OHIO MATHEMATICS INITIATIVE

Fiscal Year 2016 Progress Report

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MATHEMATICS AND OHIO'S COMPLETION AGENDA

Ohio's ability to compete and to win in the 21st century's global economy depends on its citizens' capacity to succeed in jobs that require advanced knowledge and skills – the kinds of jobs that are available only to those who have earned a bachelor's degree, associate degree or a postsecondary certificate with value in the marketplace.

This is why my primary mission as Chancellor is to dramatically raise college completion rates and to increase the number of Ohioans earning a postsecondary credential. I am committed to doing everything possible to ensure that all college-bound high-school graduates are college ready, and to increase the number of high school graduates with credit toward a college degree or certificate.

I am equally committed to initiatives that prepare adult learners for the rigors of a college-level education – and for success in their pursuit of college degrees or certificates. In addition, I am determined to increase the number of community college graduates earning bachelor's degrees through guaranteed pathways to completion, and to align our postsecondary programs with the state's workforce and economic development efforts – particularly in fields related to the STEM disciplines (i.e., science, technology, engineering and mathematics).

Much of 21st century science and engineering is built on a mathematical foundation. Yet, the reach of the quantitative sciences doesn't stop there. They are fueling innovation and discovery in many areas. Medicine, manufacturing, transportation, communication, finance and other economic enterprises depend on the mathematical sciences, which consist of mathematics, statistics, quantitative reasoning, operations research and theoretical computer science.

The Ohio Mathematics Initiative recognizes that the mathematical sciences give students the quantitative tools, logical reasoning and analytic and problem-solving skills that define a highly qualified and competitive workforce.

The Ohio Mathematics Initiative is a vital contributor to Ohio's future.

John Carey
Chancellor

OHIO MATHEMATICS INITIATIVE: A WORK IN PROGRESS

The Ohio Mathematics Initiative (OMI) is a collaborative effort of mathematics faculty members from Ohio public colleges and universities and Ohio high schools that came together to revisit and rethink mathematics courses, curricula and their relationships with other disciplines.

One catalyst for the initiative is the establishment of Ohio's remediation-free standards, which guarantee placement into college credit-bearing courses for all Ohio students achieving at or above a benchmark assessment score and matriculating to an Ohio public college or university. Other drivers of this work are the need to align course options to students' academic and career goals; increasing difficulties with course and credit applicability within the Ohio Transfer Module (OTM); and the introduction of Ohio's New Learning Standards for K-12 students.

The OMI began with the Ohio Mathematics Steering Committee, a convening of 12 mathematics faculty members from Ohio public institutions, five ex-officio members and Ohio Department of Higher Education and Ohio Department of Education staff. The Chancellor charged the committee with developing expectations and processes that result in each public college and university campus offering pathways in mathematics that yield (a) increased success for students in the study of mathematics, (b) a higher percentage of students completing degree programs, and (c) effective transferability of credits for students moving from one Ohio public institution to another.

The Steering Committee's resulting action plan was structured around five strategies:

1. Develop high-quality entry-level courses and pathways connected to coherent academic programs of study for students majoring in mathematics, other mathematics-intensive majors and academic majors that are not mathematics intensive;
2. Develop policies and processes that foster effective transfer of course credits while encouraging course innovation on all public campuses;
3. Support constructive engagement of mathematics chairpersons and faculty within campus communities and across campuses to shape curricular policy, improve instruction and bolster student support and advising;
4. Develop high-quality measures for improving mathematics course offerings and instruction; and collect, analyze and share relevant data; and
5. Improve student success in college-level mathematics courses by aligning postsecondary expectations and high school practice.

These five strategies will provide the organizing structure for OMI's FY 2016 progress report.[1]

[1] To read the OMI's action plan, see ***Rethinking Postsecondary Mathematics: Final Report of the Ohio Mathematics Steering Committee***, March 2014 at https://ohiohighered.org/sites/ohiohighered.org/files/uploads/math/MATH-REPORT_FINAL_4.22.14.pdf

Ohio Mathematics Initiative

THREE WELL-DEFINED LEARNING PATHWAYS NOW AVAILABLE TO OHIO POSTSECONDARY STUDENTS

Across the country, there is a growing recognition that college algebra – the prescribed gateway course in most mathematics departments – is not necessary for graduates in all disciplines. At the same time, there is widespread agreement that mathematics has historically posed 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. One strategy garnering substantial support is to redesign entry-level mathematics programs with learning pathways that give students choices and opportunity to succeed.

Why should entry-level mathematics programs be redesigned?

Far too many students never earn credit in a college-level mathematics course. Often, this is due to students' placement in a mathematics course that is not aligned with their academic majors and career pathways. It is not surprising that mathematics has been identified as a major barrier to many students' completion of a postsecondary degree or certificate program.

