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The impact of state policy on community college STEM programs

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Community Colleges and STEM
Examining Underrepresented Racial and Ethnic Minorities

Edited by ROBERT T. PALMER and J. LUKE WOOD
COMMUNITY COLLEGES AND STEM

Examining Underrepresented Racial and Ethnic Minorities

*Edited by Robert T. Palmer and J. Luke Wood*
CONTENTS

Foreword ix
Estela Mara Bensimon and Cecilia Santiago

Preface xiii

Acknowledgments xix

PART I
Pathways to Success: The Role of Community Colleges in Promoting Access to Minorities in STEM 1

1 Community Colleges and Underrepresented Racial and Ethnic Minorities in STEM Education: A National Picture 3
XueLi Wang

2 The Impact of State Policy on Community College STEM Programs 17
Pamela Eddy

3 The Need for Integrated Workforce Development Systems to Broaden the Participation of Underrepresented Students in STEM-Related Fields 37
Victor Hernandez-Gantes and Edward C. Fletcher Jr.
PART II
A New Dimension to the Discourse on Minority Students, STEM, and Community Colleges

4 An Expectancy-Value Model for the STEM Persistence of Ninth-Grade, Underrepresented Minority Students
   Lori Andersen and Thomas J. Ward

5 The Effect of Non-Cognitive Predictors on Academic Integration Measures: A Multinomial Analysis of STEM Students of Color in the Community College
   Marissa Vasquez Urias, Royce M. Johnson, and J. Luke Wood

6 STEMming the Tide: Psychological Factors Influencing Racial and Ethnic Minority Students’ Success in STEM at Community Colleges
   Terrell L. Strayhorn, Michael Steven Williams, Derrick L. Tillman-Kelly, and Marjorie Dorimé-Williams

7 The Propensity to Avoid Developmental Math in Community College: A Focus on Minority Students
   Bobbie Everett Frye, James E. Bartlett, II, and Kelly D. Smith

8 Moving Beyond the Barrier of Mathematics and Engaging Culturally Relevant Pedagogy in the Classroom for Racial and Ethnic Minority STEM Students in Community Colleges
   Denise Yull

PART III
Examining the Experiences of Minority Students in Community Colleges: Diverse Contexts

9 Minority Serving Community Colleges and the Production of STEM Associate’s Degrees
   Frances King Stage, Ginelle John, Valerie C. Lundy-Wagner, and Katherine Mary Conway

10 Creating Successful Pathways for Asian Americans and Pacific Islander Community College Students (AAPIs) in STEM
   Dina C. Maramba

11 Constraints and Opportunities for Practitioner Agency in STEM Programs in Hispanic Serving Community Colleges
   Megan M. Chase, Estela Mara Bensimon, Linda Taing Shieh, Tiffany Jones, and Alicia C. Dowd
12 Achieving Success: A Model of Success for Black Males in STEM at Community Colleges
Robert T. Palmer and Zachary M. DuBord

About the Editors
About the Contributors
Index
Declining college graduation rates, poor performance in mathematics and science, and an increasingly competitive and technology-driven global economy breed a setting for education reform in the United States. This environment pressures leaders at all levels of government to take action with a focus to open the pipeline in STEM disciplines, ultimately with the intention of obtaining more college graduates in these high demand areas. National and state initiatives are calling for more college degrees and workforce training to strengthen America’s workforce and its economic prosperity (2011 Higher Education Opportunity Act of Virginia, 2011; Obama, 2009). The American Graduation Initiative (Obama, 2009) targeted a goal of achieving 5 million more college degrees by 2020; likewise, the Lumina Foundation (2010) established its “Big Goal” that targets 60% of Americans having a postsecondary degree or credential by 2025. Reaching these lofty ambitions requires progress within each state. In 2011, Virginia passed its Higher Education Opportunity Act, also known as Top Jobs for the 21st Century (Top Jobs Act or TJ21) that set a statewide target of 100,000 additional degrees by 2025. If all 50 states had similar targets, the goal of 5 million additional degrees by 2025 would be possible.

The Top Jobs Act outlined 10 purposes to guide development and implementation of funding policies and to establish evaluation criteria. In summary, the purposes include:

1. To ensure an educated workforce in Virginia;
2. To take optimal advantage of the demonstrated correlation between higher education and economic growth;
3. To place Virginia among the most highly educated states and countries by conferring approximately 100,000 cumulative additional undergraduate degrees on Virginians between 2011 and 2025;
4. To enhance personal opportunity and earning power for individual Virginians by increasing college degree attainment in the Commonwealth, especially in high-demand, high-income fields such as science, technology, engineering, mathematics (STEM), and health care;
5. To promote university-based research that produces outside investment in Virginia to fuel economic growth;
6. To support the national effort to enhance the security and economic competitiveness of the United States of America through increased research and instruction in science, technology, engineering, mathematics, and related fields (STEM);
7. To preserve and enhance the Virginia higher education system's excellence and cost-efficiency through reform-based investment, technology-enhanced instruction, sharing of instructional resources between and among colleges and universities, and expanded community college transfer options leading to bachelor's degree completion;
8. To realize the potential for enhanced benefits from the Restructured Higher Education Financial and Administrative Operations Act of 2005 (§ 23-38.88 et seq.);
9. To establish a higher education funding framework and policy that promotes stable, predictable, equitable, and adequate funding, provides need-based financial aid for low-income and middle-income students and families, and relieves the upward pressure on tuition associated with loss of state support;
10. To recognize the unique mission and contributions of each institution of higher education in the Commonwealth (§ 23-38.87:10).

