



Testimony of
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Before the
U.S. House of Representatives
Committee on Science, Space, and Technology

on
STEM Education in Action: Communities Preparing for Jobs of the Future
Texarkana, TX
September 26, 2011

Chairman Hall and distinguished members of the Committee, I am pleased to be here today to speak with you about community colleges and the role that the National Science Foundation (NSF) plays in supporting their important mission in U.S. education. As you know, NSF is the primary federal agency supporting research at the frontiers of knowledge, across all fields of science and engineering and at all levels of education in science, technology, engineering and mathematics (STEM). Its mission, vision, and goals are designed to maintain and strengthen the vitality of the U.S. science and engineering enterprise. As part of the overall national R&D enterprise, the basic research and education activities supported by NSF are vital and integrated components that enable the United States to advance economically, and they provide the know-how to allow the nation to respond rapidly and effectively to a range of anticipated and unexpected challenges. Communities and community colleges are an essential element of this NSF enterprise.

It is also a pleasure to be in the Fourth Congressional District of Texas, home of several outstanding institutions of higher education. As Congressman Hall's website states,

In recent years, a growing consensus has emerged regarding the importance of science, technology, and innovation as the key driver of long-term economic growth and improved quality of life in America. Technological progress fueled by investments in research and development is estimated to be responsible for as

much as half of U.S. economic growth since World War II. It is critical that we continue our efforts in STEM education to ensure that the next generation of high-tech industries and products are developed by researchers in the United States. America has always been the leader in cutting edge technology and innovation – and we must do all we can to ensure our strong footing as a global economic leader.

One route to this leadership travels through community colleges. As President Barack Obama noted at an October 2010 White House Summit on community colleges, these institutions provide “a gateway to millions of Americans to good jobs and a better life.” They also often lead to science, technology, engineering, and mathematics (STEM) careers. Before discussing NSF’s investment in community colleges, it might be helpful to remind ourselves of a few facts about this increasingly important sector of the education system:

- **Community colleges are an increasingly important part of the education landscape.** According to American Association of Community Colleges (AACC) statistics, in 2010 there were 1,173 community colleges in the U.S. enrolling 8 million students (43% of all students in postsecondary education). Community colleges awarded 605,267 associate’s degrees and 325,452 certificates in 2010.
- **Community colleges focus on teaching.** The community college mission focuses on teaching, and these institutions respond to the educational and workforce needs of their local communities. However, some community college faculty maintain undergraduate research programs, and more faculty are using research as a learning tool in community colleges (Cejda and Hensel, 2009. *Undergraduate Research at Community Colleges*, Council on Undergraduate Research). Community college faculty have the highest teaching loads in all of higher education, and there are no graduate or upper division students to serve as teaching assistants. However, class sizes are generally small, and students have significant contact hours with faculty. Students who transfer from a community college to a four-year institution generally perform at least as well or better than the students who began their college experience on the four-year campus.
- **Community colleges are diverse.** Community colleges attract a broader range of students in terms of race, gender, age, veteran status, working status, and first-generation college attendees than other higher education sectors. Community college student populations thus better align with racial/ethnic proportions within the general U.S. population and hold promise to help diversify the STEM workforce and tap the nation’s entire human capital talent base. With 95% of community colleges having open admissions, they provide a pathway for many Americans to academic certificates, associate degrees, and transition to four-year institutions, and to realizing the American dream.

- **Community colleges are a bargain and are accessible.** According to the College Board, tuition and fees at community colleges in 2009-10 averaged \$2,544, compared to four-year public schools at \$7,020 for in-state and \$18,548 for out-of-state, and compared to \$26,273 for private not-for-profit four-year schools, and \$14,174 for for-profit four-year schools. In fact, the College Board report noted that the net cost of community college—after subtracting grant aid—was negative, so many students are not paying even the modest \$2,544 total. In 2007-2008, 62% of community college graduates graduated from public two-year schools without debt, and another 23% had borrowed less than \$10,000. In addition, 95% of the American population lives within 25 miles of a community college.
- **Community colleges prepare workers for important jobs.** According to a National Governors Association *Issue Brief*, titled “Using Community Colleges to Build a STEM-Skilled Workforce” (June 24, 2011), it is estimated that between the years 2008 and 2018 nearly 47 million anticipated “middle skill” jobs will open; 64% of these will require at least some college education and strong basic skills in math, science, and other technical areas.
- **There is increasing research interest in the value and potential of community colleges.** For example, a special issue in 2010 of the *Journal of Women and Minorities in Science and Engineering* was devoted exclusively to the “Role of Community Colleges: Broadening Participation among Women and Minorities in STEM.” The objectives were to: “(1) Address the diverse functions of community colleges and their roles in providing access and opportunity for women and ethnic minorities to pursue STEM education, (2) Understand the role of community colleges as a pathway to a baccalaureate degree and beyond in STEM fields, (3) Investigate the role of career and technical education programs in community colleges in educating and training the 21st century workforce,” and (4) discuss implications for policy and practice, and future research.

