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REGIONAL EDUCATIONAL LABORATORY at EDC

A REVIEW OF CONDITIONS AND CHARACTERISTICS LEADING TO COLLEGE AND CAREER READINESS IN SELECTED STATES: AN EMPHASIS ON STEM EDUCATION

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INTRODUCTION

In the fall of 2011, the Southern Maine Collaborative requested assistance from the Regional Educational Laboratory to identify college and career readiness (CCR) activities of the New England states (excluding Maine), and a small number of other states that were emphasizing science, technology, engineering, and math (STEM) preparation.

Our past experience and research related to STEM indicates that it is critical to situate STEM education within larger improvement efforts.[1] Thus, this review began with a broad look at the comprehensive ways New England states are ensuring that students will be prepared for successful transitions to college and careers. Because the emphasis on college and career readiness in most New England states is not specifically focused upon STEM, we identified other states enacting innovative state-wide initiatives that may serve as a model for efforts in STEM college and career readiness in particular.

RESEARCH QUESTIONS

This briefing paper was intended to address the following questions:

1) What state-level policies and implementation strategies are proposed or currently in place that are intended to promote career and college readiness in STEM?
2) What are the critical characteristics and conditions of these policies?

RESEARCH METHOD

The data collection method used three primary sources: policy and research papers, state Race to the Top (RTTT) proposals, and state departments of education websites.

In identifying sources to begin this research, as authors, we utilized what we have collectively learned over 10 years of policy research. To identify the key state strategies related to college and career readiness, we identified and reviewed policy or research papers related to the topic of CCR and STEM education policy implementation along the education pipeline, as well as any additional research papers referencing this research. We also searched for documents related to key words

and strategic areas, and scanned state websites for additional information about state strategies addressing CCR and STEM.

Once the key strategies were identified, we reviewed the five New England state departments of education websites (excluding Maine), RTTT proposals from round 2, and additional policy briefs, reports, and other documents referenced or linked with state department of education websites. Additional resources were identified with an Internet search of each key strategy and the corresponding state names.[2] This information was used to develop a narrative summary describing the landscape of college and career programs in the selected states. Each state was also reviewed for key state initiatives, which are summarized in Table 1. In addition, we identified states outside of New England receiving RTTT funds with active STEM programs to identify innovative policies and approaches with an emphasis on the essential characteristics and conditions. Our selection was based on the comprehensive nature of the state reform efforts over time and a strong state emphasis and action in STEM education These states also represent a variety of governance models: a local control state (Ohio), a small state (Delaware), and a larger state with a more centralized governance model for education (North Carolina).

As an additional resource, the appendices include a reference list of websites and selected policy reports collected during this research.

College and Career Readiness

Much of the educational improvement work of the past decade in the United States has been led by individual states and a small number of national organizations. This state-driven reform effort has resulted in the implementation and evaluation of successive initiatives. A review of policy papers indicates that a general consensus has formed among the states on the major factors necessary for improvement to take place. Those factors are teacher quality, curricular rigor and coherence, and student support.[3] The effort to improve student readiness for college and careers is considered to be the end result of improvements all along the educational pathway. Therefore, any discussion of CCR must be set within the discussion of general strategies for educational improvement and reform. States that have been working on reform have recognized over time that the improvement efforts are interconnected and to be most effective, should be implemented within a comprehensive system. Individual local efforts can spur excellent models, but without state systemic support, those efforts cannot be implemented on a scale large enough to provide equitable access for all students.[4]

The federal No Child Left Behind Act focused much of the early state effort on the improvement of teaching and learning that would result in enhanced student performance on yearly standardized assessments. Many efforts have been made to address achievement gaps between students from high- and low- resource communities. Although there have been some improvements in student performance over time by states, the effort to address the achievement gaps among different groups has been difficult. The achievement gap among student groups and the relatively poor performance of U.S. students in comparison to students in other industrialized countries has been a major concern of state and federal government.[5] These achievement gaps lead to potential problems in U.S. competition for 21st century jobs in the global economy. For states, the high costs

of student remediation and student dropouts are a further cause for concern in an era in which state and local budgets are in distress.

The Chief State School Officers and the National Governors Association have led the effort to address disparities and poor performance among states through the development of the Common Core State Standards Initiative.[6] Because states have traditionally developed their own educational standards with variations in content, depth, and breadth, the educational programs offered to students across the country also vary. This variation has resulted in weaknesses in many areas. The relatively new Common Core Standards are in the process of being implemented and are expected to provide more focus and more rigor than previous state standards. The effect of the common standards are intended to provide a solid and coherent basis for education in the United States, decrease variation among states, and enhance educational rigor.

These Common Core Standards contain "anchor standards" within grade-level standards that are considered to be the focal standards that will lead to college and career readiness. College and career readiness has been defined by the American College Testing Program as "the acquisition of the knowledge and skills a student needs to enroll and succeed in credit-bearing, first-year courses at a postsecondary institution…without the need for remediation."[7] College and career readiness has been defined by the federal government as student mastery of content and standards that "build towards college and career readiness by the time of high school graduation."[8] The U.S. Department of Education has charged states with developing standards and assessments which, "must be based on evidence regarding what students must know and be able to do at each grade level to be on track to graduate from high school, college, and career ready." [9] The National Research Council has also developed a new generation of science frameworks, and a standard setting process is underway by Achieve, Inc. These are likely to have an impact on college and career readiness efforts in the future.

KEY STATE STRATEGIES IN DEVELOPING COLLEGE AND CAREER READINESS

A review of policy research and various departments of education websites and grant proposals[10] indicate that several states are pursuing a comprehensive approach to college and career readiness with a focused concentration on STEM education. This review also allowed us to identify several common strategies among these states. These strategies fall into eight broad categories related to college and career readiness:

1. *P–16 or P–20 Council:* The formation of a state P–16 or P–20 Council that brings together education, business, and community representatives in an effort to advocate for educational reform that will lead to college and career readiness.

