

“For the things of the world cannot be made known without a knowledge of mathematics.”

Roger Bacon, 13th century philosopher

February 2016

“Students who successfully navigate the secondary mathematics curriculum too often find themselves enrolled in a postsecondary college algebra course – the prescribed gateway course – that is designed to prepare them for calculus and focuses on mathematics that may not be useful in subsequent courses in their program. Without being given an opportunity to take a course that is linked in any way to their intended area of study or to another area of interest, large numbers of these students never complete the entry-level course.

Recognizing these concerns, the Steering Committee examined a number of innovative approaches to improving student success in entry-level courses, giving special attention to those that have connected learning pathways to coherent programs of study for students majoring in mathematics, other mathematics-intensive disciplines and majors that are not mathematics intensive.”

Rethinking Postsecondary Mathematics: Final Report of the Ohio Mathematics Steering Committee. March 2014

Mathematics Pathways

Alternative learning pathways now available to Ohio postsecondary students

Across the country, there is a growing recognition that college algebra – the prescribed course and/or the gateway course by default for most degree programs – is not necessary for graduates in all disciplines. At the same time, there is widespread acceptance of the fact that mathematics poses a serious barrier to student success and completion.

The question of what kind of mathematics is necessary for students to succeed in the classroom and life is at the heart of current efforts – in Ohio and elsewhere – to prepare students for participation in our fast-paced, data-rich society. And one strategy that is attracting substantial support is to redesign entry-level mathematics courses within learning pathways that give students choices and opportunity to succeed.

Why should entry-level mathematics programs be redesigned?

Reason #1: Far too many postsecondary students never earn credit in a college-level mathematics course. Hence, it is not surprising that mathematics has been identified as a significant barrier to many students’ completion of a postsecondary degree or certificate program.

Reason #2: College algebra is designed to prepare students for calculus and a subsequent series of mathematics courses. Yet, few of the students in college algebra intend to enroll or ever do enroll in a Calculus course.

Reason #3: Research and experience tell us that contextualizing mathematics promotes student engagement and improves completion rates. This points to the need for alternative entry-level mathematics courses (e.g., quantitative reasoning, modeling and elementary statistics) that are connected to students’ postsecondary objectives.

What are mathematics pathways?

A mathematics pathway is a course or sequence of courses that a student takes to fulfill the mathematics requirements for a degree program. The term is often used as shorthand for a strategy in which an institution offers a small number of mathematics pathways aligned to students’ programs of study.

PATHWAYS, continued on next page

Ohio Department of Higher Education’s Charge to the Ohio Mathematics Steering Committee: To develop expectations and processes that result in each campus offering pathways in mathematics that yield (1) increased success for students in the study of mathematics; (2) a higher percentage of students completing degree programs; and (3) effective transferability of credits for students moving from one institution to another.

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In March 2014, after examining a number of innovative approaches to improving student success in entry-level mathematics courses, the Ohio Mathematics Steering Committee recommended the development of alternative pathways to serve the needs of students in clusters of academic programs (e.g. the social sciences, business and finance, allied health and other STEM disciplines). In particular, it urged Ohio’s public colleges and universities to remove college algebra as the **default** mathematics course for non-STEM majors.

Less than two years later, the Ohio Articulation & Transfer Network (OATN) announced statewide endorsement of a new Ohio Transfer Module (OTM) course with learning outcomes in Quantitative Reasoning. The development of this new course expands the number of well-defined learning pathways in mathematics to three – a Statistics Pathway; a Quantitative Reasoning Pathway; and a STEM (Science, Technology, Engineering, Mathematics and Medicine) Preparation Pathway – that yield increased success for students in mathematics, a higher percentage of students completing degree programs and effective transferability of credits for students moving from one institution to another.

Three well-defined learning pathways in mathematics

Developed by mathematics faculty, the three learning pathways are designed to begin discussions within and across institutions on the mathematical concepts that students need to be successful in their chosen career and academic paths. The three pathways are as follows:

Pathways	Pathway Description	Designed for students in clusters of academic programs
Statistics	College-level introductory statistics courses for students without a calculus background and who do not require college algebra or calculus	Part of the general education requirement for majors in fields that may include the following: nursing, human nutrition, social work and associates in business
Quantitative Reasoning	College-level courses designed to emphasize quantitative thinking and problem solving using quantitative methods	Part of the general education requirement for majors in fields that may include the following: communication, criminal justice, fine arts, education (early and middle childhood), history and the social sciences
STEM Preparation	College-level courses (i.e., College Algebra, Pre-Calculus, Trigonometry, Business Calculus, and/or Calculus) designed for students in mathematics-intensive majors	Part of the general education requirement for majors in fields that may include the following: business, chemistry, engineering, education (mathematics, science, technology, etc.) and physics

All students must take a minimum of one college-level mathematics course to earn a degree, regardless of major. These pathways provide curricular alternatives to faculty members seeking to provide their students with mathematics preparation relevant to their majors. According to Patrick Dowling, professor of mathematics at Miami University and a member of the Ohio Mathematics Initiative’s subgroup on New and Alternative Pathways, an additional pathway based on a new Ohio Transfer Module course may be developed for Early and Middle Childhood Education majors.



Ohio seeks alternative co-requisite remediation strategy

For far too many students, postsecondary remedial education is a dead end. Complete College America (CCA) reports that four out of 10 students entering postsecondary education in recent years have required remedial courses in English and/or mathematics prior to taking credit-bearing courses.