For the purposes of this chapter, this research study focused on the intersection of the points outlined in TJ21 that refer to increasing the number of graduates in STEM fields (4 and 6 above) and the leveraging of community college pathways to enhance college completion (7, 9, and 10 above). The legislation emphasizes the need for developing economic efficiencies and promoting partnerships and collaborations among public institutions and private partners (§ 23-38.87:19). The research questions at the heart of this study included: How does state higher education policy influence planning efforts at community colleges? What steps are Virginia community colleges taking to help support educational efforts in STEM?

The literature review presents background on the policy implementation process, central steps required for strategic planning and change, and current research on STEM pathways in community colleges. Next, a review of the data collection methods employed for this study outlines the research design process. A case study portrait sets the context for the findings from the study. Finally, the chapter concludes with a discussion of the data and a summary of recommendations for practice.
Literature Review

The strong link between demand to fill STEM jobs and the emphasis on economic development in cities and states focuses state leaders' and policy makers' attention on these issues. The National Governors Association (NGA) acknowledged the critical nature of student preparation in STEM on future prosperity for the country, noting:

Governors are in a unique position to advance comprehensive STEM education policy agendas aligned with workforce expectations that will ultimately aid state economic growth. Governors can elevate the urgency and build the political will to advance STEM education and use budgetary and policy levers to make meaningful changes across education systems.

(NGA, 2011, ¶ 3)

Scaffolding and coordination within the educational pipeline becomes central to state policies to support STEM education. The Department of Labor reported that “of the 20 fastest growing occupations, half are in the associate degree or higher category” (Bureau of Labor Statistics, 2012, p. 13). Thus, the pathways through community colleges become increasingly important for efforts to expand graduates in STEM fields. Minor (2012) underscored the importance of community colleges in this pipeline, in particular for minority students as the majority of Hispanics and African Americans holding a bachelor’s or master’s degree in the STEM field have attended a community college. Using state policy as a lever for change influences the approaches community colleges pursue to support STEM education.

Policy Implementation

The research on the policy process is robust and includes consideration for the development, adoption, implementation, and evaluation phases of the policy process (Fowler, 2009). Case studies of policy implementation targeting STEM support and completions, however, are limited (Johnson, 2012). The scant research on STEM policy reinforces the challenges facing policy implementers that contribute to the overall success or failure of the implementation (e.g., lack of motivation to implement at the grassroots' level, scarcity of resources, or mismatch of policy intentions and community needs) (Breiner, Harkness, Johnson, & Koehler, 2012; Fowler, 2009).

Fowler (2009) described the growing field of implementation research by dividing it into three “generations” (p. 272) according to eras that focused on different emphases regarding the effectiveness of implementation strategies. The first generation of implementation research revealed the difficulty of implementing policy. According to Fowler (2009), policy implementers,
specifically intermediaries who have the responsibility to actually implement policy, often lack the understanding, knowledge and skills, and resources necessary to implement the policy. The second-generation research reemphasized the challenges with policy implementation, but also focused on the design of the policies, identifying factors that were present when policies were successfully implemented. The third, and current, generation considers more carefully implementers as learners and is based on the concept of schemas, the natural tendency to rely upon previous experiences to relate to new information (Harris, 1994; Weick, 1995). Furthermore, the third-generation era of research on implementation stresses the importance of a strong social infrastructure, as an arena of idea generating and sharing network, in policy implementation (Fowler, 2009).

Through the lessons learned from the three generations of implementation research, today, we are able to identify patterns and commonalities within successful implementation processes. Fowler (2009) offered a “how to” for implementing policy, in which great significance is placed upon the mobilization process, including the steps of policy adoption, planning, and the gathering of resources. The mobilization phase typically lasts from 14 to 17 months (Huberman & Miles, 1984). Thus, in 2012, Virginia was still in the middle of this process with respect to the Top Jobs Act. At the outset of a new policy, three guiding questions prevail: (a) Is there good reason to adopt policy? (b) Is the policy appropriate for the institution and its serving region? (c) Is there sufficient support for the policy among key stakeholders? (Fowler, 2009, pp. 256–258). These questions help guide the analysis of the data for this study. Influencing the tension between planning too much and planning too little is gathering the appropriate and adequate resources for successful policy implementation. For instance, Henderson, Beach, and Finkelstein (2011) conducted an analytic review of the literature regarding changes to instructional practices in undergraduate STEM courses and found that top-down institutional mandates for change were ineffective, whereas effective change strategies involved alignment of values and beliefs about the policy and teaching strategies.