2. *Academic Standards:*
   - The institution of mandatory or default curricula that are required for graduation and are aligned with college and career skills and knowledge. Some states that have been working to increase rigor for a number of years are developing model units of instruction and curricula that have both rigor and relevance for all students.[11]

- Student proficiency or competency requirements for high school graduation.

3. *School Accountability:* A state accountability system for low-performing schools that enables the state to intervene in a structured way to improve school performance.

4. *Student Support:*

   - A state-sponsored system for dual enrollment and early college schools.

   - State-sponsored programs and support for at-risk students.

5. *Data Systems:* A data system that contains the 10 elements defined by the Data Quality Campaign[12] as being necessary to provide strong student and program quality information.[13]

6. *Teacher Quality:*

   - Improvements in teacher preparation, teacher certification, and teacher-quality standards.

   - Incentives for teachers to teach in hard-to-staff schools.

   - A teacher evaluation system that takes into account the performance of teachers in relationship to student achievement.

   - State oversight and guidance of professional development programs and regional delivery systems.

7. *Career and Technical Education (CTE):* Improvements in career and technical education through the integration of academic standards, career planning, and attention to transitions to school and work.

8. *STEM:* An emphasis on improving STEM areas of curriculum and instruction through improvements in standards and curricula, teacher professional development, and the formation of strong public/private and community partnerships.

NEW ENGLAND STATES

An examination of New England state departments of education websites and our review of key literature describing state strategies[14] for improvement indicate that the New England states are in various stages of implementing reform strategies leading to college and career readiness. Among the five New England states, Massachusetts and Rhode Island have received RTTT funding, while Connecticut and New Hampshire submitted RTTT proposals in 2010, but were not funded.

CONNECTICUT[15]

P–20 Council

Connecticut established a P–20 Council in 2009. The Council is located within the Board of Regents and seeks to integrate the activities and strategies of the early childhood, K–12, higher education, and workforce development agencies. The current work of the Council is to ensure that students have access to a clear path to jobs and postsecondary education.[16]

Academic Standards

In 2007, the state developed the Connecticut Accountability Plan for Learning Initiative (CALI). [17] CALI was the underlying basis for the Connecticut effort to turn around low-performing schools through supports in teaching and learning. The next year the Connecticut Plan for Secondary School Reform[18] was passed to increase the rigor of high school requirements, especially in the area of STEM subjects. The state now requires students to take four credits in mathematics and three in science. The Plan also requires a Student Success Plan, an individualized student education plan addressing student needs and interests, by sixth grade and a capstone project by the end of high school.[19] Although there are state efforts underway to enhance student assessment and the transition to college and work, there are no proficiency requirements beyond the required course completion and end-of-course assessment for graduation.

Connecticut has been working in recent years to provide guidance to local educational agencies on coherence and alignment in curricula. The state has adopted the Common Core Standards and is a member of the PARCC assessment consortium.[20] The development of a digital resource library is focused on developing and making available model units and lessons that align with the Common Core standards. Efforts have also included an emphasis on data-based-decision-making, professional learning communities and improvements in leadership.

School Accountability

In the area of accountability, the Connecticut Accountability and Learning Initiative (CALI) enables the state to intervene when a school has significant instructional issues as defined by the percentage of students not achieving proficiency on state tests. This intervention has focused on audits and supports in the area of curriculum, teaching, coaching, extended day and other programs. At the time of the state's submission of its RTTT proposal it had not formally adopted the federal turnaround models.

Student Support

Services for at-risk students are not well defined on the state website, but turnaround strategies listed in the RTTT proposal[21] include a host of initiatives such as after-school programs, teacher professional development, school coaches, improved curricula, and other services. Although Connecticut has been attending to achievement gaps among its students, gaps persist and are widening in some areas and among some groups.

Data Systems

In a review of college and career readiness elements by Achieve, Inc.[22], Connecticut has only seven of the ten elements needed to complete a data system that is accessible, provides complete longitudinal information, tracks important college and career readiness benchmarks, and matches teachers to students. The state has been working on a system that tracks student assessment data and transcripts and follows students into their post high school years. According to the 2010 RTTT proposal,[23] Connecticut plans to complete the remaining elements with funding from ARRA in 2009 to develop data systems to support instruction and guide decision-making for student success. This includes establishing a statewide course code taxonomy using NCES course code standards, creating a student "data mart" that contains student demographic and assessment results data,

course type and associated teacher data, and enhancing dissemination of this secure data to support decision-making at different levels of government.

Teacher Quality

Over the past several years, the state has revised its teacher certification standards, general teaching standards, and walk-through guides, and has developed curriculum guides to help establish coherence in the system. The state is working on a new teacher induction model and hopes to develop a more rigorous teacher evaluation system. The state is also working to develop a more focused professional development system that is delivered through six regional centers across the state. One of the areas that the state wishes to expand is the use of incentives to attract teachers to hard-to-staff schools and content areas that are difficult to staff.

CTE

Connecticut has seventeen technical high schools, several comprehensive high school technical programs, community college programs, and two early college high schools. The more rigorous standards adopted in 2007 require eight courses in STEM subjects and at least two career-focused courses. Efforts are underway to integrate more rigorous standards into career and technical education offerings. Articulation agreements among public colleges and universities permit students to easily move from one program or college to another and receive credit for courses completed. The state also provides the opportunity for dual enrollment programs for high school students as well as virtual course offerings. Dual enrollment programs are currently arranged locally, but a plan for creating a systemic plan for these programs is outlined in the state RTTT proposal.

STEM

The state's emphasis on STEM begins with the requirement for students to complete eight STEM courses for graduation. The state is engaged in a number of STEM public/private partnerships, is producing model curricula and end-of-course assessments, and is engaged in professional development activities through the STEM Regional Teacher Exchange and the Elementary and Middle School Math and Science Coaching Academy. The Center for 21st Century Learning has recently partnered with a number of education and industry groups in Connecticut to develop a 9–12 STEM Academy online model to be delivered in comprehensive, low-income middle and high schools and that enables students to take up to fifteen college credits.