NSF recognizes the valuable services that community colleges provide for the nation, especially in STEM fields. As stated in its FY 2012 Budget Request to Congress, NSF plans to expand and strengthen its efforts to engage community colleges through many of its programs; the Directorate for Education and Human Resources, for example, is hoping to invest \$100,000,000 in community college projects in 2012. These investments will focus on STEM career pathways including technician education and entry into four-year institutions as well as build knowledge about how to successfully achieve these goals.

The Advanced Technological Education Program

NSF’s Advanced Technological Education (ATE) Program has historically been the primary program for engagement with community colleges. In 2011 NSF introduced systematic coordination of ATE program expertise with a number of other programs in the Directorate for Education and Human Resources (EHR). The ATE program, which has been in place since 1994, is the core community college activity at NSF, bringing coherence and synergy to other relevant undergraduate education programs within

EHR. It aims to prepare the next generation of technicians for tomorrow's STEM workforce, so in this sense the focus is very specific. The ATE program currently supports proposals in three major tracks: ATE Projects, ATE Centers, and Targeted Research in Technician Education. In ATE Projects and Centers, two-year colleges have a leadership role and work in partnership with business and industry, universities, secondary schools, and government agencies to design and carry out model workforce development initiatives. The Targeted Research in Technician Education program supports research on technician education, employment trends, the changing role of technicians in the workplace, and other topics that advance the knowledge base needed to make technician education programs more effective and more forward-looking. Fields of technology supported by the ATE Program include, but are not limited to: agricultural technology, biotechnology, chemical technology, civil and construction technology, computer and information technology, cybersecurity and forensics, electronics, energy (both traditional and renewable) environmental technology, geospatial technology, manufacturing and engineering technology, marine technology multimedia technology, nanotechnology, telecommunications, and transportation technology. Given this breadth of coverage, ATE will be in a position to work across disciplines and programs to expand the qualified applicant pool of community colleges through expanded outreach, capacity building, and knowledge building activities. The ATE leadership continues to develop ways to attract new institutions to the program. One such activity is the inclusion in the ATE solicitation of a focus area for institutions that have either never submitted a proposal to ATE or have not submitted a proposal in 10 years. Over the four years that this focus area has been available, approximately 120 new institutions have submitted proposals to the ATE program.

The ATE program has supported 61 awards within the state of Texas since its inception. Currently, there are 12 active awards, and one of the ATE Centers, the Convergence Technology Center, is housed at Collin County Community College. ATE also supports the ATE Center, GeoTech, at Del Mar College as well as a range of projects in Texas that span renewable energy, welding, analyzer technician opportunities, cybersecurity, general STEM courses that lead into technician education programs, and professional development opportunities for faculty. The ATE television project (see <http://www.atetv.org/>) recently posted its first episode of the season (on biotechnology). It highlights ATE active awards and provides insights into specific career paths. The webpage includes links to related episodes, information for parents, students and educators, links to the ATE Centers, an active blog and information other resources.

Enhancing capacity for community colleges is a priority across the Foundation. Nearly all of the directorates have programs or activities that include a community college focus. For example, the Directorate for Geosciences has supported a community workshop for faculty from two-year colleges that led to creation of a centralized resources website (Carleton.edu/geo2yc), and for the past two years has funded travel grants for faculty and students from two-year schools to attend the annual meeting of the Geological Society of America. In the Engineering Directorate, the Research Experiences for Teachers (RET) program includes community colleges, and community colleges are among the partners in the large Engineering Research Centers. Across NSF key drivers for community college activities include:

Serving the needs of underrepresented minorities: According to a July 2011 NSF National Center for Science and Engineering Statistics (NCSES) *InfoBrief*, women were more likely than men to have taken community college courses. In addition, among science, engineering, and health (SEH) bachelor degree recipients in 2006 and 2007, 56% of Asians, 57% of blacks, 59% of Hispanics, 68% of American Indians/Alaska Natives, and 50% of whites had attended community colleges. According to a 2005 National Research Council (NRC) study, “in effect, community colleges have become an educational pipeline for underrepresented minorities entering the higher education system.”¹ According to the Institute for Higher Education Policy, “Community colleges provide vital access to low-income students by offering affordable education, open enrollment, course convenience, and geographic proximity.” NSF’s Louis Stokes Alliances for Minority Participation (LSAMP) program focuses on preparing community college students to transfer to four-year baccalaureate-producing institutions. The goal for these students is to become STEM B.S. recipients and ultimately progress to graduate studies in STEM disciplines.

