Chapter 6

Student Success

Stimulating Student Achievement in Mathematics

Action is the fundamental key to success.
~Pablo Picasso

Student Success is integrated with proficiency, ownership, and engagement as the final pillar of mathematical PROWESS. Two-year colleges are now at the center of the *learning college* movement (Flynn, n.d.; AACC, n.d.), where the goal of education is to put student learning first—a critical focus of the Student Success Agenda (Achieving the Dream, n.d.). Three questions are critical to this agenda:

1. What is student success?
2. How can student success be enhanced by design?
3. What can be measured or assessed that constitutes as evidence of student success?

By examining the answers to these questions, we can focus on engaging all key stakeholders in the process of promoting success for students.

What is Student Success?

With the ongoing dialogue about higher education focusing on college completion, accountability, and assessment, it is important to have a common definition for student success (Fulton, 2017). Success can be defined as meeting a goal or outcome. We therefore define *student success* as the fulfillment of a student's academic or professional goals or outcomes. During the past decade, various key performance indicators have been standard practices used in higher education literature as well as all six regional higher education accreditation agencies to measure student success (Community College Research Center [CCRC] & American Association of Community Colleges [AACC], 2015a), Cuseo, 2012). These include

- Academic Achievement or Successful Course Completion (Grade of A, B, or C) and Success in Subsequent Courses. This indicator focuses on high levels of academic achievement including academic recognition of any kind (for example, dean's list, scholarships, honors credit, Phi Theta Kappa, AMATYC Student Mathematics League, AMATYC Student Research League).
- Student Persistence or Term-to-term Persistence. Do entering college students enroll, stay enrolled and maintain their enrollment in the college? Institutional data collected on persistence should track students' continuous enrollment in consecutive terms fall-to-spring and fall-to-fall (National Student Clearinghouse Research Center [NSCRC], 2015; Berkeley, 2017).
- Educational Attainment. This focuses on entering students' persistence to completion of their degree, program, or educational goal. National data reports track students' advancement from developmental education to college credit courses, successful "gateway" course completion, and completion of degree and certificates.
- Student Advancement. The focus of this indicator is on a student's successful progress and completion of college degree or program. For example, two-year college students have diverse goals, which include transferring to a four-year university, earning an associate's degree, completing courses for professional growth, and completing courses for personal growth or to earn a job related to their degree.
- Holistic Development. This places emphasis on whether students develop not only intellectually, but also emotionally, socially, artistically, and creatively as they progress through and complete their college experience.

These indicators underscore the importance of ensuring that students are enrolled in appropriate courses aligned to meet their academic needs. Such alignment should be indicative of a high quality curriculum which seeks to answer the questions (Bailey, Jaggars, & Jenkins, 2015; O'Banion, 1997)

- What are the core skills, competencies, and content knowledge that we want our students to learn?
- How can we ensure that our students are learning (CCRC & AACC, 2015b)?
- What evidence do we have—in the form of product deliverables—that authentic learning is taking place?
- How can we, as members of a learning-centered institution, contribute individually and collectively to teaching for optimal student learning?

Enhancing Student Success by Design

Students enter our classrooms with varied academic preparation and expectations, which requires the entire college community to work together to advise and place them into appropriate pathways while creating a positive learning environment to maximize their success (Center for Community College Student Engagement [CCCSE], 2018). Producing and sustaining a learning environment that promotes student success should be a goal that unites administrators, support services, faculty, and staff. Schools should understand their student population, including barriers to student success. Support services should be available and accessible to minimize those barriers. According to AMATYC (2005, 2006), a two-year college that promotes and cultivates student success is one in which

- students experience an atmosphere where diversity is valued, individual differences are appreciated, and students have a sense of physical, social, and emotional safety
- faculty are engaged in continuous student success improvement efforts
- the institution provides academic support for faculty and students
- physical space is equipped with a variety of learning resources (such as computers, print materials, models, and workspaces) that reflect the different modalities and styles of learning.

Initial Assessment and Placement

In order to provide institutional supports for students, mathematics faculty, support staff, and administrators need to understand their student population. Because two-year colleges teach a high number of students who do not place into college-level mathematics courses, institutional leaders must recognize the challenges of programs, such as developmental mathematics, and explore initiatives to transform the ways in which they are facilitated.