MASSACHUSETTS [24]

P–16 Council

In 2008, the governor of Massachusetts and the legislature reorganized the governance of the educational system to appoint a secretary of education who has jurisdiction over elementary, secondary, and higher education in the state. This organization helped to focus and define the state role in educational improvement and has helped to facilitate the connections between the K–12 and higher education sectors necessary for creating smooth transitions between high school and post-secondary education and jobs. Problems still remain in creating uniform articulation agreements among the public colleges in the state. The governor convened a Readiness Commission to define

state actions needed to continue educational improvement, and a STEM P–16 Council was established in 2009.[25]

Academic Standards

Massachusetts has been working for the past decade on a number of comprehensive strategies that have resulted in the state being in the forefront of educational reform. Massachusetts is a local control state; the power to make decisions about education is localized with a history of LEAs making decisions as opposed to the more distant state government agency. Despite this fact, the 1993 Education Reform Act introduced the notion that in order to improve education, a strong state system needed to be in place. Those reforms included strong state standards and a 10th grade test (Massachusetts Comprehensive Assessment System, MCAS) to ensure students are prepared for graduation. Massachusetts was the first state to introduce technology and engineering standards, and the state has consistently been the top performer on the National Assessment of Educational Progress (NAEP). A succession of initiatives has established performance and accountability systems for schools and partnerships with other state agencies responsible for children and youth.

In the area of enhanced academic coursework, the MassCore[26] curriculum has been recommended and is the preferred curriculum for all students in the state. The curriculum is considered to be aligned with college and career readiness. MassCore requires four years of language arts, four years of mathematics, three years of laboratory science, three years of history, and two years of a foreign language.

The state is moving to develop curricular and instructional models that are aligned to Common Core Standards and will serve as resources for districts and teachers across the state. These resources will be available online and linked to standards and assessments by the data system.

Massachusetts is a member of the Partnership for Assessment of Readiness for College and Careers (PARCC)[27] assessment consortium, which will develop both formative and summative assessments that reflect the Common Core standards. Currently students must score a passing grade on the 10th grade MCAS test and pass a science and/or technology assessment to be able to graduate from high school. If students do not meet that score, they must develop an Educational Proficiency Plan that spells out how they will obtain proficiency for graduation.

School Accountability

In the area of school accountability, the state has developed a Framework for District Accountability that requires that districts measure eleven indicators of school effectiveness.[28] The state has developed a structured system of intervention for low-performing schools enlisting school turnaround teams to provide extended professional development and instructional support within schools.

Student Support

For low-income and at-risk students, Massachusetts has employed a number of strategies, including school turnaround teams, extended day supports, ensuring that students have teachers of high quality, a number of curricular and instructional supports, and early warning systems for student in danger of dropping out of school. The state has formed partnerships with human services agencies

to facilitate health and social services for at-risk youth. The state has had dual enrollment programs for a number of years and is pursuing the development of early college high schools and an expansion of the AP programs in low-resource schools. Several regions have developed virtual school opportunities for students, such as Greenfield,[29] but this is not a statewide initiative.

Data Systems

The Massachusetts Data Warehouse system contains all ten of the Data Quality Campaign elements determined to be essential for an effective system to track student achievement.[30] Data in the system include individual student demographic enrollment, dropout, and graduation data; individual student assessment information; student transcript information; student college-ready scores, including the MCAS, ACT, and PSAT; and data on transitions of students to post-secondary institutions. The system also enables teachers to be linked to assigned classes and will expand to link teachers to specific students.

Teacher Quality

The state has moved aggressively to improve teacher preparation and certification in mathematics for elementary and special education teachers, improved standards for administrators, supported alternative routes to certification. The licensure changes have been implemented,[31] and a number of other changes are currently in process. For example, state colleges are moving to give more math courses to teaching candidates, and the state is developing a performance-based evaluation system for teachers. A concerted effort will be made to ensure that highly qualified teachers are placed in schools with high percentages of at-risk students.

CTE

Though currently in process, the state is working to align the career and vocational technical programs to college and career readiness standards and is integrating academic and career and vocational technical content into a program of study, developing program approval requirements, and instituting career counseling and technical skill assessments.[32]

STEM

In the area of STEM education, Massachusetts has increased certification requirements of elementary and special education teachers in mathematics, introduced engineering and technology standards requirements, and is initiating six new STEM early college high schools. The state will also develop twelve International Baccalaureate Program Schools, and several STEM Innovation Schools. The state currently has seven STEM regional network programs that work with universities to provide professional development and instruction, has partnerships with several prominent STEM institutions, and works with the Greater Boston STEM Readiness Council. It is important to note that the current efforts are regional; the RTTT proposes the first state-funded systemic initiatives. Furthermore, the state has strong public/private partnerships with business and scientific organizations.[33]

NEW HAMPSHIRE[34]

P–16 Council

New Hampshire established a P–16 Working Group in 2006 consisting of education, business, and government members. The working group serves in an advisory capacity and has been charged with addressing data systems and college readiness.[35]

Academic Standards

The state has been a member of the New England Comprehensive Assessment Program (NECAP) since 2002.[36] In 2009, New Hampshire joined the Common Core Standards Initiative[37] and adopted the Common Core state standards in July 2010. However, the state has not recently updated its high school graduation requirements. According to the state department of education website, to graduate from high school, students are required to complete four credits in English, three credits in mathematics, two and a half credits for social studies and history, and only two credits in science with no laboratory requirement.[38]

The state is a top performer on the NAEP test, scoring among the top ten states in the nation for reading and mathematics for both grade levels (4th and 8th) in 2011. In fact, 4th grade students in New Hampshire tied with Massachusetts for the highest performance in mathematics.[39] However, achievement gaps remain, and the state is working to reduce those gaps and increase the number of students graduating from high school and attending college.