In addition, college algebra is designed to prepare students for calculus and a subsequent series of mathematics courses required for students majoring in science, technology, engineering and mathematics (STEM) fields. Yet, few of the students in college algebra intend to enroll or ever do enroll in a calculus course. Also, the traditional teaching methodology that primarily emphasizes procedural manipulation does little to prepare Students with the reasoning, problem-solving and data analysis skills necessary for most careers and the general needs of citizens in today's society.

Finally, research and experience confirm that contextualizing mathematics promotes student engagement and improves completion rates. This points to the need for alternative entry-level mathematics courses that are connected to students' postsecondary and career 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 program of study. 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.

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. In particular, it urged Ohio's public colleges and universities to remove college algebra as the ***default*** mathematics course for non-mathematics-intensive majors.

Three well-defined learning pathways

Less than two years later, the Ohio Articulation and Transfer Network (OATN) announced endorsement of a new Ohio Transfer Module (OTM) course with learning outcomes in Quantitative Reasoning. The development of this new course gives students three well-defined, faculty-developed learning pathways in mathematics – a Statistics Pathway; a Quantitative Reasoning Pathway; and a

Pathway: Statistics

College-level introductory statistics courses for students without a calculus background and who do not require college algebra or calculus

Designed for: Part of the general education requirement for majors in fields that may include the following: nursing, nutrition, social work and associate in business

Pathway: Quantitative Reasoning

College-level courses designed to emphasize quantitative thinking and problem solving using quantitative methods

Designed for: Part of the general education requirement for majors in fields that may include the following: communication, criminal justice, fine arts, education (elementary), history and the social sciences

Pathway: STEM Preparation

College-level courses (i.e., college algebra, pre-calculus, trigonometry, business calculus and/or calculus) designed for students in mathematics-intensive majors

Designed for: 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

STEM 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.

With these three pathways, the applicability of transfer courses and credits should become greater and more consistent, and there should be more consensus on what is appropriate for various major and pathway areas. Yet, it is widely recognized that for some majors the pathways may overlap.

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, there is some discussion about exploring the possibility of developing an additional pathway based on a new Ohio Transfer Module course for Early and Middle Childhood Education majors.

ODHE convenes workshop on designing mathematics pathways

In early April 2016, the Ohio Department of Higher Education (ODHE) convened a two-day workshop on designing mathematics pathways for faculty and campus administrators. Its purpose was to (1) help attendees define the elements of pathways design; (2) identify key issues and milestones in the process of designing mathematics pathways; (3) define action steps related to the identified issues; and (4) draft a communication plan that faculty and campus leaders can use to familiarize others with these new learning pathways.

Facilitated by staff from the Charles A. Dana Center at the University of Texas at Austin, the workshop was grounded in the Center's New Mathways Project, which is based on four principles:

1. All students should have access to multiple learning pathways aligned to specific fields of study;
2. Accelerated learning opportunities should allow most students, including those who are not college ready, to complete a college-level mathematics course in one year or less;
3. Classroom and support strategies should be used intentionally to help students develop skills as learners; and
4. Curriculum design and pedagogy should be based on proven practice.