Departments and institutions must provide multiple measures to support the decision-making process related to initial placement of students into mathematics courses (Bailey, Jaggars, & Jenkins, 2015). Mathematics faculty should be involved in the placement process, which may call for the use of a variety of assessment measures. Institutions must provide knowledgeable advisement to support students with these measures, while determining the most advanced courses for which they have the sufficient mastery of prerequisite skills and acceptable probability of success. Departments and institutions with demonstrated expertise in the area of placement do the following to achieve student success

- Ensure that mathematics faculty are involved in the design of mathematics placement measures and processes.
- Work to train advisors to place students into the most appropriate course for which they have prerequisite skills.
- Advise students into appropriate mathematics courses using a system that combines meaningful measures of readiness and attention to students' life goals.
- Provide structure for students to work closely with their advisors and faculty to ensure that their plan for mathematics learning is appropriate.
- Create opportunities for students to understand desired outcomes in mathematics courses.
- Evaluate the effectiveness of the placement processes as measures for student success.

Many students come to college with seemingly insurmountable obstacles to overcome. The flexibility of choice of courses and mathematical pathways provided by two-year colleges allow them to overcome these obstacles. A case in point is Emma's story.

Emma endures instability in her family and has had previous failures in mathematics. She has demonstrated her proficiency at circumventing obstacles. For example, one obstacle that she encountered was being denied admittance to the local high school due to the school's internal policies after her family moved. From the start of her college experience, Emma has taken ownership of her learning. She relates the following experience with her choice of her first college mathematics class upon enrollment at the two-year college. "I had the choice of going straight into College Algebra or taking the Intermediate Algebra class because ... of where I scored on the placement test and so I actually decided to take the Intermediate Algebra class just for a refresher course. I had been out of school for so long."

This is a course selection strategy employed by some students, especially non-traditional students. The students' first mathematics class is one or more levels lower than that in which their placement test scores indicate they are eligible to enroll. They describe a need to rebuild their mathematics foundation.

Advising Students

Once students are properly placed, higher education communities need to be a guiding force to them as they traverse their academic path. One method is via the use of the Survey of Entering Student Engagement (SENSE) design principle, which focuses on students having a *clear academic plan and pathway* (CCCSE, 2018). Students must appropriately be advised to follow an academic plan and a pathway that will help them to reach their goals. They are more likely to persist if they are not only advised on what courses to take but also assisted to set academic goals and to create a plan for achieving them. In order for there to be a clear academic plan and pathway for students, mathematics departments should develop, implement, evaluate, assess, and revise courses, course sequences, and programs to help students achieve their academic and career goals.

When considering alternative mathematical pathways, it is important to note that most students in the first two years of college do not take a sequence of mathematics courses that lead to achieving their goals. Either they take no mathematics at all, or they attempt one and not others. Such students are likely to not obtain a degree or certificate or transfer to a four-year institution (Mills, 2016). In the case of developmental mathematics, a small fraction of students is successful. To achieve the vision of *IMPACT*, we must employ proven mathematical pathways and instructional practices that increase student success.

Various new pathways curricula are being discussed not just by higher education institutions but also among policy makers at the provincial, state, and local levels. The multiple pathway conversation continues to grow and there are several projects currently being implemented to shorten and strengthen mathematical course-taking sequences so as to improve student success.

Learning Environment

Students and faculty must be knowledgeable about research on how students learn mathematics and the effects of variables such as age, race, gender, career goals, socio-economic background, and language skills. Instructors must recognize the need to create a nurturing environment that raises students' self-esteem and encourages them to continue their study of mathematics. In this environment, faculty, support service personnel, and students must be a team. Factors that are instrumental to student learning include

- Mathematics departments and faculty mindfulness of how their biases and prejudices may affect student learning. The classroom must be welcoming and promote principles of inclusion, access, and equity (Chao, Murray, & Gutiérrez, 2014; AMATYC, 2005).
- Faculty incorporation of innovative teaching and learning strategies that use technology and activities designed to promote active student engagement, meaningful discourse, cooperative learning, fostering active student engagement in mathematical thinking and encouraging student creativity and risk-taking.
- Faculty exploration of ways to spur appreciation of how mathematics can be used outside of the classroom environment (National Research Council [NRC], 2001).
- Faculty involvement in mathematics professional organizations (AMATYC, 2014a).
- Faculty collaboration with instructors in both mathematics and non-mathematics disciplines to develop learning communities that pair a mathematics class with a class in another

department and actively seeking out guest speakers from scientific fields.