School Accountability

New Hampshire has a strong school accountability system that was adopted in 2009 and is in the process of being implemented. The system is based on twelve school approval standards including standards for school inputs and student performance. Ten of the twelve standards for the input system are related to curriculum and instruction. Two are related to graduation. The performance-based system includes student growth and achievement, assessments, and attendance.[40] A Commissioner's task force will conduct site visits to verify that schools are meeting the standard.

Student Support

The state has several innovative options for students to gain access to high-level coursework while in high school. For example, a program called Running Start allows high school students to enroll in college-level courses and earn community college credit while they are completing requirements for high school graduation. This program has seen a sixty-one percent jump in the number of enrollments in college courses by high school students since 2004–05, and the state's RTTT proposal cites research that has shown that students who participate in these courses are less likely to need remediation once they enroll in college.[41] New Hampshire has also established a statewide virtual school, Virtual Learning Academy Charter School,[42] which provides students across the state access to rigorous content even if these courses are not taught in their school building.

The state has adopted a multi-tiered approach to students at risk of dropping out of school that promotes positive behavioral supports, the use of data systems to provide early warning, student advisories, and other supports for students who want to return to school.[43] The state's RTTT

proposal outlined the elements of an updated strategy for school turnarounds, including replacing principals who have been in low-performing schools for two or more years, targeting professional development, and placing an emphasis on data analysis. Through a Statewide System of Support (SSOS), the state proposed to provide additional support and services to these schools.

Data Systems

New Hampshire's longitudinal data system satisfies seven of the ten Data Quality Campaign essential elements necessary for effective student-based-data collection. The state is working to develop a system that enables the state to make subgroup growth comparisons at the school level and to track individual student growth. Work remains to close gaps in data collection and to develop a statewide portal linking the data system to an online standards and curricular content system.[44]

Teacher Quality

In 2010, the state updated teacher certification requirements in core content areas, increasing rigor in math and science requirements to align with the NECAP standards. The state is in the process of revising the state approval system for teacher preparation programs by placing more of an emphasis on student learning and continuous improvement.

New Hampshire received federal funding in 2003 to implement a state Teacher Quality Enhancement System with the goal of increasing the number of highly qualified teachers in critical shortage areas. A key aspect of this project is to enhance accountability measures for teacher preparation programs in the state. New Hampshire is addressing disparities in teacher quality in hard-to-serve areas through the TeachNorth incentive program, a collaborative of 32 districts in the northern part of the state. [45]

New Hampshire has not established state guidelines for teacher professional development. The state has required individual teacher plans that are related to school and district priorities. However, recent (2011) legislation requires specific linkages of individual plans to teacher evaluations that include student achievement, and a task force has been formed to develop the state model to implement the new policy.[46]

CTE

New Hampshire has policies in place that enable students to progress from high school to college in a career and technical education program.[47] The state has established an industry advisory group to advise institutions on the latest teaching techniques to align with emerging industries.

STEM

Despite an extensive Web search, we were not able to identify a comprehensive state strategy to improve STEM education. Although STEM has been defined as a priority in state documents and there are several STEM initiatives in the state, our researchers were not able to find evidence of a comprehensive strategy for New Hampshire.

RHODE ISLAND[48]

P–16 Council

Rhode Island established a P–16 Council in 2005 and, since then, the Council has been involved in efforts to align the curriculum and to facilitate the high school to career and college transition. The Council was formed with the charge of bringing alignment to the educational system, linking the educational system to needs of employers, improving the quality of teachers and administrators, and creating a unified data system.[49]

Academic Standards

The state has established graduation requirements, including the completion of four years of mathematics and English language arts and three years of science. The state has been working with Achieve, Inc., to develop end-of-course Algebra II assessments. Students must demonstrate competency on state ELA and math assessments and pass two proficiency examinations that may include end-of-course assessments, exhibitions, or portfolios.[50] The state is currently a member of the New England Common Assessment Standards Program (NECAP) and has adopted the Common Core Standards. Rhode Island is a member of the PARCC assessment consortium.

School Accountability

The state has a clear strategy and history of intervening in low-achieving schools. The state has statutory authority and a structured intervention model that includes revising hiring practices and reconstituting school organization. Through the experience gained in school turnaround efforts, the state has developed a comprehensive strategy for turnarounds that relies on ten major components, including clear standards and alignment, data-based accountability, improved leadership, community involvement, and extended learning opportunities.

Student Support

Achievement gaps among various groups are a primary focus of the state's efforts and a focus of the state's successful RTTT proposal. Approximately forty-one percent of Rhode Island students are identified as living in poverty. The state has revised standards for English-language-learner programs, adopted a statewide Response to Intervention model for special education students, improved early learning programs, and proposed a new funding formula for low-income, high-need districts. No evidence of a state-wide dual enrollment initiatives or early college programs could be found.

Data Systems

Rhode Island has instituted nine of the ten elements identified by the Data Quality Campaign as necessary for effective student-based-data collection. The state has recently invested $4.6 million in state funds to improve the system, which includes the integration of state and local information, federal reporting, transparency, and accountability, and enables different databases to communicate with one another. The RTTT funding will enable the state to complete its system. The state plans to provide teachers with online tools to build their capacity to use the instructional improvement system in their instruction to better support student learning.

Teacher Quality

In the area of teacher preparation, the state has taken a number of actions to improve teacher quality, including (1) eliminating all seniority hiring and required districts to assign teachers based on student performance and student needs; (2) raising the cut score for entrance into teacher preparation programs; (3) adopting a new teacher evaluation system that will be primarily based on student achievement; and (4) establishing a state policy that no student will have an ineffective teacher for two years in a row.[51] The state has also adopted new standards for the teaching profession.

CTE

In the area of career and technical education, the state has filed a Perkins Plan that will evaluate college/career metrics for each federally defined career cluster, identify areas needing improvement, and focus professional development on those areas. While there are many students who participate in dual enrollment activities in the state, those arrangements are usually made locally and the state has not emphasized dual enrollment as a major strategy for career and college readiness. However, the Rhode Island legislature recently (2009) passed The Rhode Island Bachelor's Degree in Three Program Act,[52] which will allow students to earn college credit for courses taken during high school, including Advanced Placement and dual enrollment courses. This could allow students to graduate up to a year early from college and save on the cost of tuition.