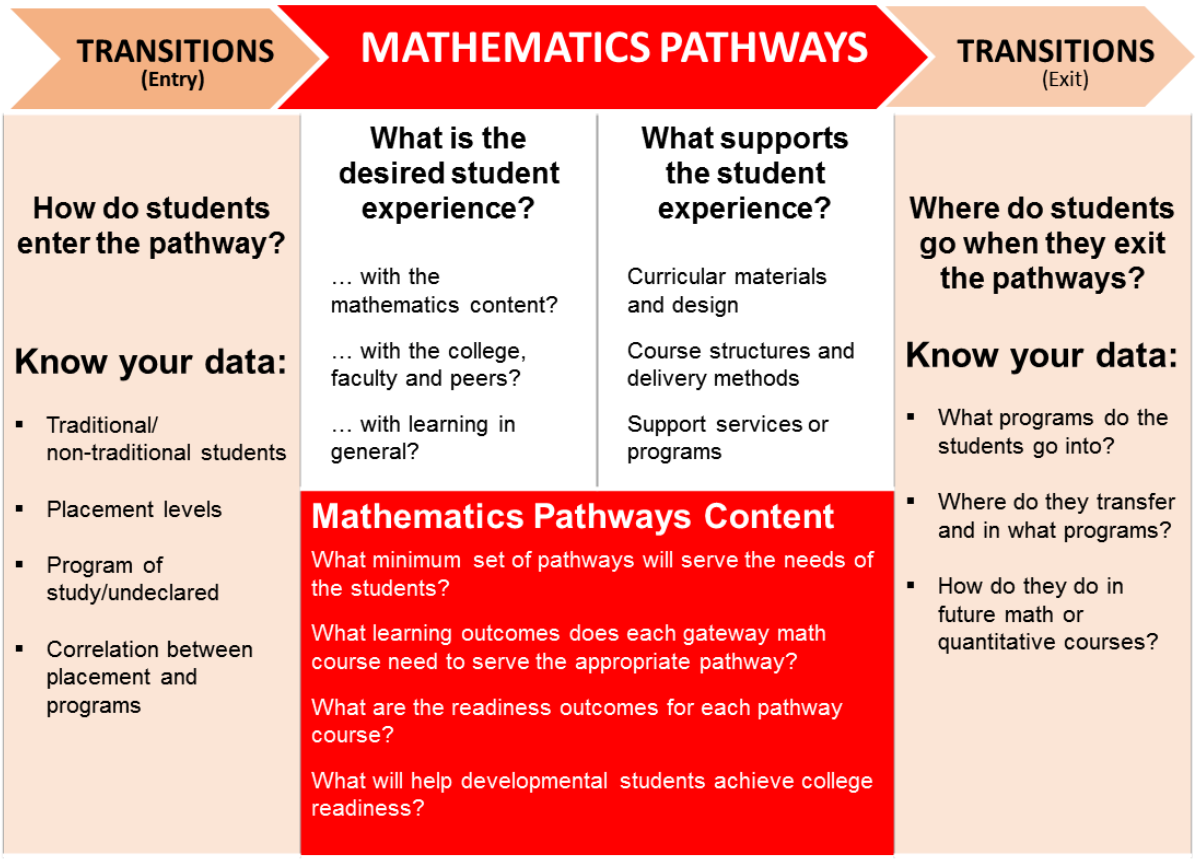
Most of the workshop's presentations and problem-solving exercises are summarized in the graphic below, which identifies an institution's students as the beginning to pathways design. Who are they – traditional or non-traditional students? What are their placement levels? What are their programs of study? Without these data, it is difficult to build learning pathways that meet the needs of students.

Identifying the desired student experience is the second step – one that workshop participants took up in small work groups. Their responses were diverse – from active learning to the presence of sufficient structure, from aspirational learning to relevance and connection to a student's education and career objectives, and from a welcome feeling of learning to clarity about expected learning outcomes and a supportive environment that makes learning possible.

Step 3 is providing supports for the desired student experience. And once again, participants were challenged to identify the supports – both in and outside the classroom – essential to success in a college-level statistics, quantitative reasoning or algebra course.

Finally, a successful pathway perspective requires not only a coherent and consistent learning experience, but also an understanding of where students go when they leave the pathway. Into what academic programs do they go? To what other institutions do they transfer credits? And how do they perform in future mathematics or quantitative courses?

The workshop was a valuable learning experience for faculty and administrators who are starting to design or implement mathematics pathways or working to build small-scale efforts. small-scale efforts.



SOURCE: Charles A. Dana Center at the University of Texas at Austin

Ohio Mathematics Initiative

OHIO PURSUES ALTERNATIVE CO-REQUISITE REMEDIATION STRATEGIES

For far too many students, traditional 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 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.[2]

If traditional remediation isn't the answer, what is?

For Ohio, there are two answers. The first is the ***Uniform Statewide Standards for Remediation-Free Status***, which guarantees students meeting the threshold remediation-free status. With the release of these standards in mathematics, which were established by the presidents of the state's institutions of higher education, many institutions are now exploring new options for credit-bearing, college-level courses. And no Ohio public institution can establish thresholds higher than the standards as the basis for campus placement and assessment policies to ensure that each student is provided the best opportunity to succeed in her or his course of study.

[2] Ohio Remediation Report (2015). https://www.ohiohighered.org/sites/ohiohighered.org/files/uploads/reports/2015-Ohio-Remediation-Report_FINAL_123015.pdf

The second is ***co-requisite remediation strategies*** for improving developmental ducation, and ultimately, college completion rates in Ohio. With the co-requisite remediation model, students who demonstrate that they are just below the college readiness thresholds are placed immediately into an entry-level, credit-bearing, college-level mathematics course ***and*** a co-requisite remedial course or other remedial support. For these students, placement with co-requisite support is the default option for remediation with the length and structure of co-requisite support varied depending on the seriousness of a student's academic weaknesses.

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 co-requisite remediation strategies in mathematics and English composition with support from CCA, the Leona M. and Harry B. Helmsley Charitable Trust and ODHE.