- Faculty involvement in training tutors specifically on how to assist students effectively in the first two years of college mathematics.
- Learning resources such as the library, disability services, student support networks, and tutoring centers focusing on the availability to students who may be in need.
- Learning resources incorporating the necessary physical space, materials, technological resources, and support staff facilitating effective learning of mathematical concepts and skills.
- Learning resources encouraging student-faculty contact.
- Student participation in student mathematics clubs and competitions.
- Students help in recruitment of fellow students, including those from underrepresented groups, into mathematics-intensive programs and careers.
- Student exploration of career opportunities in STEM-related fields.

This list updates AMATYC's (2006) recommendations addressing the diverse talents and ways of learning and teaching and is designed to be effective in developing PROWESS.

Technology undoubtedly has had an impact on the mathematics classroom. During the past decade, two-year colleges have experienced an unprecedented growth of 344% in the number of courses offered in the online and hybrid (blended) modality (Allen & Seaman, 2014). Faculty who are actively involved in the design and delivery of these courses must take action to ensure that the goals, learning outcomes, and learning experiences are not compromised in the absence of face-to-face interactions between instructor and students and between students and students. Faculty teaching courses via distance learning must receive sufficient training in this mode of delivery.

Institutional Responsibilities for Enhancing Student Success

Institutional leadership—department chairs, department leaders, and administrators—has an obligation to develop a professional mathematics department comprised of dedicated and qualified faculty and an environment that fosters their growth in their vocation. Such a department is key to student success.

Institutions Hire Qualified, Knowledgeable, and Diverse Faculty and Staff

Selecting highly qualified mathematics faculty is essential to student achievement. Departments and institutions must employ candidates who are credentialed and highly knowledgeable about teaching and learning theories for mathematics, and committed to the mission of two-year colleges. Faculty, both full-time and part-time, should be supported with appropriate office space, technology resources, and access to student information. Departments and institutions should

- develop and apply suitable criteria for hiring new faculty that reflect AMATYC's (2014b) position statement on faculty academic preparation
- advertise personnel vacancy notices widely; contact professional organizations, graduate schools, and other entities to broaden the applicant pool in order to hire diverse, qualified highly knowledgeable faculty about teaching and learning theories for mathematics
- include faculty members on all search and hiring committees, for full-time and adjunct faculty.

AMATYC's (2014a) viewpoint is not intended to replace any regional, state, or local requirements or recommendations that may apply to hiring faculty, assigning them to classes, or evaluating their performance or qualifications but rather "to provide guidelines that reflect the collective wisdom and expertise of mathematics educators throughout the United States and Canada regarding appropriate preparation for two-year college faculty involved in the teaching of mathematics, whether on a full-time or part-time basis" (para. 1).

Promote Professionalism

Professionalism with its core values of expertise, autonomy, commitment, and responsibility is at the heart of improving student success in mathematics. All mathematics faculty who teach in the first two years of college need to possess a strong academic preparation, participate in supportive professional development, be open to change and improvement, demonstrate an ability to work in teams with other faculty, and be willing to assume responsibility for carrying out multifaceted professional activities. These are not attainable without deliberate faculty action.

Effective mathematics instruction requires the integration of a variety of instructional strategies, resources and materials, technology, and delivery formats. Knowledge of instructional methods that are aligned with up-to-date research into the ways students learn mathematics must be used to improve instructional practice. Institutions should

- offer faculty professional development opportunities on multiple approaches to effective instruction
- provide instructors with appropriate resources necessary to design and implement instructional strategies that actively engage students
- establish and maintain the infrastructure and resources essential to the support, development, and teaching of distance learning courses in mathematics (these should be aligned with current best practices)
- offer training to faculty about career planning and advising for students.

AMATYC (2014a) suggests faculty be life-long learners in both content and pedagogy in order to stay current in the field of mathematics. Area of professional development might include

- graduate coursework in mathematics and mathematics education beyond the level of the individual's previous study
- courses in some other disciplines served by the two-year college mathematics curriculum may also be appropriate
- doctorate in mathematics or mathematics education
- reading journals
- instruction on the use of current technology to enhance the teaching and learning of mathematics
- attending professional conferences, webinars, mini-courses, and/or summer institutes
- publishing books and journal articles.