**Strategic Planning and Change Theory**

A number of planning and change models exist. Keller’s seminal 1983 book on academic strategy in higher education ushered in the use of strategic planning and management within colleges and universities. This time period represented the mark of declining state support for higher education and a shift in public sentiment of higher education from a public good to more of a private good (Bowen, 1977). Planning became increasingly crucial for institutional survival. Leaders sought clear and concise outlines for planning efforts. Rowley, Lujan, and Dolence (1997) created a 10-step cyclic model that involved establishment of key performance indicators (KPIs), environmental scanning, brainstorming
and formulation of ideas, development of implementation strategies, and continuous evaluation. Yet, strategic planning is not always at the center of policy development as ideologies, power, and the timing associated with defining issues often influence issue definition and agenda setting (Fowler, 2009). A focus on change, however, is a commonality for policy and planning efforts.

Fullan (2002, 2006) provides a framework for change specifically targeting education. His research on change theory challenges us to consider “what ‘theories of action’ really get results in educational reform”? (2006, p. 3). Fullan’s (2006) model contains seven core premises: focus on motivation, capacity building with a focus on results, learning in context, changing context, reflective action, tri-level engagement, and persistence and flexibility in staying the course. Central to this framework are motivation and engagement because the remaining five premises depend upon the synergy of the desire to change and the willingness to participate in action. The implementation phase of policy involves change and depends on the implementers’ motivation for enacting the policy and their capacity or ability to influence how the policy applies in practice (Fowler, 2009). The discourse presented in the early policy process stages of policy development and adoption lays the foundation upon which the later stages of the policy process, specifically implementation and evaluation, are built. According to Fowler (2009), it is in these early stages that “a misguided policy adoption process undermines the entire implementation” (p. 285). Fullan (2006) would argue that “if one’s theory of action does not motivate people to put in the effort—individually or collectively—that is necessary to get results, improvement is not possible” (p. 8). Many policies do not result in change due to resistance on-the-ground.

Johnson (2012) utilized Fullan’s (2006) theoretical framework of change to study the implementation of a state STEM policy. The study reported several successful strategies including the use of early conversations about shared vision, the development of a strategic plan to guide change, the creation of a structure supporting accountability, and the celebration of small wins. Despite the challenges of implementing the state policy due to funding and timeline and competing agendas of the stakeholders, Johnson (2012) offered hope that successful policy implementation is possible, particularly when a dedicated leader builds the case for change, manages and communicates the message of change with constituents, charts the course of action, and keeps all involved parties on track towards the established goals.

**STEM in Community Colleges**

Recent research on STEM in community colleges focuses primarily on the experiences of students in general (Hagedorn & Purnamasari, 2012; Heidel et al., 2011; Lenburg, Aguirre, Goodchild, & Kuhn, 2012) and students of color specifically (Malcom, 2010; Reyes, 2011) versus how state policy regarding
STEM is implemented within the sector. Knowing more about the student experience in the classroom can help inform policy formation and identify and leverage best practices that support student success. Likewise, vocational education and contract training provides a forum to learn more about what helps students in these learning environments complete their programs. A study conducted by the Business Higher Education Forum (BHEF, 2010) sought to create a framework to enhance stakeholder understanding of the community college in workforce development and degree attainment. This research offered two broad frameworks. The first, a regional model, focused on the interactions of the community college, government, and workforce to increase the number of graduates. The second, a sectoral model, focused specifically on a single labor market or profession. Both of these frameworks center on the role of the community college as an actor in discovering solutions to workforce training and education. Indeed, community colleges are increasingly recognized as a potent lever for economic development (Obama, 2009).

The National Governor’s Association (NGA; 2011) published an issues brief offering several insights of the advantages of utilizing community colleges to meet the demands of today’s workforce. The brief presented arguments to support expanding STEM education and STEM-related workforce skill development, including the need to expand regional STEM-skill needs of the industry, providing incentives for STEM course completion at the institutional and individual student levels, supporting more effective mathematics remediation, and creating requirements for transferable community college STEM credits and credentials (NGA, 2011). With 90% of the U.S. population living within 25 miles of a community college and the traditionally low-cost tuition rates at these colleges (Cohen & Brawer, 2008), community colleges are an attractive and convenient option for bolstering a STEM-skilled workforce. Their return on investment, estimated at 16%, further contributes to the reliability of community colleges to fill in the gaps and in order to do so, efforts will need to be made to address the “policy gaps” (NGA, 2011, p. 1).

**Virginia Case Background**

Research highlights how state-based policy initiatives are a response to the convergence of federal science and economic policy, with a focus on high tech economic activity across the states (Douglass, 2007). A survey of 22 Virginia Community College workforce development leaders found that healthcare skill training was the highest demanded need in their regions, followed by STEM training in general (Landon, 2009). Central to building technology training capacity are higher education and business and industry collaboration. The Virginia Business Higher Education Council created a 2020 vision to prepare Virginia’s workforce for the top jobs of the future initiating the Grow by Degrees Coalition (see http://growbydegrees.org/). In 2009, Bob McDonnell, then
Attorney General, ran on a campaign platform to raise the bar for educational attainment “to bring strong and sustainable economic opportunity and expansion” to the Commonwealth (McDonnell, 2009, ¶ 6). Fulfilling this campaign promise, Governor McDonnell created the Higher Education Commission that helped craft the 2011 legislation for what is now the Top Jobs Act.