ODHE offers workshop on co-requisite models for developmental education

In April 2016, the Ohio Department of Higher Education hosted two, one-day "Bridges to Success" workshops to assist the state's public colleges and universities in linking redesigned gateway mathematics courses with degree programs as they plan and implement co-requisite supports to promote student success. Designed for campus teams of faculty, advisors and administrators, the workshop promoted:

- Student intake processes that facilitate early identification of the support needed for success and the establishment of academic direction;

- The development of college-level mathematics and English courses or course sequences specifically aligned with a student's program of study;
- Academic and nonacademic support provided in conjunction with gateway courses, whenever possible; and
- Institutional mechanisms to generate, share and act on data to keep students on track, from intake to completion.

Workshop participants reviewed research showing that many students placed in developmental education courses could succeed in college-level gateway courses if additional supports were provided. They also were reminded that the sooner students take courses that count toward a college degree, the greater the chance is for them to earn that degree. Yet, for many students, access to credit-bearing courses is delayed.

Finally, multiple presentations documented that co-requisite remediation makes these credit-bearing courses relevant, viable placement determinations for more students – placements that result in significantly improved student outcomes.

Colleges and universities that sent a team to one of these workshops were invited to respond to a request for proposal (RFP) for planning and piloting a process for creating degree pathways that include redesigned mathematics courses and co-requisite remediation strategies. Submission of a proposal was voluntary.

Ohio's "Bridges to Success" initiative, including the campus-level planning grants, is being supported by a grant from the Helmsley Charitable Trust. The Trust's grant is intended to build on the OMI's foundational work by engaging faculty, advisors and administrators as they implement redesigned gateway math courses through STEM, statistics and quantitative reasoning pathways that are aligned with students' degree and career objectives.

Co-requisite remediation models have shown that it is possible for developmental students (almost regardless of their performance on high-stakes placement exams) who receive just-in-time academic support to succeed at the same rates in gateway courses as students without identified developmental needs.

QUANTITATIVE REASONING BUILDS MATHEMATICS SKILLS THAT STUDENTS WILL NEED IN CLASSROOMS, CAREERS AND LIFE

The Education Testing Service Center for Research on Human Capital and Education recently reported that U.S. students – millennials born between 1980 and the early 2000s – across all socioeconomic levels scored lower than students in most countries around the world in literacy, numeracy and problem-solving skills.

The solution? A robust curriculum that develops these skills that are so critical to the ways in which we use quantitative information in our daily lives.

What is Quantitative Reasoning?

Quantitative Reasoning (QR) is the application of mathematics to the analysis and interpretation of real-world quantitative information, in the context of a single discipline or across multiple disciplines. The main objective is for students to learn how to analyze real-life situations in ways that allow mathematical tools to be used in a down-to-earth way to generate useful solutions. Simultaneously, highly refined traditional skills, such as intricate algebraic manipulations without context, take a back seat.

Traditional mathematics courses often look inward to the core of the discipline as they are designed to develop formal symbolic skills and abstract reasoning, often using a specially designed language. On the other hand, QR courses always look outward, aiming to develop practical understanding using familiar language that is plain and straightforward. QR is all about promoting practical, robust mathematical habits of the mind.

Why teach QR?

Quantitative reasoning is among several important 21st century intellectual skills all students should master, including analytic inquiry, critical and creative thinking, written and oral communication, information literacy, teamwork and problem solving. In this context, QR courses:

- Strengthen mathematical abilities that students will need in the classroom, in their careers and throughout their lives;
- Engage students in a meaningful intellectual experience that gives them an in-depth understanding of relevant mathematical concepts – and the ability to deal with quantitative information as citizens and in the workplaces;
- Improve students' quantitative and logical reasoning abilities, allowing them to use a variety of mathematical strategies – breaking difficult questions into component parts, looking at questions from a variety of perspectives and looking for patterns – in diverse settings;
- Improve students' ability to communicate quantitative ideas orally and in writing; and
- Encourage students to take other courses in the mathematical sciences.

It should be noted that numerous faculty members across multiple Ohio public colleges and universities requested that a QR course be included in the Ohio Transfer Module (OTM).

A new OTM course in Quantitative Reasoning

A new OTM course with learning outcomes in QR, TMM011, was adopted in December 2015. It is a challenging, rigorous, college-level course that builds upon the skills and knowledge required for high school graduation by the state of Ohio.

TMM011 should be considered as part of institutions' general education requirements for majors in non-mathematics intensive fields that include communication, criminal justice, fine arts and education, as well as the social and behavioral sciences.

