Community Colleges and the Developmental Mathematics Crisis

Thesis

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Abstract

Community colleges play an essential role in the American educational system. Millions of students attend two-year schools to earn college credit towards a degree or certification. Those who choose these schools come from all backgrounds, and the majority of students is deemed not ready for college-level courses and, therefore, referred to developmental courses. There is a problem with the developmental course sequence, however, because most students never make it through to take for-credit courses. This paper looks at ways to address these issues to improve the system and increase the number of students leaving college with degrees.
Dedication

Dedicated to instructors at community colleges who believe in the success of their students.
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Chapter 1: Culture of the Two-Year College

The stigma concerning community colleges and their standard of education has not always shed these institutions in the best light. Many people hold the view that community colleges are for a lower caliber student—someone who was denied acceptance into a public university or, perhaps, did not put forth his best effort to learn what was required of him in high school. These views are outdated, however, and the two-year college plays a much more dynamic role in today’s postsecondary education system than it has in years past. An increasing amount of students in all stages of life are realizing the benefits of taking courses at their local community college to jumpstart their educational journey. Nearly half of all college graduates begin college by taking courses at a community college. More specifically, nearly half of those who obtain bachelor’s degrees in science and engineering took classes at a community college. One-third of those who went on to receive a master’s degree in these fields had began their college careers at two-year school (Labov, 23). Students from all backgrounds are finding that community colleges can play a beneficial role in their education process.

Part of the misconception people have about community colleges is how credit transfer to a four-year university works. There are many students who choose to attend branch campuses of state universities, rather than attend community colleges that are oftentimes closer to the campus of the university they wish to attend. There
is some confusion about how these credits will transfer over. For instance, some students choose to attend a satellite campus of Ohio State University (OSU) over Columbus State Community College (CSCC). They have the notion that they want their degree from Ohio State, not realizing that credits from CSCC will count towards that. For those students seeking a four-year degree, the transition from a two-year college to a public university is becoming more seamless than in years past. In Ohio, there are statutes in place requiring that most coursework from technical and community colleges transfer to public state universities. In fact, CSCC and OSU have a close relationship since so many students opt to complete some of their coursework at both institutions over the time it takes them to acquire their degree. In the mathematics department specifically, these two schools have even coordinated course codes and textbook requirements. Relationships between two- and four-year schools, such as this one, have helped the evolution of the role community colleges play in postsecondary education.

**Benefits of a Two-Year College**

While both two- and four-year colleges possess many of the same qualities, there are several distinct benefits of taking courses at the community college level at some point on the path to a degree. Community colleges are the path of choice for more students than ever before. The cost alone is enough to compel most applicants. For the 2014-2015 school year, the average cost for tuition and fees at a two-year institution is $3,347 per year. On average, a public four-year institution would cost a student $9,139 (College Board, 2015). Specifically, Columbus State Community
College charges students $135.93 per credit hour, meaning a student enrolled in twelve credit hours for two semesters would pay $3,262.32. A student taking two-semesters of full-time enrollment at The Ohio State University would pay $10,037 (Columbus State Community College, 2014; Ohio State University, 2015). A student is considered full time and is charged the same tuition at The Ohio State University if he is enrolled in anywhere from twelve to eighteen credit hours, so if a student took eighteen credit hours for two semesters at Columbus State Community College, he would still be saving $5,143.52 each year. These two institutions are located less than three miles apart, so one can imagine living expenses would be comparable, yet a huge discrepancy in tuition and fees exists between the two. With the debt of graduating students rising from year to year, this difference in price is not to be overlooked. In 2013, the average graduate left school owing $28,400 (US News, 2015). With a competitive job market meeting students after graduation, this debt is not easy to pay off. Students need to make sure the degree or certification they are seeking will provide them with the skills to make them stand out to employers.