Institution Responsibility for Creating Learning Support Environments

When two-year college students describe their early college experiences, they typically reflect on occasions when they felt discouraged or considered dropping out. Their reasons for persisting usually included one common element: a strong, early connection to someone at the college (CCCSE, 2009, 2018). Students generally benefit from having a personal network for academic and social support. One of the main challenges that institutions face is a better understanding of students' experiences.

While this is a challenge, it is also an opportunity for colleges to be purposeful in creating learning support environments that address students' socio-academic needs. We suggest some ways to create a supportive learning environment.

- **First Week of School**. The first week of school is often a period when students experience high levels of back-to-school anxiety and stress. These are sometimes caused by the busyness of that week, and the necessity to quickly meet academic "housekeeping" requirements such as registration, textbook purchase, familiarization of where classes are held, as well as course syllabi. An effective and supportive educational environment reduces challenges at the beginning of the term. We suggest colleges provide a supportive environment during that week to help alleviate stress levels. This can involve having more counselors or advisors to assist with registration. Precision-scheduling dramatically reduces late add-ons to classes and enforces an application deadline for new students allowing faculty to reclaim the first week for learning.
- **Mathematics Support Services**. Departments and institutions should provide services that support both student success and social interaction among mathematics students, for example, tutoring services, mathematics clubs, peer or faculty mentoring.
- **Supplemental Instruction**. This is a learning support program that utilizes student peers to provide student-led instruction. A Supplemental Instruction (SI) session, which is student-led, creates a non-threatening environment where students, regardless of their sociocultural or academic background, can interact with each other (Arendale, 2002). Arendale's research indicates that SI can have a positive impact on student learning.

Institutions have the responsibility to actively foster and support the professional development of their mathematics faculty to improve their instruction which will lead to student success. To facilitate this, colleges should provide mathematics faculty with

- reassigned/release time for professional enrichment projects and/or activities
- financial support for such things as those associated with participation in workshops, conferences, college coursework, and professional collaboration activities
- compensation or reassigned/release time for the development of curriculum, innovative pedagogical approaches to instruction, and new educational media
- sabbatical or professional leave (AMATYC, 2014b).

Corequisite Pathways Model

The "corequisite" model allows for students to go directly into college-level mathematics classes while receiving learning support at the same time (California Accelerated Project [CAP], n.d.; Complete College America [CCA], n.d.). The CAP details methods of implementing corequisite remediation, including "pairing a transfer-level course with a support course, extending instructional time through additional lecture or lab hours, or requiring students to participate in academic support services or supplemental instruction" (para. 3). At the time of this publication, several states have enacted or are in the process of the legislative actions related to guided pathways, which includes the corequisite model (Educational Commission of the States [ESC], n.d; Johnstone, 2017).

Linking Developmental Math with Student Success

A course on student success is typically taught as corequisite to (in conjunction with) the "redesigned" first college mathematics course. The content includes concepts from the learning sciences (i.e., mathematics study skills, anxiety reduction, technology usage, awareness of college

academic support resources) to help students develop the skills and "tenacity" needed to be successful in mathematics, other college level coursework, and in their future careers and lives as citizens. Students often build stronger bonds with their peers, including classmates, faculty, and staff because they spend more time together (CCCSE, 2017; Kuh, 2007).

During high school, Hannah was never very good at mathematics. When she came to college, she realized that she had not applied herself during high school and it was time to get serious about school. She enrolled in an elementary algebra course, which she succeeded in quite well. Hannah then simultaneously enrolled in an Algebra Success Course and College Algebra. She was accustomed to a lecture format course, and was successful in that format. The new course was group-oriented coursework where students needed to support each other in the learning. Hannah found this new style of coursework challenging and soon realized that "the pressure was put on me to learn instead of pressure put on the teacher to lecture." Hannah realized that, despite a student's past experiences, success in a course means that students need to be prepared to take the skills and knowledge imparted by the teacher and apply those skills to mathematics concepts. According to Hannah, the faculty created a mathematics program that "uses several different learning techniques to try and help accommodate as many students as possible. I think that is great because it will benefit not only me, the traditional learner, but other nontraditional types of students." Hannah feels that after that first college math class, she "found that the classes after that [got] easier once you [understood] the strategies for learning and understanding mathematics."