When the Top Jobs legislation was signed in 2011, early enrollment projections predicted that Virginia institutions would add 6,000 new seats for in-state students. Of this total, 4,000 of the 6,000 expected students enrolled in a Virginia Community College (DuBois, 2011), which was more than anticipated. The fact that two-thirds of new enrollment occurred at the community college level underscores the important role two-year colleges have in preparing graduates for work demands. The State Higher Education Executive Officers (SHEEO) organization reported on degree completion by program areas for all states (2011). For STEM degree programs in Virginia, community colleges show a completion rate of 26.3% within the sector, which is 17.25% higher than the national average and only slightly below the completion rates for the highest level research universities in the state (Research, high activity—16.00%; Research, very high activity—33.48%). As such, community colleges play a significant role in STEM education in the state of Virginia.

Projections indicate that the Virginia will have the second highest proportion of STEM jobs as a fraction of job openings through 2018 (8.2%); only the District of Columbia has a higher rate (Carnevale, Smith, & Melton, 2011). However, the state has a lower anticipated rate of STEM jobs for those with an associate’s degree (8.3% compared to the high in North Dakota of 23.8%). A full 93% of STEM jobs in Virginia will require a postsecondary degree (Carnevale, Smith, Stone, et al., 2011). The bulk of these jobs will require a bachelor’s degree or higher, and community colleges provide a prime gateway into these degree programs given their convenience and cost. An anticipated 30% increase in STEM jobs is predicted in Virginia, which is 13% higher than the national norm.

The state of Virginia recognized these facts regarding demands for graduates as the Top Jobs Act reflects with its focus on STEM education and the educational pipeline. Further, Northern Virginia Community College (NOVA; 2012) initiated a program, SySTEMic Solutions, to expand the STEM pipeline and provide a pathway for students from area high schools to NOVA, to George Mason University, and into the workforce. Counselors are embedded into regional high schools and work to identify students for the program and support them during the application process. Once at NOVA, retention counselors continue to support these students as they transition to college and ultimately transfer to a four-year college or into the workforce. These support mechanisms recognize the fact that many of the participating students are first-generation college students who are often low-income and from minority groups.
Project Background

The methods for this research included a review of the Virginia Higher Education Opportunity Act of 2011 to determine the influence of the legislation on STEM programming and the anticipated role for community colleges. As noted above, several factors were included in the TJ21 that target both of these areas. Next, a review of the strategic plan (Achieve 2015) for the Virginia Community College System (VCCS) occurred. The features of the plan are highlighted in the findings section. As well, the strategic plans of the 23 community colleges within the state were analyzed to determine links with the overarching state planning document, in particular noting plans for STEM programming and implementation plans for the campuses. Finally, interviews were done with key stakeholders in the state to understand their perception of the implementation phase of TJ21 and to note how change was occurring on the state's community college campuses.

Findings

A summary of the planning efforts at the Virginia Community College System provides a background to understand better how the new Top Jobs Act policy, in particular the focus on STEM programming, has begun to be implemented in the community college system and on individual campuses. The relatively recent passage of the legislation and the typical timeline for policy implementation places this snapshot in the early stages of the process. This initial investigation provides a benchmark for subsequent evaluation in the future. This study found three main findings. First, for the VCCS was already engaged in updating their strategic plan, thus the implementation of the goals outlined in the TJ21 state policy had to be incorporated into a planning process already underway. Second, the change obtained so far in the implementation of the policy has been incremental and first-order change (Bartunek & Moch, 1987). Finally, the state policy implies a coordination of efforts along the educational pipeline that occurs in a limited fashion in reality.

Context of the VCCS

The Virginia Community College System was established in 1966 by the General Assembly to better serve the needs of local communities through the provision of educational and vocational training opportunities. The mission of Virginia's Community Colleges is to give everyone the opportunity to learn and develop the right skills so lives and communities are strengthened (Virginia's Community Colleges, 2012). There are 23 community colleges in the state operating on 40 campuses. The majority of the colleges are serving rural areas (17), with the remaining campuses located in suburban areas (5) or urban cities (1). The campuses range in size from small (enrollment of 1,052) to large
(enrollment of 48,996). Three of every five undergraduate students in the state attend one of Virginia’s community colleges (VCCS fast facts, 2012). Virginia also has one junior college, Richard Bland College (RBC) that is not in the VCCS. Instead, RBC is a branch campus of the College of William and Mary. As such, RBC has its own unique planning efforts underway that are not coordinated in the VCCS Achieve 2015 matrix; RBC was not included in this study.

The chancellor of the system, Glenn DuBois, utilizes broad-based strategic planning. In 2003, he oversaw a planning effort titled Dateline 2009 in which targets were established for student recruitment, graduation, and transfer rates. This initial 6-year plan was updated in 2009 and the new plan is titled Achieve 2015. Five key areas were identified for this plan: Access, Affordability, Student Success, Workforce, and Resources (see http://www.vccs.edu/WhoWeAre/Achieve2015.aspx). The objectives of Achieve 2015 are in line with national and state priorities, supporting the preparation of a strong workforce for the jobs of the future. The student-first agenda charts the course for Virginia’s Community Colleges in an effort to strengthen lives, communities, and ultimately the Commonwealth’s economy. Each of the 23 colleges in the state has individual campus plans that align, or not, with the overarching state plan. These individualized plans allow the campus to capture the unique context of their location and to capitalize on their areas of expertise, as well as acknowledge the differences in size among the campuses. Individual campus presidents are evaluated using a set of president’s goals that are linked to the overarching system plan.