Community colleges, as the name suggests, are tuned into the needs of the surrounding workplaces and citizens. Because of ever-changing technology and competitive job markets, businesses expect prospective employees to be immediately ready for jobs. Community colleges play a huge role in this preparedness through their certification and training programs. According to the Ohio Association of Community Colleges, the expected growth rate of employment of associate degree graduates is 18.8 percent, compared to the 7.3 percent average expected of all occupations. (OACC, 2014). This not only underlines the importance of community
colleges serving as gateways to four-year degrees, but it sheds light onto the fact that two-year colleges are producing job-ready employees on their own. Certain two-year schools have programs that go above and beyond to get students the certifications they need for jobs. CSCC, for instance, has a program called FastPath, which provides the materials required and allows students to take these certification tests at no additional cost. Following the trend that community colleges adapt to the surrounding market, CSCC has four job paths within this program, including patient care, building services, food services, and logistics—jobs that are relevant to the Columbus-area needs. Along with the basic computer skills needed for the job, the FastPath program provides help with resume writing, interview preparation, and job search assistance. (CSCC, 2015). These resources are invaluable to many students who are looking to join the workforce but do not have the tools to market themselves competitively.

Community colleges are efficient at creating employable citizens as well as preparing students to further their education. These traits give two-year schools a broad appeal. The Ohio Association of Community Colleges notes that 87 percent of associate degree graduates were employed or attending a four-year school within six months of graduation. This is an undeniable rate of success for students coming in with either of these goals. Close to 60 percent of new registered nurses, along with nearly 85 percent of law enforcement officers, firefighters, and EMTs received their credentials through community colleges. The standard of preparation for these certifications closely matches those from larger state schools. The Ohio Registered Nurse Exam revealed students who took the exam after attending associate degree
nursing programs passed the test at the same rate as students from baccalaureate degree programs—90 and 91 percent pass rate, respectively (OACC, 2014). Because of their ability to provide training for jobs that are in high demand in the surrounding area, community colleges are becoming an essential link in creating a competitive job market.

Some of the draw of community colleges is centered around their cultural emphasis on teaching. Large state universities are a big jump from high school classrooms, and community colleges can often provide a smoother transition for students. The average classroom size for community colleges in Ohio is 19 students. This can actually be a drop from what some students have experienced in high school. For students looking into dual enrollment courses (courses that count towards both high school and college requirements), the culture of community colleges could more closely match what they are used to. Instructors at community colleges focus 71 percent of their work time on teaching, whereas at larger schools, much of the draw for faculty is that one would be able to work on his research. (7) Because their main focus is teaching, faculty members are encouraged to participate in professional development, targeting both teaching and learning. The American Mathematical Association of Two-Year Colleges (AMATYC) is the only national organization dedicated to the betterment of student learning and teacher instruction of mathematics at two-year schools, and it has supported the idea of colleges providing professional development opportunities for their faculties. Suggested changes include “curriculum revision to concentrate on fewer topics, each of which would be covered in greater depth; technology both as a tool and as an instruction medium; group learning;
assessment; student projects requiring sustained effort; and laboratory experiences involving mathematics” (AMATYC, 2014). New ways of teaching take time for instructors to learn, and colleges should recognize the importance of this investment in their faculty.

Community colleges open doors for many students who would otherwise be unable to pursue a degree in higher education. Two-year schools have open admission policies, providing opportunities for students who may not have preformed well in high school. Developmental courses are offered in large numbers at two-year schools, which is encouraging for students who are intimidated by the academic standards of higher education. It allows for a time of exploration to see if college is the right fit for students without being a huge commitment of finances or time. Because of the way tuition is structured, community colleges are very flexible and can fit with a wide variety of schedules. Charging per credit hour allows students to not have to take a minimum number of credits. This is oftentimes more convenient for students who have other responsibilities, such as maintaining a full-time job or raising a family while pursuing a degree.