STEM

Rhode Island has been active in improving curricula and instruction in STEM areas. In 2005, a Blue Ribbon Panel on Math and Science Education called attention to major areas needing improvement, including teacher preparation and professional development, student learning opportunities, curriculum and instruction, and industry partnerships and communication.[53] The state has defined proficiency goals for students in math and science in its strategic plan. Revised graduation standards require four years of mathematics and three years of science. The state will focus its RTTT funds on eliminating achievement gaps among low-income students in STEM subjects. A partnership with the Charles A. Dana Center at the University of Texas in Austin has served 300 teachers in seventeen local educational areas to improve their STEM teaching skills. The state has established a statewide STEM Resource Center at Rhode Island College, which has been funded through the original Blue Ribbon Panel that is now called "Project Making the Grade." Educational STEM Leadership Councils have been formed across the state to strengthen the use of the NECAP data in curriculum and instruction in STEM areas. Revisions to the Basic Education Program guidelines have included the addition of engineering and technology content to the academic standards that were developed in 2007.

VERMONT[54]

P–16 Council

The state has had a number of task forces engaged in conversations on high school redesign through the past decade, but budget and other constraints have limited the efforts to develop new systems. The state established a P–16 Council in 2010.[55]

Academic Standards

Vermont has high graduation rates, low drop-out rates, and ranks near the top of states on the NAEP. The state has adopted the NECAP and is in the process of adapting those standards to the Common Core standards. Students are required to take four years of English language arts, three years of math, and three years of science. The state has not yet identified college and career readiness standards, but implementation of the Common Core Standards in mathematics and English language arts expected to improve student performance. There are no proficiency requirements for graduation. Eighty-two percent of all students graduate from high school, but a smaller percentage progress through two- and four-year institutions.

School Accountability

Under Act 60 of the state education laws, Vermont is charged with holding schools accountable and intervening in low-performing schools. The state has conducted a number of audits based on several improvement metrics and has sent coaches to low-performing schools.

Data Systems

The Vermont Data System has met eight of the elements determined to be essential and is working on a system that matches student level data across the P–20 system. According to Achieve, Inc., the next steps for Vermont in attaining a complete longitudinal data system include making student data available to stakeholders and linking student data from K–12 and postsecondary education systems. [56]

Student Support

Services for at-risk students in Vermont are delivered through state and federal grants and have as their focus behavioral support, tutoring, or double classes in mathematics and English language arts; extended day, summer, and Saturday classes; and other supports. A wide range of intervention services are available. The state has adopted the Response to Intervention model[57] and previously had an inclusive model for special education. The state has promoted co-teaching as the desired delivery model for classroom instruction.

Teacher Quality

Vermont has several teacher preparation programs but does not require candidates to pass assessments to obtain certificates. We could not identify any new initiatives to upgrade teacher preparation programs through an Internet search, but such efforts may be ongoing. Professional development is offered through individual schools and five regional Education Service Agencies (ESAs). Most programs delivered are national models, and much of the professional development delivered in Vermont conforms to the National Staff Development Council guidelines. The ESAs are moving to devote their resources to providing training on a number of state priority areas.

CTE

Though not a statewide initiative, individual high schools, depending upon their resources, are initiating alternative high school experiences for students and have made their own arrangements for students to obtain college credits and transition to community colleges or state colleges.

The state community college system has developed a Career Readiness Certificate,[58] which ensures holders have proficiency in certain basic math and language arts areas. The state has seventeen career and technical centers that deliver programs through clusters and a work-based learning center.

In the area of dual enrollment, Vermont has a number of programs to encourage transition and college attendance. The Community College of Vermont offers an Introduction to College course[59] that high school students can take for no cost. If students take this and pass this course, they are entitled to take one course free of charge. The state college system enables accelerated students to take college courses at state colleges and universities and the Fast Forward[60] program coordinates career and technical centers with college programs and courses. The Vermont Technical College has initiated the VAST program,[61] which enables high schools students to take their senior year at the college as part of a combined senior year/first year of college program. This program specifically targets students interested in science, technology, and mathematics.

STEM

For fifteen years, Vermont has been leading in the development and implementation of embedded, sustained professional development through its Institutes for Science and Math education.[62] This model has been adopted at the national level. The design includes teacher participation and funding for one year of intensive mathematics and science instruction delivered by teacher leaders and professors, followed by sustained assistance in the classroom.

SUMMARY OF NEW ENGLAND STATES

The following is a chart that captures the conditions and characteristics of comprehensive approaches to achieving career and college readiness among the New England states, excluding Maine. Following the chart are descriptions of each state's efforts.

Table 1: State Strategies Related to College and Career Readiness

Strategies	CT	MA	NH	RI	VT
P–16/20 Council	x	x	x	x	x
Academic Standards					
▪ Graduation standards aligned with college and career readiness/knowledge and skills (prior to Common Core adoption)	x	x		x	
▪ Graduation proficiency measures		x		x	
State accountability systems for all low-performing schools	x	x	x	x	x
Student Support					
▪ Comprehensive state-sponsored system of early college and dual enrollment programs	x	x	x		x

Strategies	CT	MA	NH	RI	VT
▪ Comprehensive state support systems for at-risk students	x	x	x	x	x
Complete student-level longitudinal data systems, number of data-quality standards in place (out of 10 elements)	6/10	10/10	8/10	9/10	8/10
Teacher Quality					
▪ State improvements in teacher preparation programs, certification, and teacher quality standards	x	x	x	x	
▪ State upgrades to teacher evaluation system	x	x	x	x	
▪ State oversight of professional development programs	x	x		x	x
Career and Technology Education improvements, career planning	x	x	x		
Enhanced state systematic STEM programs and public/private partnerships	x	x		x	x