The Virginia Community College System was able to leverage the language already established in their aggressive strategic plan, Achieve 2015, to outline their plan of action for meeting the goals of TJ21. Aligning with the objectives of national and state initiatives to confer more degrees, particularly in the area of STEM degrees, the VCCS is targeting improvements to remedial instruction and student success. The VCCS is implementing a redesign of developmental education and other reengineering efforts to help support the policy goals of increased numbers of graduates.

**Hopping on a Moving Train**

The State Council of Higher Education for Virginia (SCHEV) requires 6-year plans from colleges. As a result, the leaders of the community colleges already had in place a framework for planning and change when TJ21 was passed. The colleges could look at their existing plans and determine how they could align plans underway with objectives of the state policy.

The goals of Achieve 2015 are further distilled into strategies, referred to as the chancellors’ goals. These goals are evaluated each year and adjustments are made to the language to ensure that VCCS and its campuses are addressing the
most current issues with its progress towards Achieve 2015. In particular, under the Access goal, one of the strategies focuses on educational programs and states that the objective is to “annually develop 10 new academic programs (degree, certificate, or career studies certificate) that respond to emerging, critical workforce needs, particularly in *STEM-related areas* (science, technology, engineering, and mathematics)” (D. VanCleave, personal communication, April 3, 2012, emphasis added). In the first year of Achieve 2015, the 2010–2011 chancellor’s goals did not include the emphasis on developing STEM-related academic programs. It is inferred that this STEM reference was included later in support of the adoption of TJ21, which took place in April, 2011, and only 1 month before the adoption of the 2011–2012 chancellor’s goals in May, 2011.

The review of the individual campus strategic planning documents highlighted a range of alignment with the overarching system goals outlined in Achieve 2015. Eleven of the campuses had alignment with the central plan and included specific references to some of the chancellor’s goals. Of this subset, one rural-serving, medium-sized college developed a specific plan for STEM that included several goals and sub-goals to guide the college’s progress. Another 11 of the campuses had mixed alignment with the system goals. In these instances, the colleges had a framework in place similar to the system plan, but the language used to communicate the goals did not mirror Achieve 2015. Only one college (suburban, multi-campus) did not have a plan linked from the VCCS website and there was no mention of Achieve 2015 on the college’s webpage. As well, the language used to communicate the college’s goals did not mirror Achieve 2015. Table 2.1 provides a summary of the alignment of the overarching plan and the individual college’s plans.

The majority of rural campuses in the state have plans that align with the overarching state planning document (59%), whereas the bulk of suburban colleges have mixed alignment (80%). Further analysis of the individual campus plans found approximately half (48%) of the campuses with specific references to STEM. The plans referred specifically to the goal of increasing access. This focus is appropriate given the references in the Top Jobs Act to increasing graduates in STEM fields. Planning references on individual campuses targeted creation of new academic programs, with several referencing addressing specific community based and critical workforce needs to determine what programs to develop. One campus identified the goal to increase enrollment of at-risk and underserved students, particularly mentioning women and minorities in

<table>
<thead>
<tr>
<th>Alignment</th>
<th>Number of Colleges</th>
<th>College Classification</th>
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<tbody>
<tr>
<td>Aligns</td>
<td>11 (48%)</td>
<td>10 rural; 1 urban</td>
</tr>
<tr>
<td>Mixed</td>
<td>11 (48%)</td>
<td>7 rural; 4 suburban</td>
</tr>
<tr>
<td>Not Align</td>
<td>1 (4%)</td>
<td>1 suburban</td>
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TABLE 2.1 Alignment of College Plans with State Plan
STEM programs. Two of the campus plans outlined the creation of a new Academic Technology Center or building a new center. One campus took the perspective that strategic faculty hiring was required to increase the number of STEM graduates, pointing out that they sought to obtain a 40:60 ratio of tenured faculty to adjunct faculty members. Since 2000, a total of 29 new STEM programs have been created within the VCCS (SCHEV, 2012). Fourteen of the colleges created one or more programs in this timeframe. New programs were created on 11 of the 17 rural campuses and three of the five suburban campuses.

**Change or Wordsmithing?**

The objective to increase graduates in the state and to bolster programming for STEM degree majors resulted in the articulation of particular goals and objectives for the state’s colleges. As noted above, the planning efforts of the VCCS readily accommodated inclusion of the goal to increase graduations in STEM areas. Bartunek and Moch (1987) argued that first-order change is incremental in nature and occurs within existing frameworks, whereas second-order change involves deeper changes to the existing frameworks. The first year of implementation of the TJ21 policy involved first-order changes. The planning process underway accommodated the changes required in the policy, but the beginning stages of second-order change may be emerging as the VCCS focuses on issues around developmental education. The role of development education is discussed more fully in the following section on the alignment of the educational pipeline.