Mathematics Faculty at Two-Year Colleges

Mathematics departments at community colleges are staffed with teachers whose educational backgrounds can range from a master’s in Mathematics Education to a PhD in mathematics. To be a full-time faculty member, an instructor must have at least a master’s in mathematics, or equivalent graduate coursework in mathematics. A part-time instructor could have a master’s in mathematics education, although there
is a movement to only hire those applicants who have a master’s degree in mathematics for the part-time positions as well. The American Mathematical Association of Two-Year Colleges (AMATYC) is the leading national organization dedicated to the betterment of teaching mathematics at community colleges and has several suggestions for the preparation instructors at these schools should have. AMATYC’s position statement on the academic preparation of mathematics faculty at two-year colleges states the following: “Only properly qualified personnel [should] be permitted to teach mathematics. Ill-prepared faculty can do much harm to students’ knowledge of, beliefs about, and attitudes towards mathematics” (AMATYC, 2014). Included in these guidelines for well-qualified faculty is the need for instructors to be reflective about their teaching and proactive about improving through professional development. As a whole, community colleges’ mathematics faculty need to be flexible to the needs of the department since mathematics departments serve the needs of both STEM and non-STEM students. Although graduate mathematics courses are a requirement for all hires, graduate level courses in statistics and pedagogy are strongly recommended. Two-year schools often do not have a separate department for statistics courses, another reason for the need of flexibility of instructors.

Across the nation, many community colleges are staffed with part-time adjuncts, rather than an entire fleet of full-timers because of budget restrictions. Part-time faculty teaches 60 percent of precollege mathematics courses at community colleges, and the courses part-time faculty cover make up about 45 percent of the mathematics courses in the department. At CSCC, part-time faculty members make
up around 75 percent of the mathematics department. These adjuncts are responsible for teaching 82 of the 99 developmental mathematics courses offered the Spring 2015 semester. Because these faculty members are responsible for so many key courses within the department, they must also be supported through professional development. A line of communication must be open between full-time faculty and adjuncts to ensure the quality of instruction across the department.
**Chapter 2: Developmental Mathematics Sequences**

**Students in STEM Fields**

There is a discrepancy in the number of students who leave high school intending to pursue a degree in science, technology, engineering, or mathematics (STEM) and the number of students who obtain such a degree. In Eric Bettinger’s study of 18,000 Ohio students, he found that only 14 percent of students in community colleges who left high school intending to enter into a STEM field were still in a STEM field at the time of their last enrollment. Furthermore, only 3.4 percent of students made the transition to a STEM program from a non-STEM major (Olson, 20). Unpreparedness for college mathematics could play a major role in why students find themselves giving up on pursuing a STEM degree. There is trend towards students choosing to fulfill their mathematics requirements at two-year colleges, as can be seen in the figure below.
Figure 1: Total enrollment in four-year college mathematics and two-year college mathematics (Olson, 89).

While these figures account for dual enrollment courses, they are not adjusted for mathematics courses that are taught outside of the mathematics department, such as pre-college education units that two-year schools sometimes have to teach their non-credit courses. So, the number of students enrolled in mathematics courses at two-year colleges, one can safely say, is underestimated.

**Placement Tests**

Community colleges take in thousands of students each year, so there is a great need to efficiently place students in appropriate classes to foster their success.
Most two-year schools use computer-based assessments to allow for immediate, automatic scoring. There is little research about the accuracy of this placement technique, although it is certain there are students who are placed in a developmental mathematics sequence unnecessarily. There is a need for more customized placement exams to ensure students are recommended to take courses that match their abilities and set them up for success in future coursework. The Community College Research Center (CCRC) of Columbia University conducted studies to learn about the effectiveness of computerized placement exams and found that “using test scores alone to make placement decisions resulted in large numbers of ‘severe placement errors.’ [Here,] severe underplacement signifies placing a student in developmental education who is predicted to get a B or better in a college-level course. A severe overplacement signifies placing a student in a college-level course who is predicted to fail there.” Of the 75 percent of students in their study who were referred to developmental mathematics, 18 percent of those students were determined to be underplaced. On the other hand, only 8 percent of students placed in college mathematics courses were considered overplaced (CCRC, 2013). Two factors could contribute to increased accuracy of placement exam scores: high school GPA and placement exam preparation.