Another example of NSF’s interest in community colleges is the Tribal Colleges and Universities Program (TCUP), which was established in 2001 to provide support for increased capacity for STEM educational programs in the Nation’s tribal colleges, as well as many Alaska Native and Native Hawaiian-serving institutions of higher education. The TCUP eligibility pool includes over 40 institutions, many of which are in remote geographic areas, and most of which serve students in economically disadvantaged regions. Although the program emphasized information technology in its early days, it has evolved to support new degree programs in mathematics, science, pre-engineering, and, recently, engineering. Several of the two-year colleges that comprise the majority of the TCUP pool now offer four-year degrees in STEM fields such as computer engineering and environmental science—degrees with cultural relevance and local significance, as the students can graduate while remaining near home, and are then competitive for jobs in these fields that traditionally have gone to others outside the communities. The investment back in the community made by these graduates is incalculable.

Providing pathways for STEM careers: NSF’s NCSES reports that “over the academic years (AY) 2001 to 2007, the percentage of SEH graduates who had ever attended community college at some point in their studies remained fairly steady, at around 50% for bachelor’s degree recipient and just under 45% for master’s degree recipients.” Many students enrolling in community colleges enter with specified STEM career goals, but find they lack the foundational skills needed to be successful. NSF will coordinate across programs that support community colleges to facilitate the implementation of successful models for developmental education. For example, the Bridge to Biotech program at the City College of San Francisco was developed with funds from NSF’s Course, Curriculum and Laboratory Improvement (CCLI) program, which is now called Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES). The San Francisco program is currently being adapted and

¹ National Research Council, 2005. *Enhancing the Community College Pathway to Engineering Careers*.

implemented at other community colleges. NSF is hoping to coordinate with private foundations in this effort.

Building the foundation for future STEM teachers: According to a recent report, “more than 20% of all teachers begin their college careers at two-year institutions and nearly half of all teachers complete some of their science or mathematics courses there.”² Therefore, building strong STEM courses that articulate with four-year teacher preparation programs is vital in the preparation of a strong teaching workforce. Through its programs that focus on preparing teachers, such as NSF’s Robert Noyce Teacher Scholarship program (NOYCE) and the proposed Teacher Learning for the Future (TLF) program, NSF will support efforts to build collaborations between two-year and four-year teacher training programs with a goal of helping to both increase the number of qualified teachers in pursuit of the Administration’s goal—to increase the number of college graduates by 50%—and to study the need for and to develop approaches for teacher training necessary for the 21st century. The ATE program also supports teacher education efforts, and a recent award is increasing the ability of secondary STEM teachers and students to learn collaboratively and apply STEM skills using information and communications technology (ICT). The project is housed in the National Center for Teacher Education (NCTE), a part of the Maricopa Community Colleges District.

Ensuring smooth critical transitions: Transitions from secondary school to two-year colleges and from two-year colleges to four-year colleges are especially challenging in STEM fields. For example, recent work by the Carnegie Foundation for the Advancement of Teaching focuses on the serious issues in the mathematics preparation of community college students: “Many students who attend community college begin unprepared to succeed in mathematics.... Students are more likely to fail developmental mathematics than any other courses in higher education. Failure rates in individual developmental courses exceed 35%, and two-thirds of students fail to complete the entire sequence of courses to which they are referred.” (See <http://www.carnegiefoundation.org/problem-solving/developmental-math>).

At NSF, programs will coordinate their efforts to study key transitions and develop mechanisms to help students succeed in negotiating them. The National Academy of Sciences has received funding from ATE to conduct a study beginning in 2011 on the changing and evolving dynamic between two-year and four-year colleges and universities. Pathways through community colleges to STEM careers as well as transitions and articulations from secondary schools to community colleges and community colleges to four-year institutions are expected to be focus areas of this study. Results of the study will inform and support education pathways across educational levels and inform NSF’s planning activities for community colleges.

Boosting graduation rates: NSF will play a role in addressing the President’s 2020 goal of producing the highest proportion of college graduates of any country by helping to increase the graduation rate of recipients of both associate and baccalaureate degrees

² National Association of Community College Teacher Education Programs, 2008. *The State of Affairs: Impacts and Implications of STEM Teacher Education at Two-Year Colleges*.

in STEM disciplines. In addition to the strategies enumerated above, NSF will encourage proposals to its STEM education research programs that focus on better understanding matters such as the competencies needed by STEM students for successful transfer from two-year to four-year institutions; the performance of community college transfers compared to students who matriculate at four-year institutions; and the elements that contribute to student success and desire for STEM careers among community college students.

Conclusion

Clearly, community colleges contribute a great deal to the STEM education pathway and resulting workforce. NSF remains committed to helping to ensure their continued success.

Mr. Chairman, I want to thank you very much for holding this important hearing, and inviting me to testify. I would be pleased to answer any questions you may have.