Assessing Student Success

We have defined student success and established the core skills and competencies we want our students to learn. Now, we focus on how best to assess student success. From the onset, any form of assessment should be evidence-based and data driven. Institutions and departments should embody a culture of evidence; that is, "collective mindset, one in which critical decisions affecting students are informed by data and evaluated in light of whether student achievement increases" (Manning, 2009, p. 5).

Assessment and Maintenance

Assessment refers to processes that provide information on the nature and quality of learning. As identified in Chapter 4, this feedback is critical for the three areas where faculty can assume ownership: Curriculum, Course Design, and Learning Environment. A single assessment activity may produce information on just one component or it may address multiple areas. In all, the purpose of assessment is to improve learning and build PROWESS. To do so we suggest

- Assessment should be an ongoing process of collecting pertinent evidence that informs instructors about students' level of mathematics proficiency.
- Assessments should be authentic: that is they should accurately evaluate students' abilities in real-world contexts.
- Assessments should focus on evaluating students' higher order thinking skills collaborative work, and communicative skills.

Assessments are used at different levels: each classroom, each course, and each program. Each level seeks to provide acceptable improvement over time. The validity and reliability of assessments should be measured and developed as part of the process. Presumptions about either validity or reliability of particular assessments need to be supported by evidence. Recent shifts in the primary mission of two-year colleges from access to completion have resulted in greater emphasis on outcomes-based assessments for greater accountability across the various stakeholders. The lists below describe what and how assessment is done at each level: Classroom, Course, and Program.

Classroom Assessment

- use Learning Assessment Techniques (LAT), such as exit tickets, quick writes, and concept maps, which have emerged as effective instruments for unifying teaching, learning, and assessment (Barkley & Major, 2015)
- use Classroom Assessment Techniques (CAT) which identify a set of learning outcomes together with an active learning instructional activity and guidelines to analyze the student's work (Angelo & Cross, 1993)
- incorporate assessment activities into the classroom on a regular basis
- provide continuous feedback, and in ways that are most helpful to student learning
- adjust classroom activities in response to assessment information
- discuss assessment results with students and explain how the information is being used to make instructional decisions
- use a variety of assessment techniques including formative, summative, and authentic assessments
- use assessment data as a learning tool to address misconceptions and misunderstandings
- assessments should support learning and be useful for both instructors and students.

Course Assessment

- develop core student learning outcomes for each mathematics course in collaboration with other local or regional faculty in the K-20 system
- communicate course outcomes to students at the beginning of the course
- use course assessments to measure achievement of those outcomes and determine needed improvements
- use results of assessment to improve the learning environment during the course and in subsequent semesters.

Program Assessment (AMATYC, 2012)

- identify assessment tools linked to desired institutional student learning outcomes and proceed through the assessment implementation cycle to implement improvements
- develop assessments to monitor placement and progression in sequences and pathways
- train faculty to participate in the development and assessment of general education outcomes in mathematics and determine which of the general education outcomes are met when students complete a given mathematics course
- continually use assessment results to evaluate program effectiveness, and provide feedback to faculty, administrators, and students.

Institutional Research

Institutions generally collect a vast amount of data for various reasons. For the purposes of student success in mathematics, we suggest a culture of evidence that focuses on

- using results to determine "what works" and what requires improvement
- collecting and sharing systematic, timely, useful, and user-friendly information about student learning and educational experience
- establishing a culture that encourages all stakeholders to rigorously examine and openly discuss institutional performance
- tracking cohorts (e.g., first time in college, first generation, degree-seeking vs. non-degree seeking, major) of entering students to measure outcomes and identify areas for improvement
- disaggregating data by student characteristics, such as age, gender, race or ethnicity, and income level
- using the results of student and institutional assessments to make routinely informed decisions about strategic priorities, resource allocation, faculty and staff development, and improvements in programs and services.

Working Together for Student Success

Increasing the number of students who achieve student success is not easy. There are no quick fixes for the problems that face today's two-year colleges, particularly as they relate to the mathematics curriculum in the first two years. We need a long-term sustained focus from professional organizations, college leadership, faculty, staff, and policy makers. As noted previously, a collaborative spirit is imperative to improving mathematics prowess and college teaching.

Would you like to design a new approach in your classes that would promote student success? Are you wondering what can be done to inspire your institution to have a concrete plan for improving student success? Do you already have great information or activities involving student success? Head to AMATYC.org/IMPACTLive and find innovations your colleagues are using or contribute innovations and ideas of your own.

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