Although part of the reason students find themselves unprepared for collegiate mathematics is because of differing standards between high school graduation standards and college-readiness standards, high school GPA can be an important addition to placement policies. Assessment exams cannot possibly take into account all the factors that make for a successful college student. Since high
school GPA is a more cumulative measure than one test, it gives colleges a more complete idea of a student’s motivation and commitment. The CCRC study found the following results:

“Using high school data combined with test scores was predicted to lower severe placement errors by 3 to 4 percentage points. Using the best of either high school transcript information or assessment transcript scores was predicted to lower severe placement errors by up to 5 percentage points… Using the best of either high school transcript data or test scores was also predicted to significantly lower the rate at which students would be assigned to remediation. Using [this method] would not only send more students immediately into college-level classes, but it would also maintain or increase the success rates of students in those classes” (CCRC, 2013).

A multi-faceted approach to student placement will increase the number of students who are correctly assigned to developmental or collegiate mathematics courses. Higher rates of accuracy for placement methods will decrease the number of students who are placed in developmental classes, allowing colleges to put more of their resources into courses that earn students credits towards a degree.

Student preparation for placement exams is also an area that will impact student success. Incoming students may have misconceptions about the exam that lead to not putting much effort to doing well. Some students lack confidence in their mathematics ability and feel as though taking a refresher course will benefit them, not realizing the sequence of courses they will have to take before they will be able to take a class that counts towards a degree. Many of the students enrolled in developmental mathematics courses fail to prepare for the placement exam, even
though study materials are often made available by the colleges. The figure below shows the results of a CCRC study on students’ preparation for the placement exam.

Figure 2: Placement Exam Preparation Among Developmental Math Students (Fay, 2013).

The 69 percent of students who did not prepare for the placement exam indicated they were aware ahead of time that they would be required to take one. The colleges that were included in this study all provided study materials for students, although they might not have been advertised effectively. Also, students may not understand how the results of the placement test will affect their time in college; some students “only realized that the placement process could result in multiple semesters of not-for-college-credit math coursework after they took the exam...Students reported that if they had understood the consequences of poor performance on the placement exam,
they would have approached placement testing differently” (Fay, 2013). Encouraging
preparation for placement exams could lead to more accurate assessment of a
student’s skill level and allow students to bypass developmental courses.

Developmental Mathematics Courses

Especially for students going into a STEM program, mathematics is a core
requirement. Levels of mathematics beyond algebra provide students with reasoning
skills, set students up for college success, correlate with graduation from college, and
indicate earning in the top 25 percent of income from employment (Gaston, 36). Many students choose to fulfill their mathematics courses at community colleges; 47
percent of mathematics enrollments in higher education are at community colleges.
Startlingly, 57 percent of these students are enrolled in precollege level (non-credit)
courses (Olson, 30). Students find themselves in these developmental courses for
several reasons—they were never taught college preparatory mathematics, they were
taught but were unable to demonstrate proficiency, adult students who are returning
from the workforce to further their education and need to refresh their quantitative
knowledge, and prospective educators who may have to teach this type of
mathematics. Overall, the number of students taking mathematics courses has
increased, but in recent years, the highest rise in enrollment has been for
developmental courses that do not receive credit. The following figure shows the
trend in mathematics enrollment at community colleges.
This is not the type of growth mathematics instructors would like to see. The success rate of students who are enrolled in these developmental courses is around 20 percent. Students are coming to these courses widely unprepared, and community colleges are using a vast amount of resources, in terms of faculty, having to teach so many sections of developmental mathematics.

The effectiveness of developmental mathematics courses is under question. One-third of students enrolled in these courses will fail on their first attempt, and students who never retake the course to earn credit drop out of college (Gaston, 37).
Students referred to taking developmental courses often have to complete a series of courses before they can think of taking a mathematics course for college credit. Cullinane (2010) suggests the following:

“The multi-course structure of the traditional developmental mathematics sequence impedes student success rather than fostering it. After referral to a developmental sequence, some students fail to enroll in the first class. Others who successfully complete one or more courses do not necessarily continue to the next class. In fact, more students ‘leak’ out of the developmental pipeline because they do not enroll in the first or a subsequent course than because they actually fail a course.”