Given the first-order change underway, it is important to investigate the role language plays in how the state policy is being implemented. How leaders frame change for campus members matters in how these stakeholder groups make meaning of the changes underway (Eddy, 2003; Neumann, 1995). The placement of the focus on STEM within the campus website and strategic plan begins to highlight the role it has on campus. As noted above, less than half of the colleges (48%) had specific references to STEM in their planning documents. Both the chancellor of VCCS and the vice chancellor of Academic Services & Research were interviewed to determine how TJ21 requirements were being integrated into the colleges in the state. Both central office leaders noted how New River Community College (NRCC) represented a leading force in developing STEM programs ahead of the mandate from the state. The current president of NRCC, Dr. Jack Lewis, added, “STEM is certainly not new to New River Community College.” The college operates a facility at the mall that offers a state-of-the-art facility. According to the college’s website, “The mall location features 14 classrooms, over 200 computers for student use, a science lab, two auditoriums, testing and conference rooms and office spaces” (Lewis, n.d.). Symbolically, having STEM programs concentrated in a location with high visibility sends a message to the community, students, and employers.
According to Chancellor DuBois, some of the changes within the system since the passage of TJ21 have been in the reward structure. He noted, “Modifications were made to the funding formula to include funds for enrollment growth, and performance funding for STEM-related initiatives. STEM is what is hot and the capital request for buildings and equipment were made in support of STEM” (personal interview, April 19, 2012). Funding has been used as an inducement for change. As President Lewis of NRCC stated, “The community colleges are in a unique position of being the shining star in bearing up and responding to this legislation because we have two-thirds of all undergraduates in Virginia” (n.d.). Recognition is apparent for the need to align with the state’s priorities.

The rhetoric around the state goals and ambitions for TJ21 are apparent in the language of the VCCS Achieve 2015. Yet, as the vice chancellor summarized, “The performance measures that are to be developed and the lineage to STEM will serve as a testing ground for how serious we are about STEM—which will drive action” (personal interview, Susan Wood, Vice Chancellor, May 2, 2012). The ability of TJ21 to have a lasting and significant impact will be dictated by continued state focus and support in this arena. Colleges will respond when they are rewarded for their behaviors. TJ21 did not propose a particular systematic change or alteration to the underlying framework of higher education.

How leaders frame change on campus also impacts how campus members will react (Fairhurst & Sarr, 1996; Weick, 1995). As President Lewis reflected, “I’m always amazed at how expectations lead to outcomes” (n.d.). One of the ways changes concerning STEM are framed is via the college’s and system’s strategic planning documents, location of references to STEM on the website, institution of new programming targeting STEM areas, creation of reward structures to support STEM activities, and removal of barriers for students to pursue STEM majors. As Lewis offered, “We put emphasis on the success story at award ceremonies. For example, recently a former student spoke with a stirring speech that was so honest with the students about what it is to be a nurse … Role models are brought in for every pinning ceremony and graduation to raise the expectations and the bar” (n.d.). The fact that only half of the colleges, however, have specific references to STEM highlights the early stages of implementation of the policy. Because the presidents are evaluated on the ways in which they reach the goals set by the chancellor, leverage for further change is possible. A true test of implementation will be in assessing outcomes of heightened STEM programming and focus and STEM graduation rates over the next five years.

Coordination in the Educational Pipeline

The focus of TJ21 on creating pathways through the educational system calls attention to community colleges that serve as bridging institutions between
high schools and four-year universities. An historic feature of community colleges is articulation agreements with four-year colleges. As the chancellor noted, “Transfer relationships are good, so the next step may be to create more 3 + 1 arrangements” (personal interview, Glenn DuBois, April 19, 2012). Already in place in Virginia were transfer grants. Beginning in 2007, eligible transfer students could obtain $1,000 if they graduated with an associate’s degree, met academic requirements, and were accepted in one of the state’s four-year universities the fall after their community college graduation (Two-Year College Transfer Grant Program, 2007, § 23-38.10:9). An additional $1,000 is available for students who pursue a STEM degree. As the vice chancellor for Academic Services and Research noted, “Coupled with the guaranteed admission agreements, STEM could be furthered for those students who want to transfer, creating a powerful tool for families to get access to selective 4-years and financial support by coming to a 2-year college first” (personal interview, Susan Wood, Vice Chancellor, May 2, 2012).

Influencing student success at the community college is college readiness. A two-prong approach is underway to address issues of deficiency. First, more communication is occurring about college expectations in high schools. Second, VCCS is extensively revising their developmental math and English programs. The first of these changes to delivery of developmental programming were implemented in spring 2012 for math, whereas the initiatives for developmental English will begin in spring 2013. A Chronicle article highlighted the changes to programming in Virginia, summaizing: “Its (VCCS) colleges will soon replace their semester-long developmental-math courses with nine units, which can be taken as one-credit classes or Web-based lessons with variable credit hours that allow students to complete more than one unit in a self-paced computer lab and classroom” (Gonzalez, 2011, ¶23). The changes were implemented without a formal pilot program and represent a clear break from past practice. This type of fundamental change is more in line with second-order or deep organizational change as it represents questioning of the assumptions of the existing system and using data to change operations (Bartunek & Moch, 1987).

