Growing Roles for Science Education in Community Colleges

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In an increasingly global society and economy, education and training beyond compulsory primary and secondary education—especially in science, technology, engineering and mathematics (STEM)—is essential to a nation’s competitiveness and its standard of living. Community colleges, originally developed at the turn of the 20th century as open-admissions junior colleges and offering the first two years of a baccalaureate education, help meet this need. These colleges have evolved into comprehensive institutions, preparing students to transfer to upper-division universities or to enter the workforce directly. Enrolling 43% of all U.S. undergraduates (1), community colleges play important roles in developing public scientific literacy, educating scientists and engineers, and addressing the nation’s need for well-prepared technicians (2). But challenges remain.

Some challenges are cultural, such as misperceptions that community colleges serve only low-performing students or hire faculty who are unable to secure a position at a 4-year institution. Other challenges are systemic, such as high teaching loads, inadequate funding models, and industry hiring practices. This article will focus on the challenge of helping students to complete 2-year programs or transfer to 4-year programs.

Educating Diverse, Local Communities

Community colleges prepare a growing percentage of the U.S. technological workforce (3). In 1999 and 2000, almost half of the science and engineering baccalaureate recipients and almost one-third of the master’s degree recipients had attended community colleges (4). Forty percent of U.S. teachers complete some of their mathematics or science courses at these institutions (5). Students who attend community colleges include 47% of first-generation college students, and 53% of Hispanic, 45% of Black, 52% of Native American, and 45% of Asian/Pacific Islander college students. Although the average age of community college students is 28, still 46% of them are age 21 or younger (1).

Community colleges develop curricula to respond to the needs of local economies, working closely with industry, government, and other education sectors. These colleges have become the institutions of choice for workers, including university graduates upgrading their skills and displaced workers preparing to reenter the workforce (6). By the year 2018, it is projected that 12.3% of STEM jobs will be filled by associate degree holders (the primary degree conferred by community colleges) (7). The Obama Administration, noting that jobs requiring at least an associate degree are projected to grow twice as fast as those requiring no college experience, has called on community colleges to increase the number of graduates and program completers by 5 million students over a 10-year period, a 50% increase (8).

Completion and Transfer Must Improve

Too many students do not make it successfully through remedial programs into college-level courses, and too many do not complete their college-level programs or are unable to transfer to 4-year programs because of insufficient financial support or poor institutional or state policies and practices (9, 10). Problems are caused by failures to collaborate between institutions, as well as a lack of continuity and integration within programs resulting from overuse of adjunct faculty and graduate teaching assistants. Furthermore, when state requirements for attaining associate degrees differ or there is insufficient harmonization in course content, it is difficult for students to transfer credit from one institution to another.

Improving Practice and Policy

The first major effort to improve student completion in community colleges, set in motion in 2004, is Achieving the Dream: Community Colleges Count (ATD), a national initiative focusing on students of color, working adults, and students from low-income families. About 10% of community colleges across 22 states are now part of ATD. The initiative has increased student persistence rates by as much as 13% (11). Efforts have focused on precollege programs for underprepared students, improving performance in “gatekeeper” courses that allow students to continue along a course sequence, improving the experiences of first-year students, advising students on academic and personal issues that affect their ability to succeed, student support services, and tutoring. ATD colleges are also working to strengthen linkages to secondary schools, engage the community, and change state and federal policies that create barriers for students (12). ATD institutions share strategies and assess progress by noting trends in the percentage of students who successfully complete courses, advance from remedial to credit-bearing courses, enroll from one term to the next, and earn a degree or certificate.

The American Association of Community Colleges (AACC) is currently working with partners to define accountability metrics for community colleges (13). Success measures will likely include course completions, moving students from developmental education to college courses, transfer rates, graduation rates, and job-placement rates disaggregated by specific populations. Although ATD is focused on improving student success rates within the institution, Complete College America is dealing with interinstitutional and state policies and practices (14).