Following the Quantitative Reasoning Pathway, the successful student should be able to demonstrate three essential outcomes (or competencies):

1. ***Numeracy.*** Students will develop and use the concepts of numeracy to investigate and explain quantitative relationships and solve complex problems in a variety of real-world contexts.
2. ***Mathematical Modeling.*** Students will make decisions by analyzing mathematical models, including situations in which the student must recognize and/or make assumptions.
3. ***Probability and Statistics.*** Students will use the language and structure of statistics and probability to investigate, represent, make decisions and draw conclusions from real-world contexts.

ODHE hosts faculty workshop

Mathematics faculty and administrators from the state's public colleges and universities gathered in mid-March 2016 for a full-day QR workshop led by Dr. Eric Gaze, director of the QR Program at Maine's Bowdoin College. The workshop had three objectives:

- Give participants a better understanding of the basics of a QR course and effective pedagogy;
- Increase awareness of the new Ohio Transfer Module QR course learning outcomes; and
- Explore non-lecture, active learning approaches to teaching QR that promote students' use of oral and written communication.

Asserting that mathematics can be relevant to everyday life – a notion that is not supported by an algebra-centered general-education curriculum – Gaze made the case for a curriculum that addresses the quantitative reasoning needs of all students, by providing meaningful engagement in mathematics that will simultaneously develop quantitative literacy and spark an interest in STEM fields. "Taught effectively," Gaze said, "QR courses can provide the foundation for a mathematics curriculum that meets the needs of all learners."

What made the workshop most valuable is that Gaze used the day much like he promotes learning in his QR courses. Lecture-style presentations were held to a minimum as attendees tackled a series of QR projects in small-group settings. These projects included the analysis and interpretation of data, such as the following:

- Data from a Brookings Institution study on why poor Americans die earlier than rich Americans;
- Changes in federal spending patterns and debt levels over a 20-year period;
- Data on global energy use and efforts to minimize our carbon footprint;
- Data showing that consumption of sugar-sweetened beverage calories declined over a period of eight years;
- Changes in global gross national product (GNP) and the relative value of currency;
- Data on the long-term damage (for young children) from lead; and
- Data presented by Bloomberg View on the causes of mortality in the U.S.

By exploring these data sets, attendees discovered how students, through a well-taught QR course, can learn how to use and interpret ratios, use proportional reasoning, use estimation, use and interpret percentages, develop fundamental financial literacy, understand and interpret absolute and relative change, contrast linear and exponential growth, and much more.

LEARNING OUTCOMES REVISED FOR OHIO TRANSFER MODULE (OTM) MATHEMATICS COURSES

Easy credit transfer and accelerated student mobility are cornerstones of Ohio's system of higher education. They provide newly minted high school graduates and returning adults with a clear pathway for gaining the skills and knowledge necessary for productive and satisfying careers in the 21st century economy.

This is the rationale for the Ohio Articulation and Transfer Network (OATN), which was initiated by the Ohio General Assembly in the late 1980s and was built by the Ohio Department of Higher Education in collaboration with the state's public colleges and universities, for all students to be able to know in advance the credits that are ***guaranteed*** to transfer and apply to their degree programs.

At the heart of this system is the Ohio Transfer Module (OTM), a set of general education courses for which students are guaranteed transcripted OTM credit between Ohio public colleges and universities.

Each public college or university submits its proposed OTM courses to the OATN for review by its faculty panels. These reviews focus on course content as well as student learning outcomes. Faculty review based on both course content and student learning outcomes promotes incorporation of innovative and non-traditional teaching, learning and assessment approaches to traditional courses.

During FY 2016, the OMI convened faculty panels to review and revise the existing OTM courses with an emphasis on ***student learning outcomes*** – and on how they are assessed using formative and summative assessments. Panels have completed work on college algebra and introductory statistics. Revisions are still being made to trigonometry and pre-calculus.

Guiding principles

In reviewing and revising OTM course criteria and processes, faculty panels' work was shaped by several guidelines:

- Focus on student learning outcomes;
- Define what distinguishes courses as "college-level";
- Focus more on the decision-making process of students (the "why") as opposed to rote processes (the "how");
- Seek to start a discussion at the departmental and instructor level about whether assessments are measuring learning outcomes;
- Increase departmental flexibility in determining pre-requisite courses and credit hour requirements; and
- Avoid triggering resubmission of already-approved courses, while relying on course redesign efforts at the campus level.

Rethinking College Algebra (TMM001, revised December 8, 2015)

College algebra provides students a postsecondary-level academic experience that emphasizes the use of algebra and functions in problem solving and modeling. In this context, solutions to problems in real-world situations are formulated, validated and analyzed using appropriate mental, paper-and-pencil, algebraic and technology-based techniques utilizing a variety of mathematical notations.