As the vice chancellor reflected, “Another barrier to increasing STEM graduates is a cultural barrier to innovation; thinking that the way we have always done it is the way we should do it” (personal interview, Susan Wood, Vice Chancellor, May 2, 2012). The increased use of data to assess operations and the efforts supporting strategic planning begin to address this historical area of challenge in change initiatives. At NRCC, a partnership between the college and its neighboring four-year university helps support STEM training programs. Of note, NRCC’s nursing program enrolls a number of students who already have bachelor’s degrees but are seeking specific training. Townsend (1999) referred to this trend as reverse transfer, which is becoming more common for technical programs and career re-tooling.

On the other side of the educational spectrum are dual-enrollment programs. As noted above, Northern Virginia Community College created the SySTEMic
Solutions model, a recognized program to open up the STEM pipeline from high schools to the community college and work or transfer. As well, another program already underway is the placement of career coaches in nearly half of the high schools state-wide. According to DuBois, "There are approximately 150 career coaches in local high schools and they talk about STEM." DuBois added, "Enrollment increased by 8% when career coaches were placed in the high schools; they are a game changer" (personal interview, Glenn DuBois, April 19, 2012). This type of bridge building program allows for a more seamless flow of students between K-12 schools and the community college.

Discussion and Conclusion

The analysis on the implementation process of the Virginia state policy (TJ21) to expand the number of graduates in the state and to enhance a focus on STEM highlights a number of conclusions. The work already underway by the VCCS with both their strategic planning and their reengineering efforts provided a context prime for implementing the changes outlined in the higher education legislation as mechanisms were already in place. The legislation resulted in slight nuances made to existing plans and policies versus a wholesale change effort. What the policy allowed was a way for leaders of community colleges to frame their efforts on campus to emphasize the activities underway to enhance STEM programming and training. The strategic plans of the college created a template for some of this effort, as did the college's websites, technical centers, and STEM-oriented events. Leaders help campus members and college stakeholders to make sense of changes on campus. Involvement in the campus strategic planning process provides one venue for this sensemaking to occur for campus members (Weick, 1995).

Pointedly, the chancellor of the VCCS serves in the role of "sense-giver" (Thayer, 1988, p. 250, italics in the original). The messages sent out of the chancellor's office regarding the importance of the Achieve 2015 planning document are clear and numerous. The prominence of the plan on the system website and the references to the planning document on individual campuses in the system highlight how the chancellor has framed the importance of planning to heighten student success. The passage of TJ21 resulted in the VCCS evaluating the Achieve 2015 planning documents to accommodate for the requests of the policy, namely the focus on STEM. The existing plans already targeted increasing the number of graduates from the state's community colleges.

A mechanism to help create and reinforce the focus on STEM in community colleges is the use of an institutional saga (Clark, 1972). As noted in the findings, President Lewis of NRCC used graduation events and pinning ceremonies to provide student testimonials about the importance of their technical training to their ultimate careers. Moreover, the presence of the technical center in the mall became part of the saga of the college's approach to innovation.
The SySTEMic Solutions program at NOVA reinforces a saga revolving around technology too. Because of the infusion of technology into the area high schools as a result of building a bridge with dual enrollment through the program, the saga is reinforced in the community.

Yet, not all the colleges in the VCCS have this level of prominence in promoting STEM. On the one hand, the implementation phase of TJ21 is still in its infancy and the focus might be in early stages on some of the campuses. On the other hand, the regional needs of the colleges may differ such that how STEM programming needs are interpreted or valued may depend on location. For instance, small rural schools may find that their limited resources result in programming that looks markedly different than their larger, suburban counterparts. As well, the needs of employers in the region may differ. The projected increase of need for STEM professionals in the state may mask some of the regional differences. Investigation into deconstruction of anticipated demand should occur for more targeting programming to result.

Barriers to full implementation of the TJ21 legislation revolve around funding, access, and college readiness. Current funding is rewarding colleges that focus on STEM programming, but if this program funding is eliminated, the continued support of STEM might be jeopardized. McDonnell and Elmore (1987) identified four main frameworks employed by policy makers to obtain change. These include mandates, inducements, capacity-building, and system-changing. The TJ21 Act falls within the area of inducements and capacity-building. Funding is used in the format of performance funding to promote more graduates in STEM. Inducements typically result in short-term gains that go away once the funding is eliminated, whereas funding for capacity building can result in longer term gains. In this case, changes to programming within Virginia’s colleges can institutionalize changes that result in more graduates.

The processes underway with the 6-year plans in Virginia and with the Achieve 2015 process in VCCS in particular, may ultimately result in system changes (McDonnell & Elmore, 1987) or second-order change (Bartunek & Moch, 1987). The recent reengineering of developmental programming at the community colleges indicates a move toward deeper changes in the system. What remains unknown, however, is if these initiatives will have staying power and if changes will occur in other facets of the organization. Contributing to the early success of the implementation of TJ21 within the community college sector in Virginia was the change already underway.