Four-year institutions do not yet play much of a role in community college initiatives to improve student success and completion. Any effort to improve communication across sectors would be beneficial. Programs like NSF’s Advanced Technological Education (ATE) function in this capacity. Community college educators lead ATE programs that involve universities, secondary schools, and businesses to prepare and strengthen the skills of the nation’s technological workforce in strategic fields (e.g., environmental technology and cybersecurity) (3).

Other issues need to be addressed for student success, e.g., improving the mathematics sequence (necessary for any STEM area). The Carnegie Foundation for the Advancement of Teaching has an initiative to revise...
the content and teaching of developmental mathematics courses (15).

In April 2010, six national community college organizations committed member institutions to match President Obama’s goal (16). But in the face of enrollment pressure, states have cut funding to public higher education, including community colleges.

Hundreds of thousands of students were turned away from classes last fall, roughly 140,000 in California alone (17), and the situation may get even worse. Financially needy community college students primarily rely on the federal Pell grant, as state aid policies vary considerably. Only 10% of community college students take out any type of federal student loan and are much less likely to access financial aid than are counterparts in other institutions. Although austere budgets may cause policy-makers to become more interested in eliminating duplication and waste across institutions, 2- and 4-year institutions might be forced to compete for scarce funding. Federal funds, other than student financial aid, are primarily directed toward research projects at 4-year institutions. Although university educators should be interested in developing the pipeline of students, current incentives in 4-year institutions reward research and attracting grants to campus more than teaching or working in other ways with undergraduates. Federal, state, and local resources should focus on the specific needs of community colleges so that they can realize their potential role in the preparation of STEM students. For example, resources and incentives should be provided to make it possible to enroll more students full-time and provide them with accelerated instruction, backed by rigorous faculty professional development.

But improving educational attainment in the United States can best be met if educators take the lead. If not, policy-makers may find less appropriate ways to force institutions to develop stronger policies, e.g., for transfer and articulation (promoting equivalence of course content, and transfer of credit, between institutions). College and university faculty and administrators need to work together to improve completion rates and facilitate the transfer of students from community colleges into upper-division course work through improved articulation and student advising.

Many 4-year institutions could increase their own overall graduation rates, while enrolling and graduating more students of low socioeconomic status, by increasing their numbers of community college transfers (18). Transfer students do better in 4-year universities than if they had come directly from high school with the same credentials (18). However, not enough community college students transfer.

Articulation is important: 82% of students who have all credits transfer from a community college to a 4-year institution graduate within a 6-year time frame; this number drops substantially to 42% when only some credits transfer (19). Community college and university faculty should agree on expectations and standards so that courses are more easily transferable. But articulation polices differ drastically by state. Public institutions in some states share common course numbers and statewide transfer agreements. In other states, transfer of courses is very difficult, e.g., having only institution-by-institution transfer agreements, making degree completion more time consuming, difficult, and expensive both for students and taxpayers.

An International Movement

The need to open the doors of higher education beyond the relatively limited enrollments in selective universities has spawned an international movement to develop or expand institutions that are generally less expensive, more accessible, more flexible, and tied more closely to business. For example, several countries have followed the British model, developing Further Education (FE) or Technical and Further Education (TAFE) institutions to provide technical education beyond high school. These institutions are generally more centrally controlled than U.S. community colleges and are not considered part of higher education, which limits local flexibility and the ability of students to progress to a bachelor’s or higher degree level. Recently, international interest in the U.S. community college model has increased (20), many countries have established community colleges based on it, and/or sending (or receiving) delegations to (or from) U.S. community colleges to explain the U.S. model and how it might be adapted elsewhere.

Community colleges must be seen as part of an educational continuum that bridges secondary schools and 4-year colleges and universities. Their impact on STEM education can be greatly enhanced by collaboration of teachers and faculty across educational sectors. At education councils where regional stakeholders convene to address elementary, secondary, and higher education, participants appear to be helping break down barriers across this continuum, but much more is accomplished when administrators and faculty are directly involved.

What is being learned about helping students be successful in community colleges should help universities to be more successful with their students. Given recommendations that the science curriculum needs to be reformed to include project- or research-based experiences as early as possible, this undergraduate research model is one in which community colleges will likely play a much larger role over the next decade.