNESSEE

Teachers can leverage the Tennessee STEM Innovation Network (TSIN), a partnership created in 2010 between the state Department of Education and Battelle Memorial Institute that promotes the learning of STEM subjects in K-12 schools across the state. Among

the initiatives within TSIN is the Innovative Leaders Institute, a year-long program that provides opportunities for educators to meet education leaders across the state, visit schools to examine different methods of STEM integration, and share best practices with colleagues. The Innovative Leaders Institute is led by principals from across Tennessee who are recognized as leaders in maintaining high student performance and low teacher turnover at schools.⁷⁴

WEST VIRGINIA

In February 2017, West Virginia University was awarded \$1.2 million from the National Science Foundation to support more than 25 new high school STEM teachers in the Doddridge County and Marion County school districts. Participating students will receive scholarships as assistance for completing coursework in the program, after which two years of teaching in high-need districts is required for each year of support provided by the scholarship.⁷⁵

Conclusion

If states hope to boost economies through the growth of middle- and high-wage STEM jobs, it will be critical to devise strategies to provide students with the skills and knowledge necessary to succeed in both today's job market and that of the future. Accomplishing this will require a sustained focus on teacher preparation, particularly for high-demand STEM subjects at both the primary and secondary levels. The areas of math, science, engineering and technology – and the many sub-fields that fall into these broad categories – are essential for ensuring a prepared workforce that meets the demands of STEM occupations. As a result, investing in STEM teacher preparation now can have significant, long-term rewards in the future.

Studies suggest that loan forgiveness and loan repayment programs, along with scholarships designed to encourage students and professionals to enter the teaching profession, are effective if the financial benefits involved sufficiently address students' high tuition costs. This is particularly the case for individuals considering teaching in high-need school districts.⁷⁶

However, there is evidence to suggest that incentive programs with minimal financial assistance, such as \$3,000-\$4,000 per year, are not necessarily effective at attracting students to pursue teaching careers in critical geographic areas.⁷⁷ Though the evidence for this is not universal,* it nevertheless underscores the importance for policymakers to fully understand whether the levels of financial support currently provided to students are achieving the intended results.

To complement financial incentives, which can be costly for states with difficult budgetary decisions and limited resources, policymakers and education officials should consider alternatives that may provide other avenues to prepare prospective teachers for STEM subjects. Leveraging the expertise of the private sector, an increasingly popular option for state leaders, provides a multitude of benefits without the financial burden that student loan incentives place on budgets. Likewise, philanthropic and federal grants have the potential to provide significant long-term benefits for states, teacher preparation programs, and students who are considering entering the teaching profession.

The South has experienced notable growth in the number of STEM occupations during the past several years. From May 2009 – May 2015, the Bureau of Labor Statistics found that 14 out of 15 states in the region added STEM jobs to the workforce; in four states, the growth was greater than 15 percent, significantly higher than the national average of 10.5 percent. Tennessee and Oklahoma experienced the largest growth in the number of STEM occupations, with increases of 24.9 percent and 24.4 percent, respectively, the second and third highest in the nation. Georgia, Texas and South Carolina followed, with increases of 18.9 percent, 15.6 percent and 12.0 percent, respectively. Despite these significant gains, employment in STEM

* One study from CALDER found that Florida's Critical Teacher Shortage Program (FCTSP), which provided awards from 1986 until 2010 and offered annual incentives of \$2,500-\$5,000, encouraged people to pursue teaching certification and reduced attrition rates in high-need subjects.

occupations, as a percentage of the overall workforce, remains comparatively low across the South. With the exception of Virginia, every state in the region has a lower percentage of employment in STEM occupations than the national average of 6.2 percent (See Table 4).⁷⁸

Due to this growth—and the potential for more progress in the future—policymakers increasingly are seeing the importance of recruiting potential educators with backgrounds and interests in STEM subjects to consider the teaching profession, even when other professional opportunities may be available to them. Ultimately, steering these students and professionals toward the education sector will play a major role in the economic future of the Southern region, as well as the nation as a whole.

Table 4		STEM employment in the South, May 2009 - May 2005	
State	Percentage change in STEM occupations	Absolute change in STEM occupations	STEM occupations as a percentage of total employment
Alabama	2.6	2,480	5.2
Arkansas	6.3	2,790	4.0
Georgia	18.9	38,400	5.9
Florida	2.7	9,520	4.6
Kentucky	3.3	2,370	4.0
Louisiana	4.2	2,960	3.8
Mississippi	-0.8	-290	3.3
Missouri	3.0	4,290	5.4
North Carolina	10.3	22,370	5.8
Oklahoma	24.4	16,470	5.3
South Carolina	12.0	9,960	4.8
Tennessee	24.9	25,590	4.6
Texas	15.6	102,190	6.5
Virginia	2.7	8,410	8.8
West Virginia	6.5	1,570	3.6

Source: Bureau of Labor Statistics, 2017.

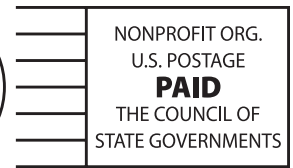
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REGIONAL VIEW NATIONAL REACH

This report was prepared by **Roger Moore**, policy analyst and committee liaison of the Education Committee of the Southern Legislative Conference (SLC), chaired by **Senator Dolores Gresham** of Tennessee. This report reflects the body of policy research made available to appointed and elected officials by the **Southern Office of The Council of State Governments (CSG)**.

Opened in 1959, the **Southern Office of CSG** fosters intergovernmental cooperation among its 15 member states, predominantly through the programs and services provided by its **Southern Legislative Conference**. Legislative leadership, members and staff utilize the SLC to identify and analyze government policy solutions for the most prevalent and unique issues facing Southern states. Meanwhile, SLC member outreach in state capitols and coordination of domestic and international delegations, leadership development and staff exchange programs,

meetings, and fly-ins support state policymakers and legislative staff in their work to build a stronger region.

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