Change requires the creation of a shared vision (Fullan, 2006; Kotter & Cohen, 2002). The processes in place to create Achieve 2015 built on planning efforts began in 2003. Establishing a track record of planning and creating processes to increase involvement of stakeholders meant that VCCS was in a different starting point to be able to implement the changes outlined in TJ21. An argument can be made that TJ21 merely provided a particular frame or saga to planning already underway and that the Act did not require the community
colleges to fundamentally change their plans or actions. The announcement of President Obama’s American Graduation Initiative and the introduction of Governor McDonnell’s TJ21 legislation received little criticism as the message was communicated that there was too much at stake to ignore the need to invest in America’s higher education system (The White House, 2009; Virginia Higher Education Opportunity Act, 2011). As outlined by Fowler (2009) above, the questions asked in creating policy about the rationale and appropriateness to adopt the new policy and support of stakeholders provide a means of evaluation. With respect to the TJ21 and its implementation in Virginia’s community colleges, the responses to these questions show that there was a need to implement the policy given the shortages in STEM and in college graduates in the state and that stakeholders supported these goals.

The period of time following the onset of these initiatives is what Fowler (2009) referred to as the mobilization for implementation and it includes “policy adoption, planning, and the gathering of resources” (p. 285). The successful implementation of a new policy hinges on the mobilization phase because it establishes the case and foundation on which the implementation of the policy will be built, establishes the reason for the policy, and often can incentivize stakeholders to see it successfully adopted and implemented. According to Fullan (2006) and Fowler (2009), motivation is critical for effective educational reform and policy implementation. Davies’ (2006) approach further supports and reinforces the need for buy-in from stakeholders when he describes the importance of “ground[ing an] agenda and its priorities in the needs of state residents” (p. iv), again making the connection between the policy and its intended outcomes. Creating a shared vision, ensuring that a strategic plan drives efforts, forming partnerships with a key stakeholders and leaders, and establishing a structure where partners are held accountable leads to successful implementation (Johnson, 2012). The leadership in VCCS supports the change efforts underway.

The VCCS has been operating under the strategic goals of Achieve 2015 for two years and continues to refine the strategies for reaching these goals on an annual basis. With the introduction of the TJ21 legislation just one year ago, the emphasis placed on STEM degree production created the opportunity for the VCCS to tweak the language in their established plan to include an intentional pursuit of new STEM-related academic programs. Slight changes in language allowed for a framing of the policy within an already existing structure. In this reference, the VCCS did not need to change their direction as they were able to easily incorporate the pursuit of STEM programs under the umbrella of Achieve 2015. With implementation strategies and evaluation measures already in the works, the VCCS was able to continue its course with Achieve 2015 and the redesign of developmental mathematics, making strides toward increasing the number of STEM graduates per the TJ21 legislation with only minor programmatic modifications.
However, there is more that can and should be done to ensure the attainment of the TJ21 STEM-related goals and performance incentives. As noted, the changes to date have primarily involved first-order change, versus deep second-order changes (Bartunek & Moch, 1987). According to the National Governor’s Association (2011), policy gaps still need to be addressed so that improvements in building a STEM-skilled workforce can be realized. It is important that community colleges identify regional STEM-skill needs from businesses and gain a better understanding of the labor market demands; support new models of STEM skill development, such as career pathways, STEM early college high schools, earn and learn programs, and STEM bridge programs; and ensure STEM credits and degrees are transferrable (NGA, 2011). Given that only 48% of the community colleges in Virginia had specific reference to STEM in their planning documents may indicate that local needs are still being determined or that some regions have different requirements for STEM.

A sense of urgency for change was created with the passage of TJ21 (Kotter & Cohen, 2002), in particular for STEM. What remains unknown is how well the current change initiatives will become institutionalized within the community college system. The presence of a continuous planning cycle bodes well for attention to current challenges as a venue is present to accommodate external changes. While it is likely that the VCCS will continue to refine its practices to better serve the needs of the state and regional communities, future monitoring of performance will be necessary to ensure adequate progress is achieved and maintain appropriate accountability.

Other states can learn some central lessons from the experiences to date in Virginia. First, it is important to create a shared vision to support policies regarding STEM in community colleges. Incorporating a process to support STEM programming within an existing planning process is preferred to merely using STEM policy as an add-on. Second, using data to determine effectiveness of programming and to identifying community need is critical. Communicating with key stakeholders in the community, involving K-12 educators and employers, and framing the initiatives using similar language helps to institutionalize changes in policy. How community college leaders talk about changes to promote STEM matters. The ways in which leaders frame change on campus influences how campus members and community stakeholders understand what is going on and form their interpretations of activities and outcomes (Eddy, 2003). Finally, moving beyond first-order change requires a level of commitment to asking hard questions about past practices, how things are done, and what can be changed. This level of change requires top-level leader buy-in, constant communication, and recognition that nothing is sacred. True, deep change is hard. The analysis conducted on efforts in the state of Virginia indicates that the implementation of the new higher education policy may ultimately result in true change. Time will tell.
References

2007 Two-Year College Transfer Grant Program. (§ 23-38.10:9).