With respect to learning outcomes, the faculty panel recommended that students be expected to:

- Use function notation to communicate about functional relationships;
- Understand how functional correspondences are encoded in graphs, formulas and equations;
- Know how to decipher and decode functional correspondences from graphs, formulas and equations – and to tie these representations together using each to support the others; and
- Be able to use these tools independently in support of an analysis of the functional relationship.

This revised perspective on OTM College Algebra student learning outcomes is an attempt to help students think and use, rather than rehearse and perform. It also reflects a renewed commitment to giving students direct and deliberate instruction on how to use mathematics to think about real-world problem solving in science, technology, engineering and mathematics (STEM).

Rethinking Introductory Statistics (TMM 010, revised December 8, 2015)

The faculty panel's review of this OTM course – which stresses conceptual understanding and critical thinking and introduces statistical methods to students in all disciplines – was guided by the American Statistical Association's recommendations for the teaching of introductory statistics. These recommendations include: (1) emphasize statistical literacy and develop statistical thinking; (2) use real data; (3) stress conceptual understanding, rather than mere knowledge of procedures; (4) foster active classroom learning; (5) use technology to develop conceptual understanding and analyze data; and (6) use assessments to improve and evaluate student learning.

The faculty panel concluded that successful students should be able to:

- Summarize univariate and bivariate data by employing appropriate graphical, tabular and numerical methods, and describe the attributes of or relationships between the data;
- Identify the characteristics of a well-designed statistical study and be able to critically evaluate various aspects of a study; recognize the limitations of observational studies and common sources of bias in surveys and experiments; and recognize that association is not causation;
- Compute the probability of compound, independent and disjoint events, as well as conditional probability;
- Compute probabilities using discrete and continuous distributions, especially applications of the normal distribution;
- Explain the difference between statistics and parameters, describe sampling distributions and generate distributions to observe the Central Limit Theorem;
- Estimate population parameters using point and interval estimates and interpret the interval in the context of the problem; and summarize the relationship between the confidence level, margin of error and sample size;
- Given a research question, formulate null and alternative hypotheses; describe the logic and framework of the inference of hypothesis testing; make decisions using p-value and draw appropriate conclusions; interpret statistical significance and recognize that it does not necessarily imply practical significance; and perform hypothesis testing with at least one test related to a quantitative variable and at least one test related to a qualitative variable; and
- Interpret statistical results in context when statistical information is presented in news stories and journal articles.

MATHEMATICS CHAIRS AND LEADS DRIVE OHIO MATHEMATICS INITIATIVE

In 2014, the Ohio Mathematics Steering Committee called for bold action to build an Ohio mathematics community capable of leading change by ensuring that as many stakeholders as possible understand and accept the state's change strategy, effecting change into the culture of all public colleges and universities and their partners.

Today, the OMI is a statewide effort being driven by an engaged mathematics community that includes members of the steering committee, departmental chairs/ leads and mathematics faculty. It also includes institutional administrators, faculty whose students need mathematics for success, secondary faculty preparing students for postsecondary education, and business leaders who need future employees with skills in mathematics and analytical reasoning.

Mathematics Chairs/Leads Network

The Mathematics Steering Committee recommended that a statewide network of mathematics chairs and leads be formed in order to create an infrastructure that allows for timely, meaningful, cross-institutional communication. As a result, the Mathematics Chairs/Leads Network was formed, composed of chairs and leads from 36 of Ohio's public institutions. The Network is charged with exchanging evidence-based information and reviewing evaluation data linked to specific initiatives or policies.

Much of the OMI's substantive work is being conducted by five subgroups composed of faculty members from the state's public colleges and universities. These subgroups are as follows:

New and Alternative Pathways
Subgroup 1 is focused on improving student success in entry-level courses by aligning mathematics to academic programs of study; improving instructional delivery mechanisms; and developing, implementing and evaluating co-requisite strategies to support under-prepared students.

Redesign of the Ohio Transfer Module (OTM) Criteria
Subgroup 2 is redesigning OTM course criteria and processes to focus on student learning outcomes, increasing departmental flexibility in determining pre-requisite courses and credit hour requirements for OTM courses and defining what makes a course "college-level."

Communication, Outreach and Engagement
Subgroup 3 is working to improve communication among mathematics faculty and stakeholders across institutions, promote mathematics faculty participation in professional group meetings and engage the mathematics community with the work of the OMI efforts.

Data Collection, Analysis and Sharing
Subgroup 4 is working to develop quality measures for improving student success in mathematics, then collect, analyze and share relevant data.

Alignment Between Secondary and Postsecondary Content and Instruction
Subgroup 5 has been charged to conduct a national scan of promising alignment practices; conduct regional meetings and workshops to generate conversation among secondary/postsecondary faculty and state education policy leaders; and share promising alignment practices.