Students are more likely to complete the non-credit courses and go on to take courses required for their degree if they have fewer courses spent in the developmental mathematics sequence. The following figure illustrates this point:

![Figure 4: Proportion of Student Outcomes in the Developmental Math Sequence](Cullinane, 9).
The most startling group of students are those 44 percent who were placed in and passed pre-algebra but did not go on to complete the subsequent courses that would prepare them to receive college credit. The system of developmental courses needs improvement to allow students to gain the skills needed for their intended career without hindering their progress to a degree.

The majority of community colleges make use of placement tests to assign students to their first mathematics course. Sally Johnson notes that at her school in Nevada, 60 percent of the 10,000 students who took such a placement test ended up in the lowest levels of mathematics, which equates to fifth and ninth grade levels of knowledge. Of the students who start in the fifth grade level math courses, only 3 percent go on to receive any college credit for a mathematics course (Olson, 33). In efforts to reduce the number of students enrolled in these developmental courses, some community colleges resort to the alternative choice of providing review courses before students take the placement exam. This may save students from spending a whole semester taking a course that will not count towards their degree requirements.

The standards for which students are considered prepared for collegiate mathematics vary widely between institutions. A more standardized approach for these guidelines across a state’s network of community colleges would lead to an easier credit-transfer process and more seamless course progression. Community colleges generally feel as though they understand the needs of their own students, leading them to set their own cutoffs for placement exams. While this does allow for individual colleges to adjust for the needs of their students, it leaves ambiguity about what it means to be prepared for collegiate mathematics. A CCRC study of one
state’s attempt to standardize placement tests and cutoffs for developmental courses while giving individual schools room to make decisions showed the benefits of meeting in the middle. The study focused on New Jersey’s system of 19 community colleges. Members who met to make decisions included not only administrators, but instructors as well, noting, “If it was just the presidents who voted it in, they would go back and have a mutiny…You have to have grassroots buy-in. You have to give everyone time to digest. Then you have to give them opportunity to give feedback…The final decision was made at the presidents’ council but not without the complete confidence of the academic officers and faculty” (CCRC, 2013). Before the committee was formed, state placement test cutoffs varied from school to school, so the first goal was to agree on one standard. The committee then set 80 percent of the content for developmental courses, allowing for each college to adjust the remaining 20 percent to cater to the needs of their students. This new policy “served to reconcile the tension between consistency and autonomy by creating a state policy framework that gives colleges autonomy to be responsive to their student body…New Jersey’s experience demonstrates that efforts to create consistent developmental policies can prompt deeper thinking, ongoing discussions, and further reform” (CRCC, 2013). This approach would also allow high schools to have a clearer understanding of what it means to be college-ready. Currently, high school graduation standards do not match college-readiness, which can clearly be seen by the number of students being recommended to developmental courses.

STEM majors tend to have a rigid set of prerequisites, meaning a student has little flexibility in the order in which he is able to take classes. Switching into a
STEM major would then mean a student virtually has to start his schooling at the beginning, making a STEM major an unappealing choice for most students at community colleges. According to Bettinger, students who were enrolled in STEM courses for more than 40 percent of their first semester were less likely to leave the major. Students who left their STEM major were found to be just as likely to pass their initial STEM courses, which suggests that the choice to change programs relied not only on difficulty of courses but perhaps the high level of commitment required by the major. Students who invested a large portion of their credit hours during their first semester to major-specific courses were more likely to follow through with that major, alluding to the fact that the time it takes to achieve a degree is of great importance.