Remediation also is a serious issue in Ohio, where the Ohio Department of Higher Education reported that 32 percent of students who graduated from an Ohio high school in 2014 and then enrolled in a public two- or four-year college or university had to take remedial courses in mathematics or English prior to enrolling in a credit-bearing course.¹

To assure consistency in remedial placement practices across Ohio, state legislation called on the state's public colleges and universities to adopt Uniform Statewide Standards for Remediation-Free Status by the end of 2012. These common standards are the basis for student placement policies to ensure that each student is provided the best opportunity to succeed in her or his course of study.²

To address concerns with limited success of traditional developmental course design and delivery, Ohio is pursuing a **co-requisite strategy** for improving remedial education, and ultimately, college completion rates. With the co-requisite course model, students who demonstrate a few academic deficiencies are placed immediately into entry-level, credit-bearing college courses **and** co-requisite support courses. For these students, co-requisite support varies depending on the student's specific needs.

To ensure that all students have a clear pathway to a degree with appropriate coursework and supports, the state is continuing to work on the development of a co-requisite remediation strategy in mathematics and English composition with support from CCA, the Helmsley Charitable Trust and Ohio Articulation and Transfer Network. With the statewide endorsement of the Ohio Transfer Module course learning outcomes for Quantitative Reasoning, as well as the revision of learning outcomes for the existing Statistics and STEM courses, the state will link these courses with appropriate degree pathways AND align co-requisite strategies (or developmental courses) to the gateway courses and pathways.

To ensure that co-requisite programs have a solid foundation, CCA has offered six pillars:³

Pillar One: Institutions must end the practice of using placement exams to sort students into multiple levels of remedial education; instead, they should deploy a comprehensive intake process to discern students' academic goals, career goals and overall college readiness, helping inform the choices they make regarding programs of study.

Pillar Two: Treat all students as college students on day one, rather than as remedial students who must demonstrate their readiness for college before entering a program. As a result, the default placement for the vast majority of students who may not be optimally prepared for college-level coursework should be credit-bearing courses with built-in or concurrent support.

Pillar Three: The vast majority of students who require additional academic support in college-level courses should receive it as a co-requisite while enrolled in a college-level course.

Pillar Four: Institutions must abandon the use of long remedial education sequences that prevent students from completing college-level courses in one academic year. They should enroll all students in college-level courses and give them the support they need within the first academic year.

Pillar Five: College Algebra should no longer be viewed as the default gateway mathematics course. Instead, it should be viewed narrowly as a preparatory course for programs that require pre-calculus or calculus. Colleges should develop alternative gateway mathematics courses for programs of study that do not require calculus.

Pillar Six: Co-requisite support will dramatically increase the number of students who pass a college-level gateway course and enter a program of study within one year. Supports should continue for these students through the implementation of other game-changer strategies.

¹ Ohio Department of Higher Education. 2015 Ohio Remediation Report.

² Ohio Department of Higher Education (2012). Uniform Statewide Standards for Remediation-Free Standards. https://www.ohiohighered.org/sites/ohiohighered.org/files/uploads/reports/2012_UNIFORM_STATEWIDE_REMEDIATION_FREE_STANDARDS.pdf

³ Complete College America. Pillars for Co-requisite Remedial Education.

Getting the word out

Ohio Department of Higher Education schedules workshops to help institutions plan for new programs



Three workshops have been scheduled to assist campuses as they implement Quantitative Reasoning courses, align mathematics courses with degree programs, and design and implement co-requisite supports in mathematics and English composition. According to Stephanie Davidson, vice chancellor, academic affairs at the Ohio Department of Higher Education:

“As readers can see in the descriptions, at the right, the workshops invite participation from campus faculty (all three workshops) and administrators (two of the three workshops). Institutions are urged to assemble teams that will help keep the work connected on their campuses.

“There are exciting changes on the horizon for all campuses and the students they serve. Some of these changes involve courses and programs that will give students new choices and greater opportunity to succeed, others address the need for modern course instructional materials and delivery technologies that reflect best and promising practices that support teaching and learning.”

Faculty Training on Quantitative Reasoning Workshop

March 14, 2016

Columbus State Community College

Eric Gaze, director of the Quantitative Reasoning (QR) Program at Bowdoin College, will provide training on effective QR pedagogy. Three faculty members from each of Ohio's public institutions of higher education, including the chair/lead of the mathematics department, will be invited to attend.

Designing Math Pathways

April 6 and 7, 2016

Columbus State Community College

Faculty from the Charles A. Dana Center at the University of Texas at Austin will provide a two-day workshop to help Ohio faculty and administrators plan for all aspects of designing and implementing mathematics pathways. Ohio public colleges and universities will be encouraged to send at least two mathematics faculty members, representing both developmental and gateway mathematics coursework, and an administrator such as a dean who oversees mathematics programs and has the authority to support cross-institutional work. Mathematics faculty should attend both days. Administrators will be invited to attend both days or may select to attend only on day two.

Bridges to Success: Linking Co-Requisite Courses, Gateway Courses and Degree Pathways

April 20, 2016

Sharonville Convention Center, 11355 Chester Rd, Cincinnati OH

April 21, 2016

Spitzer Conference Center, Lorain County Community College

The Ohio Mathematics *Bridges to Success* initiative is intended to link redesigned gateway mathematics courses with co-requisite developmental education strategies and degree pathways. These workshops will require campuses to send teams of 10-12 faculty and administrators from a variety of disciplines. The workshops are supported by the Helmsley Charitable Trust and will lead to a grant opportunity for Ohio's public institutions of higher education. Because there is a connection to earlier workshops, it is hoped that some of the faculty who attend the Faculty Training on Quantitative Reasoning and Designing Math Pathways workshops will also participate in the Bridges to Success Workshop.