GOOD DATA ARE KEY TO UNDERSTANDING STUDENT SUCCESS

When the Ohio Mathematics Steering Committee completed its work in early 2014, data gathering and assimilation varied widely among public universities and colleges; and the kinds of data collected differed greatly from institution to institution. Moreover, institutions' data sets were rarely being shared. Consequently, it is not possible for members of Ohio's postsecondary mathematics community to think in terms of data-informed decision making without extensive planning and agreement about what will be collected, how data will be analyzed and how results will be shared and used.

Convinced that the analysis and sharing of program data can lead to improved course offerings, instruction and student success, the steering committee called for the development of quality measures for improving student success in mathematics; then for the collection, analysis and sharing of relevant data.

In addition, the steering committee said the Ohio Department of Higher Education should work collaboratively with the state's public colleges and universities – and particularly the chairpersons of their mathematics departments – to develop a common protocol for collecting, analyzing and reporting data relating to student success and program effectiveness.

With this charge, the data subgroup adopted a two-pronged strategy: (1) search for data collected at ***the state level*** that might be used to inform OMI initiatives; and (2) see what research and reports generated by ***mathematics departments and/or institutions*** could be used to improve student success in mathematics.

With respect to state-level data, subgroup members identified the need to refine the appropriate state-level data elements that would inform mathematics initiatives. To facilitate data searches and the preliminary analysis of selected data, they drafted Memoranda of Understanding (MOUs) to allow faculty and students at Cleveland State University and the University of Toledo to explore these data.

Subgroup members also have begun to compile departmental and institutional data – from Kent State University, Cleveland State University and elsewhere.

With these searches under way, a timeline has been established for the development of data templates and the identification of ongoing research needs by the end of 2016.

COMMON ASSESSMENTS RECOMMENDED FOR REMEDIATION-FREE STANDARDS

The numbers are staggering. Nearly one-third of freshmen in Ohio's public colleges and universities are not ready for college coursework. Typically, they begin by taking remedial classes in mathematics or English to prepare for college-level coursework. And one in 10 incoming freshmen is required to take both remedial mathematics ***and*** English classes.[3]

Exacerbating the problem, our long standing approaches to providing remedial support for these students have fallen short. As Complete College America (CCA) reports, for too many students, traditional developmental courses serve as a "bridge to nowhere." Nationally, 1.7 million beginning students each year take remedial courses, but most of them will never graduate. In Ohio, only 35 percent of students who take a remedial course graduate in six years, compared to 56 percent of all students.[4]

To assure consistency in college readiness determinations and course placement practices statewide, Ohio lawmakers directed the leaders of the state's public colleges and universities to establish the *Uniform Statewide Standards for Remediation-Free Status* along with related assessment threshold scores. In 2012, the institutional leaders agreed to a common set of standards and related assessment scores in mathematics, science, reading and writing, regardless of an institution's admissions selectivity.

College readiness assessments expanded

To assure currency of the assessments used to determine college readiness in Ohio, late in 2015 the Inter-University Council (IUC) provosts and Ohio Association of Community Colleges (OACC) chief academic officers directed a faculty panel to (1) identify existing large-scale standardized assessments used by Ohio's public institutions to determine college readiness as defined by the state's *Uniform Statewide Standards for Remediation-Free Status*; (2) evaluate the predictive validity of the identified assessments as determined by student success in courses subsequent to gateway courses; (3) evaluate the revised recommended college readiness score for the ACT reading assessment and determine if the cut score for students earning Remediation-Free Status should be adjusted; and (4) recommend the array of large-scale standardized assessments to be used to determine college readiness.

The 2015-2016 review was prompted by multiple factors including the following: Ohio institutions' growing utilization of an array of assessments for placement purposes; the change in the national benchmark for college

[3] Ohio Department of Education and Ohio Department of Higher Education (December 2015). *Ohio Remediation Report.* See https://www.ohiohighered.org/sites/ohiohighered.org/files/uploads/reports/2015-OhioRemediation-Report_FINAL_123015.pdf

[4] Cited in Churchill, A. (2013). "Ohio's college remediation rate crisis – and what can be done." Thomas B. Fordham Institute

readiness on the ACT reading exam; and the decision by ACT to eliminate its COMPASS assessment by the end of 2016.

In fulfilling its charge, the 2015-2016 faculty panel:

- Gathered information from Ohio public colleges and universities regarding institutional placement practices and large-scale standardized assessment utilization;
- Evaluated the success of students placed using large-scale standardized assessments not currently identified in the *Ohio Statewide Uniform Standards for Remediation-Free Status;*
- Evaluated the success of Ohio students who presented with ACT scores of 19, 20, 21, 22 and 23, respectively; and
- Developed recommendations for assessments to be added to the *Uniform Statewide Standards for Remediation-Free Status* document as reported here.