OTHER SELECTED STEM STRATEGIES

In addition to examining the New England states, we selected three RTTT states to review for their STEM strategies. Our selection was based on the comprehensive nature of the state reform efforts over time and the strong state emphasis and action in STEM education. Although we are focusing on these states' STEM initiatives here, each of these states also has strong initiatives in place in the college and career strategies described above. The timeline of the study allowed us to describe only a few states, but many others have developed innovative strategies that could be considered by others. [63]

OHIO

Ohio has been working on a comprehensive system of improvement for a number of years. The state has been awarded a RTTT grant and has in place a number of the key strategies (cited previously) defined to foster improvement. Although the state is a local control state with strong school board governance, the state moved early to develop strong state systems for STEM education. The Ohio STEM Learning Network was begun in 2007 as a public-private partnership to improve STEM education. The network includes ten STEM schools, twenty-eight K–8 programs of excellence, seven regional STEM hubs, and over three hundred K–12 STEM partners in higher education and business.[64] Over 100,000 students have received improved STEM instruction and exposure. At present, all students must take the Ohio Core curriculum, which requires four credits of mathematics and three of laboratory science and demonstrated proficiency for graduation.[65] The state is a member of both PARCC and the Smarter Balanced Assessment consortium and is paying

particular attention to key student transition points and the development of strong end-of-course assessments.

NORTH CAROLINA

North Carolina has taken an aggressive approach to developing early college and STEM-focused high schools. Since 2003, the North Carolina New Schools Project[66] and the Gates Foundation have developed one hundred early-college- or STEM-focused high schools across the state. The Project is now working with fourteen STEM-focused high schools to improve student achievement. The state's funded RTTT grant will enable North Carolina to focus and expand its STEM initiatives by forming four cluster high school networks as anchor centers to support existing STEM schools, expand professional development and technology use in schools, and expand collaboration with business partners. These collaborations are planned to develop "design" teams of professionals who will ensure that the curricula and instruction are innovative and applicable to advancing technologies. The clusters will be designed around four areas: (1) engineering and energy; (2) aerospace; (3) biotechnology and agri-science; and (4) health and life sciences.[67] The North Carolina Board of Education has recently adopted a STEM plan that creates a strategy for integrating more STEM content into coursework, sharing STEM resources across counties, and developing a public awareness plan.

DELAWARE

Delaware has worked with Achieve, Inc., to increase its graduation requirements in the area of science and mathematics and has a number of programs in place to enhance STEM education. The presence of DuPont in the state has fostered the integration of engineering and technology into the content of elementary schools instructional programs. The Delaware Project Lead the Way[68] program is focused on high-needs schools. The state has worked with the Massachusetts Institute of Technology to provide professional development for teachers and to develop an integrated STEM curriculum. The state STEM Coordinating Council is targeting six low-performing schools to expand AP courses, provide professional development to teachers, and extend student tutoring and after-school programs. The state has sponsored scholarships and loan forgiveness programs as incentives to attract STEM teachers, and is implementing a STEM residency program in partnership with the University of Delaware.[69]

SUMMARY

States have developed a number of strategies to improve STEM education, which might be categorized as follows: (1) increased rigor and graduation requirements in STEM areas with the development of curricular resources; (2) increased requirements for teacher preparation and certification; (3) innovative professional development programs; (4) incentives and programs to attract STEM candidates into teaching; (5) the formation of partnerships and networks; and (6) efforts to extend strong instruction and support to low-performing schools. Also important are (7) improvements to career and technology education (CTE), including career planning, and (8) Enhanced state systematic STEM programs and public/private partnerships

Although states vary in their approaches, most have begun with enhanced rigor and requirements for student mastery for graduation. This approach will be aided by the implementation of college and career readiness standards in the Common Core. States that have been working on this area for some time are now moving to develop model curricular modules aligned with the Common Core and state curricular resource centers that will be available for teachers online. Other states that have had various assessments in place for some time are introducing requirements for students to demonstrate proficiency for graduation.

Another important area of focus has been on teacher preparation, certification, and professional development. Several states have moved to increase the requirements in STEM areas for teacher candidates, and some states are reviewing professional development guidelines to ensure that these programs include best practices and are focused on priority areas. Many states have introduced incentives for attracting the best teachers and are paying attention to the equitable distribution of teachers to low-performing schools.

Other aspects of this comprehensive approach that are equally important are a strong state accountability and intervention system for low-performing schools, a strong data system, and improvements in career and technical education. In the area of STEM education, the array of strategies is encouraging. It is clear from our review that states that have identified clear improvement goals and moved early and systemically to foster improvement are farther along the improvement road.

LIMITATIONS

The limitations of the study include incomplete or dated material on state websites and in policy reports. Furthermore, although the information on RTTT proposals may be from the spring of 2010, descriptions of initiatives may now be out of date or include plans for initiatives that are not currently be in place, particularly if the state did not receive funding. Due to the limitations of the data available, wherever possible, we triangulated findings with other sites, including the Education Commission of the States and Achieve, Inc. Achieve, Inc., in particular, is a good source because it is an independent organization created by national leaders, such as governors, to promote and support college and career readiness across the nation.

We had also originally planned to also conduct interviews with key staff at the department of education in each state, but there was not enough time to incorporate interviews into this report.

Although states may have some of these strategies in place in individual school districts, we noted their presence only if there was a strong state effort evident to establish the strategy as part of a comprehensive system of improvement.