In the way it is currently taught across most institutions, mathematics is generally isolated from other fields. It is unlikely that students will be taught skills that will help them solve problems in other areas of study, such as the sciences. If mathematics were taught in context of these real life applications, students may feel more motivation to learn. Most technical occupations do not require mathematics knowledge above trigonometry or calculus, yet many STEM programs require students to take additional courses beyond these. This is discouraging to students who would be interested in pursuing a STEM degree. There is value in the type of reasoning these courses develop, but there must be new ways to help students long-term, not just teach skills that will benefit them in one compartment of their schoolwork. Giving students the ability to reason through conditions of uncertainty is a skill that is more transferrable to real life than rote procedural skills often taught in
courses like algebra or statistics. A program developed by The Carnegie Foundation for the Advancement of Teaching seems to address many of these issues. The goal of this program, named Statway, is to lean away from the decontextualized mathematics currently being taught (Cullinane, 6). The rationale of such a program is to provide students with skills they can take with them into the workforce, similar to the aim of community colleges. This program is not necessarily aimed at STEM majors, but programs like this one could be utilized in the future to bypass the need for many students to take developmental mathematics courses to earn credits that do not even contribute to their future success in their desired career. This would allow mathematics departments to focus more of their energy on keeping students motivated within STEM majors.
Chapter 3: Conclusions

Community colleges are increasingly being recognized as one of the most important sectors of higher education. Educating nearly half of all college students, two-year colleges have the ability to transform the higher education landscape. In fact, “most entering community college students intend to transfer and earn a bachelor’s degree—so many that four-year institutions would not be able to accommodate them all as incoming freshman. Community colleges greatly expand our nation’s postsecondary capacity” (CCRC, 2015). The group of students who have added credits from two-year colleges to their transcripts is diverse. Students who take courses at community colleges at some point over their educational journey become nurses, teachers, engineers, go on to receive graduate degrees, and more. The two-year college has become more of a launching pad than ever before, and prospective higher education students are recognizing the benefits of starting coursework at these schools. The need for policy change within the higher education system, and the importance of the two-year college, has been recognized nationally. In 2015, President Barack Obama presented the evidence demonstrating the key role community colleges play in educating the American workforce. He noted: “In the coming years, jobs requiring at least an associate degree are projected to grow twice as fast as jobs requiring no college experience. We will not fill those jobs—or keep those jobs on our shores—without the training offered by community colleges.” The
Healthcare and Education Reconciliation Act would grant $2 billion over 4 years to community colleges. This would allow for qualified and college-ready students to be granted tuition to cover the full cost of attending two-year colleges. This investment in community colleges will help train more workers and prepare students for higher degrees.

Community colleges have broad appeal because of their accessibility. Open enrollment policies provide opportunities to students who have been away from schooling, are not ready for a four-year degree, or need only technical training for a job. The flexibility of scheduling through increased course offerings on nights and weekends allows students to attend to other commitments while continuing their education. Charging based on the number of credit hours taken is another way two-year schools cater to the needs of their students; they do not have to be overwhelmed by a required minimum amount of credit hours. Community colleges are less of a financial strain on students as well, with tuition costing a fraction of most four-year universities. Students are leaving college owing an average of nearly $30,000. With these numbers, students cannot risk not being able to find a job after graduation. Community colleges adapt to their environment much more than larger schools; they offer job training specific to the area’s needs, enabling students to be specifically trained for jobs that are available nearby. Instructors are committed to teaching and learning; they work closely with students and understand the tools students need to go on and become successful.

The missions of community colleges place emphasis on teaching, and student learning and success is a priority. Community colleges must support the continued
betterment of their instructors through professional development. This is one way for two-year colleges to improve the effectiveness of their precollege mathematics sequences. These schools must then provide their faculty with the following: “reassigned/release time for research and study; compensation for expenses associated with participation in workshops, conferences, and college courses; compensation for reassigned/release time for the development of curriculum and innovative approaches to instruction; and sabbatical or professional leave” (AMATYC, 2014). The faculty plays a key role in the success of students. Colleges must support their instructors and invest in the future of their departments. Part of the problem with current professional development policies is that these opportunities for teacher education are limited, nearly exclusively, to full-time faculty. The majority of instructors at most community colleges are part-time adjuncts, who are the individuals placed in developmental mathematics classrooms. AMATYC suggests that these adjuncts be “provided with in-service training in order to properly institute curricular change and improve teaching methodology, [be integrated] into the departments and encourage[d] to participate in departmental functions, and [there should be] open communication between adjunct faculty and the department chair with regard to work load, courses taught, and schedule” (AMATYC, 2014). Since adjuncts play such a large role in the developmental education system, they should be just as valued and encouraged to improve as full-time faculty.