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[1] National Academy of Sciences. (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future.* National Academy of Sciences, Washington DC, National Academies Press; National Science Board. (2007). *National action plan for addressing the critical needs of the U.S. science, technology, engineering, and mathematics education system*. Washington DC: National Science Board; Tucker, M. (2011). *Standing on the shoulder of giants: An American agenda for education reform.* Washington, DC:

National Center on Education and the Economy. National Governors Association. (2007). *Innovation America: Building a science, technology, engineering and math agenda.* Washington, DC: Author.; Achieve Inc. (2009). *Taking root: Lesson learned for sustaining the college and career ready agenda.* Washington, DC: Achieve, Inc.; Achieve, Inc. (2011). *State college and career ready high school graduation requirements.* Achieve Inc. (2007). *Aligning high school graduation requirements with the real world.* Achieve, Inc.; Schmidt. W. (2011). *STEM Reform: Which way to go.* Paper prepared for the National Science Foundation; Price, D. & Coles. A. (2006). *College access: Understanding the education pipeline.* Information brief prepared for the Bill and Melinda Gates Foundation; Change the Equation. (2011). *All over the map.* Washington, DC: Author. Available at changetheequation.org; Richardson, N., Berns, B., Sandler, J. & Marco, L. (2008). *Recent initiatives to improve alignment and instructional quality in the states.* Newton, MA: Education Development Center, Inc.; Pathways to Prosperity Project. (2011, February). *Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century.* Cambridge, MA: Harvard Graduate School of Education. Available at http://www.gse.harvard.edu/news_events/features/2011/Pathways_to_Prosperity_Feb2011.pdf

[2] Key search terms for the key strategies include: graduation and/or diploma requirements, graduation accountability and/or competency measures, teacher licensure requirements, particularly in math or science, teacher incentives, teacher preparation programs, longitudinal data systems, professional development offerings, supports for at-risk students, dual enrollment, early college, STEM network of academies or schools, early college, career planning, school turnaround and leadership programs, college and career readiness.

[3] Thomas B. Fordham Institute. (2006). *The state of state standards 2006.* Cincinnati, OH: Author; Consortium for Policy Research in Education. (2006). *Scaling up instructional improvement through teacher professional development: Insights from the local systemic change initiative.* Philadelphia, PA: Author; National Science Board. (2006). *National action plan for addressing the critical needs of the U.S. science, technology, engineering, and mathematics system.* Washington, DC: Author; Achieve, Inc. (2009). *Taking root: Lessons learned for sustaining the college and career agenda*. Washington, DC: Author; National Center for Public Policy and Higher Education. (2010). *Beyond the rhetoric: Improving college readiness through coherent state policy.* San Jose, CA: Author; Symonds, W., Schwartz, R., & Ferguson, R. (2011). *Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century.* Cambridge, MA: Harvard Graduate School of Education; Tucker, M. (2011). *Standing on the shoulder of giants: An American agenda for education reform.* Washington, DC: National Center on Education and the Economy.

[4] Tucker, M. (2011), *Standing on the shoulders of giants: An American agenda for education reform.* Washington, DC: National Center on Education and the Economy; Richardson, N., Berns, B., Sandler, J. & Marco, L. (2008). *Recent initiatives to improve alignment and instructional quality in the states.* Newton, MA: Education Development Center, Inc.; Achieve, Inc. (2009). *Taking root: Lessons learned for sustaining the college and career agenda*. Washington, DC: Author.

[5] Ibid.

[6] Common Core Standards Initiative: www.corestandards.org

[7] American College Testing Service. (2010). *First look.* Iowa City, IA: Author p.1.

[8] U. S. Department of Education. (2011). *ESEA flexibility.* Washington, DC: Author. www.ed.gov/sites/default/files/esea

[9] U. S. Department of Education. (2010). *College and career-ready standards and assessments.* Washington, DC: Author. p. 2.

[10] A number of key policy research documents were reviewed and are included in the list of important links at the end of the paper. Chief among these are papers from Achieve, Inc., the American College Testing Service (ACT), the U.S. Department of Education, the Education Commission of the States, and individual papers referenced in Endnote 1. In addition, the RTTT proposals for the states mentioned in the paper (2010 phases 1 and 2) were reviewed. We searched each state department of education website of the states reviewed, and when necessary searched for important papers under their general subject matter through Google searches.

[11] Several states are developing curricular models and units that are aligned with the Common Core Standards. In our review, Ohio is developing modules that are aligned with the standards and professional

development curricula. The state has set the date of June 2011 for the development of these model curricula. Massachusetts is developing a digital library of curricular models aligned to the standards that will be available to teachers online. For more information on state activity in this area, please see the state RTTT.

[12] Data Quality Campaign. (2011). *10 essential elements of a state longitudinal data system.* Washington, DC: Author.

[13] The 10 Essential Elements are:
1. A unique statewide student identifier that connects student data across key databases across years
2. Student-level enrollment, demographic and program participation information
3. The ability to match individual students' test records from year to year to measure academic growth
4. Information on untested students and the reasons they were not tested
5. A teacher identifier system with the ability to match teachers to students
6. Student-level transcript information, including information on courses completed and grades earned
7. Student-level college readiness test scores
8. Student-level graduation and dropout data
9. The ability to match student records between the P-12 and higher education systems
10. A state data audit system assessing data quality, validity and reliability

[14] See Endnote 10.

[15] Connecticut State Department of Education: http://www.sde.ct.gov/sde/site/default.asp

[16] Education Commission of the States, P-16/P-20Councils: http://mb2.ecs.org/reports/Report.aspx?id=910

[17] CALI Initiative Information: http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&Q=321754

[18] Secondary School Reform: http://www.sde.ct.gov/sde/cwp/view.asp?a=2702&Q=322264

[19] Connecticut State Department of Education: www.sde.ct.gov

[20] Partnership for the Assessment of Readiness for College and Careers (PARCC): http://www.parcconline.org/

[21] Connecticut's Race to the Top Proposal: www.ed.gov/programs/racetothetop/phase2

[22] Achieve, Inc. State Profiles: http://www.achieve.org/StateProfiles

[23] Connecticut's Race to the Top Proposal: www.ed.gov/programs/racetothetop/phase2

[24] Massachusetts State Department of Education: http://www.doe.mass.edu/

[25] Richardson, N., Berns, B., Sandler, J. & Marco, L. (2009). *Implementation strategies for improving STEM education and workplace in Massachusetts.* Newton, MA: Education Development Center, Inc.

[26] MassCore: www.doe.mass.edu/hsreform/masscore

[27] Partnership for the Assessment of Readiness for College and Careers (PARCC): http://www.parcconline.org/

[28] The 11 essential conditions are:
1. Effective district systems for school support and intervention
2. Effective school leadership
3. Aligned curriculum
4. Effective instruction
5. Student assessment
6. Principal's staffing authority

7. Professional development and structures for collaboration
8. Tiered instruction and adequate learning time
9. Students' social, emotional, and health needs
10. Family-school engagement
11. Strategic use of resources and adequate budget authority

For more information about these essential conditions and school accountability in Massachusetts, see http://www.doe.mass.edu/sda/review/school/process.html?section=essential

[29] Massachusetts Virtual Academy at Greenfield: http://www.k12.com/mava/

[30] Data Quality Campaign. (2011). *10 essential elements of a state longitudinal data system.* Washington, DC: Author.

[31] Massachusetts Educator Services: http://www.doe.mass.edu/educators/

[32] Massachusetts Department of Elementary and Secondary Education: www.doe.mass.edu

[33] More information on Massachusetts is available in the Race to the Top Proposal. This and other RTT first and second round 2010 proposals can be found at www.ed.gov/programs/racetothetop/phase2

[34] New Hampshire State Department of Education: http://www.education.nh.gov/

[35] Education Commission of the States, P-16/P-20 Councils: http://mb2.ecs.org/reports/Report.aspx?id=910

[36] New England Comprehensive Assessment Program: http://www.measuredprogress.org/necap

[37] Common Core Standards Initiative: http://www.corestandards.org/

[38] New Hampshire Department of Education: www.education.nh.gov

[39] NAEP scores: http://www.nationsreportcard.gov/

[40] New Hampshire Accountability System: http://www.education.nh.gov/instruction/school_improve/account_sys.htm

[41] New Hampshire's Race to the Top Proposal: www.ed.gov/programs/racetothetop/phase2

[42] Virtual Learning Academy Charter School: http://www.vlacs.org/

[43] National High School Center. *New Hampshire multi-tiered approach to dropout prevention:* www.betterhighschools.org

[44] New Hampshire's Race to the Top Proposal: www.ed.gov/programs/racetothetop/phase2

[45] TeachNorth: http://www.teachnorth.org/

[46] New Hampshire Taskforce on Effective Teaching: http://www.education.nh.gov/teaching/index.htm

[47] College Tech Prep and New Hampshire Career Pathways: http://www.education.nh.gov/career/career/career_pathways.htm

[48] Rhode Island State Department of Education: www.ride.ri.gov

[49] Education Commission of the States, P-16/P-20 Councils: http://mb2.ecs.org/reports/Report.aspx?id=910

[50] Rhode Island Department of Education: www.ride.ri.gov

[51] Rhode Island's Race to the Top Proposal:www.ride.ri.gov/commissioner/racetothetop

[52] The Rhode Island Bachelor's Degree in Three Program Act press release: http://www.rilin.state.ri.us/news/pr1.asp?prid=5939

[53] Project Making the Grade: The Governor's Blue Ribbon Panel on Mathematics & Science Education. An Action Report for Rhode Island. Available at http://media.umassp.edu/massedu/stem/Project%20Making%20the%20Grade.pdf

[54] Vermont State Department of Education: http://education.vermont.gov/

[55] Education Commission of the States, P-16/P-20 Councils: http://mb2.ecs.org/reports/Report.aspx?id=910

[56] Achieve, Inc. State Profiles: http://www.achieve.org/StateProfiles

[57] Vermont Family Network, Response to Intervention: http://www.vermontfamilynetwork.org/i-need-help-with/special-education/response-to-intervention/

[58] Community College of Vermont, Governor's Readiness Certificate: http://www.ccv.edu/careerreadyvt

[59] Introduction to College Studies, Community College of Vermont: http://www.ccv.edu/intro_to_college_studies

[60] Vermont State Colleges, Special Programs: http://www.vsc.edu/Pages/Special-Programs.aspx

[61] Vermont Technical College, VAST: www.vtc.edu/right.php/pid/3/sid/465

[62] The Vermont Institutes: http://www.vermontinstitutes.org/

[63] These proposals are available at http://www2.ed.gov/programs/racetothetop/phase2-applications/index/html

[64] Ibid. p. P2-1.

[65] Ohio Core, Graduation Requirements: http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEPrimary.aspx?page=2&TopicRelationID=1702

[66] North Carolina New Schools Project: http://newschoolsproject.org/

[67] North Carolina Race to the Top Proposal. www.ed.gov/programs/racetothetop/phase2

[68] Project Lead the Way: http://www.pltw.org/

[69] Delaware Race to the Top Proposal. www.doe.k12.de.us/rtt

Appendix A: Online Data Sources

Topic	Link
Achieve, Inc. College and Career Ready Fact Sheet	http://www.achive.org/files/stateFACTsheet
Achieve, Inc. State Profiles American Diploma Project (ADP)	http://www.achieve.org/StateProfiles
ACT: College Readiness: A First Look at the Common Core and College and Career Readiness	http://www.act.org/research/policymakers/pdf
Early College High School Initiative	http://www.earlycolleges.org/
Education Commission of the States, P–20 councils	http://mb2.ecs.org/reports/Report.aspx?id=910
Education Commission of the States: High School Level STEM initiatives	http://mb2.ecs.org/reports/Report.aspx?1409
Education Commission of the States: High School Level STEM initiatives	http://mb2.ecs.org/reports/Report.aspx?1409

Appendix B: State Department of Education Websites

State	Link
Connecticut	http://www.sde.ct.gov/sde/site/default.asp
Maine	http://www.maine.gov/education/
Massachusetts	http://www.doe.mass.edu/
New Hampshire	http://www.education.nh.gov/
Rhode Island	http://www.ride.ri.gov/
Vermont	http://education.vermont.gov/