In the current job market, students have to be competitive to obtain employment. Academic advising needs to be integrated into degree-specific departments, shifting the responsibility from administrative units to instructors who
better understand the skills obtained by each course and the path a student needs to follow lead him to his desired career. Teachers in classrooms are more in tune with the abilities of students and difficulty level of courses; they will be able to guide students to the correct program and career path. Community colleges could then use administrative advisors to aide in things such as resume writing and interview training. The goal of community colleges is to educate students and train workers; sending out job-ready students is in line with that goal.

The transfer of credits from two-year to four-year colleges needs to be smoother. “Loss of credits had consequences for degree attainment: Students who transferred almost all of their community college credits were 2.5 times more likely to earn a bachelor’s degree than students who transferred fewer than half of their credits” (CCRC, 2015). Despite of the stigmas of “lowered expectations from attending a two-year college, the vocational focus of some community college programs, and the potentially lower level of rigor at community colleges, [researchers] found that none of these were correlated with failure to complete a four-year degree. Instead, the largest barrier to bachelor’s completion for community college students was loss of credits upon transfer” (CCRC, 2015). Students who are awarded an associate degree are more likely to go on an receive a bachelor’s degree, as can be seen in the following figure:
To encourage student’s to use this method of vertical transfer to four-year degrees, community colleges and four-year universities should work together to ensure junior status to associate’s degree holders. This would provide universities with a source of students who are likely to complete a degree and increases their capacity for lower-division STEM courses.

Mathematics departments need to have their own full-time faculty members in charge of the hiring process of new instructors and should make decisions based on the where the department has holes to fill. “A mathematics department with experts or specialists in pedagogy, statistics, computing, applied mathematics, analysis, and pure mathematics is manifestly stronger than one in which all members have similar academic backgrounds” (AMATYC, 2014). Community college students have a diverse set of needs, and departments should be able to place instructors in
classrooms who understand these needs and promote individual success of students. Adjuncts are a key component to the faculty at two-year colleges and, therefore, must be supported through professional development. AMATYC suggests these part-time faculty members be provided with in-service training and be integrated into the values of the department.

**Developmental Courses**

The estimated cost of all the developmental courses offered in the United States is over $7 billion (CCRC, 2014). Since so many students are enrolling in colleges but are unprepared for the coursework, the structure of developmental mathematics needs improvement. Nearly 60 percent of incoming two-year college students are recommended to take at least one precollege-level mathematics course. This means any changes made to developmental programs would affect over half of the students at community colleges. Rather than helping student progress, the current trend of putting students in several non-credit classes to prepare them is proving to be a barrier to collegiate success; many of the students who are placed in a developmental sequence of courses never complete the courses. The students who stop taking the developmental courses do not necessarily fail the course, they simply choose to end their schooling or change their intended major. The following figure shows the gradual loss of students in developmental mathematics courses.
A trend for students to leave their intended STEM major is a result of this. STEM majors are known to become valuable members of the American workforce, so encouraging students to obtain these degrees is essential. New standards for these developmental courses must be established to aid student success, rather than hinder it.

One noticeable outcome of the current system of developmental mathematics is that there are several opportunities for students to exit the sequence, whether by failing a course or by never enrolling for the next one. Shortening the process will take away these opportunities for students to fall through the cracks of the sequence and maximize the motivation they have to continue on to credit-earning courses. A concern of faculty members is that accelerated developmental courses will not provide students with the skills needed to go on to subsequent courses, but the
evidence shows “compared with students in the traditional developmental course sequence, students in the [accelerated] program were more likely to complete gatekeeper math…Among those who enrolled [in college-level mathematics], there was no statistically significant difference in pass rates between [accelerated and traditional developmental students]. Accelerated students did not accrue more college-level credits than peers in a longer sequence” (CCRC, 2014). So, if there is no difference once students get to a credit-earning course, it is in colleges’ and students’ best interest to not keep students in unnecessary semesters of developmental mathematics. Accelerated programs serve to eliminate the steps at which students drop out of the developmental sequence. A study of City University of New York’s accelerated developmental program showed that only those accelerated programs that also provided support in other ways contributed to student success. This support included pedagogical changes and curriculum adaptation. This underlines the idea that support for faculty must come before changes made for developmental sequences. Instructors must be prepared for these changes so students can put confidence in fact that they will be able to be successful in for-credit courses. “Additional supports could include required tutoring or co-requisite coursework for at-risk students; early warning-systems to identify struggling students, so that instructors may intervene early in the course; and a support network for instructors, to help them collaboratively develop strategies for working with struggling students” (CCRC, 2014). Accelerated sequences should introduce college-level material; students will have the chance to “test out” collegiate mathematics in an environment that is supportive of their learning. This type of instructor-supported accelerated
development falls in line with the missions of community colleges that stress effective teaching and student progress.

The teaching of these noncredit courses cannot be the same as high school classes. These classes need to be more driven by applications, giving students tools they can use to carry them into collegiate mathematics and helping expand options available to them in further schooling and in their job search. Mathematics at the college level should be a tool to enable student success, not the barrier that it has been to students. Teaching with more emphasis on real-world applications will make these courses more useful to students. Instructors should choose specific content to prepare students for employment while providing students with a broad enough mathematical skill level should they change their plans and switch to a more mathematics-intensive major. The goal of a developmental mathematics course is to develop students’ basic skills and problem-solving strategies; students should leave a course with an intuition of mathematical principles and procedures. When students learn mathematics in isolation from other disciplines, they cannot appreciate the tools gained from these courses, causing many students to lose interest in continuing their mathematics education. Developmental courses should be the link between mathematical knowledge and being a skilled problem-solver in the workforce.

As part of the developmental mathematics reform, the process of placement tests needs to be addressed and improved. Students should be made more aware of the consequences of the results of their performance on the test. Preparation for the test should include sample questions and a review of concepts to be covered. CSCC offers a “Bootcamp” course to help students look over the material. It is a five-day
course that is free for students. Advisors should sit down with incoming students to stress the importance of these tests, so students are aware of how they can set themselves up for success. If students can use this refresher to do well enough on a placement test to not be enrolled in non-credit courses, they will save both themselves and the college time and resources.

As seen with the New Jersey system of community colleges, two-year schools should work together to set one standard for which scores on a placement test would mean a student would be recommended to a developmental sequence. A mixture of standard policy and individual autonomy would allow for colleges to customize coursework to fit their students’ needs, while giving high schools and colleges in the state to have a better understanding of what it means to be college-ready.

**Mathematics Departments**

Education is something that takes effort from all angles. Dedication from community college faculty is what keeps this important sector of higher education going. So many future teachers are taking courses at community colleges, and they need to experience good instruction so they can pass it to the next generation. There is a cycle of ineffective instruction which leads to students who fail to learn mathematics properly who then become ineffective mathematics teachers.

Several departments rely on their students to take mathematics course. Mathematics faculty should be involved in areas outside of their department to address the needs of all students at the college. Designing lessons specific to the degrees and careers students intend to pursue will help students develop more
relevant skills. Mathematics departments should make use of technology, such as computer and calculator display equipment and laboratories to provide students with a real-world experience of how they will use mathematics in the future. Faculty should be given time to adequately train themselves and develop new teaching methods to include this technology in their lessons.

Because community colleges do have the autonomy to develop a curriculum that is relevant to their students, new hires in mathematics departments should be given a full-time mentor. This person can serve as a guide to answer questions about the values of the particular college and provide an example of how to properly engage in teaching at a two-year college. Excellent teaching is a standard that must be upheld by both full-time and part-time staff. With so many future teachers taking courses at community colleges, a proper example must be set of how mathematics should be communicated to students. Community colleges are the key to stopping the cycle of bad instruction leading to bad students who are future educators.
References