Based on the faculty panel's work, the IUC provosts and OACC chief academic officers presented their recommendations for assessments to be added to the *Uniform Statewide Standards for Remediation-Free Status* in June 2016.

Their recommendations included the following:

- Remove the COMPASS Assessment for both English and mathematics;
- Increase the ACT reading sub-score to ≥22 (previously ≥21);
- Remove the Accuplacer Elementary Algebra Assessment while retaining the Accuplacer College-Level Mathematics Assessment;
- Add the MapleSoft T.A. for mathematics only, with a required score ≥50% correct responses;
- Add the ALEKS for mathematics only, with a required score ≥46; and
- Add the PlaceU (WebAssign) for mathematics, with a required score ≥18.

The university and college leaders also recommended that the remediation-free standards undergo another review in 2017 to consider additional recommendations, including but not limited to the potential for developing an Ohio Mathematics Assessment to determine readiness for all credit-bearing gateway mathematics courses, given the constraint of existing large-scale standardized assessments in evaluating readiness for courses other than college algebra.

In May 2016, the IUC and OACC presidents adopted the 2015-2016 recommended changes for implementation in the 2016-2017 academic year. There is no statutory deadline for approval of the recommendations by institutions' boards of trustees. However, each institution is responsible for assessing the needs of its enrolled students in the manner adopted by the presidents. Also, the board of trustees or managing authority of each state institution of higher education is required to adopt the remediation-free standards – and any related assessments – into the institution's policies.

The remediation-free standards and thresholds are ***not*** intended to replace college and university admissions policies; any admitted student who has earned remediation-free status in a subject will be eligible to enroll in a college credit-bearing course in that subject. However, institutions may still require placement examinations to determine the entering course that provides a student the best opportunity to succeed in her/his program of study.

OHIO SEEKS BEST AND PROMISING PRACTICES TO ALIGN P-16 CONTENT AND INSTRUCTION

The charge given to OMI's P-16 alignment subgroup is formidable: (1) to conduct a national scan of best and promising practices designed to align secondary and postsecondary content and instruction; (2) to plan and host an Ohio Student Success Summit; (3) to study the effects of Ohio's Remediation-Free Standards; and (4) to conduct regional meetings for secondary and postsecondary faculty and state education policy leaders to explore best and promising practices designed to align P-16 mathematics content and instruction.

Much of the subgroup's work during FY 2016 was dependent on the efforts of the other subgroups (i.e., changes in OTM course requirements, clarification of gateway course learning outcomes, well-defined mathematics pathways, co-requisite remediation strategies and the like). Yet, subgroup members were not waiting idly for these "products." During the first part of the year, they planned and executed an Ohio Student Success Summit. And throughout the year, they reached out to include P-12 mathematics faculty and administrators in their work.

2015 Ohio Student Success Summit

In late April, near the end of FY 2015, postsecondary mathematics faculty, academic advisors and institutional leaders – joined by mathematics teachers and counselors from high schools and career centers in their service areas – converged on the Greater Columbus Convention Center for the 2015 Ohio Student Success Summit. Nearly 225 mathematics educators gathered with a shared understanding that much of 21st century science and engineering – as well as medicine, manufacturing, transportation, communication and a range of economic enterprises – depend on the quantitative sciences. They also came to:

- Find out how the adoption of Ohio's New Learning Standards would impact high school graduates' readiness for and success in college-level courses;
- Discover how new teaching and learning strategies could be used to support learners for whom mathematics otherwise could be an insurmountable obstacle to degree completion; and
- Learn more about how the state's public colleges and universities are developing or revising college-level mathematics courses to align with the skills and knowledge students need to be successful in their programs of study.

Key agenda items

Summit participants heard:

- A robust discussion of the state's New Learning Standards for Mathematics, which shift education's focus from high school graduation to readiness for college and careers;
- A national overview of the Common Core State Standards for Mathematics;
- An update on the state's articulation and transfer guidelines, which are designed to ease the way in which students can move between Ohio's public colleges and universities by transferring credits and applying them toward the requirements of a postsecondary degree or certificate; and

- A discussion of the National Science Foundation's mathematics education research agenda, with emphasis in the areas of modeling and computation, data science, scaling, high school to college and career transitions, and equity and access.

At the end of the Summit, Dr. Susan Wood and Dr. Uri Treisman of the Charles A. Dana Center at the University of Texas at Austin told participants this is no time to be satisfied with past successes or to consider further effort unnecessary. They offered "a call of actions," which included:

- ***Center on students.*** Make things easier for students to understand. Reform should create useful maps for students.
- ***Engage faculty.*** Reform must be faculty-driven, and that means both postsecondary and secondary faculty. It also means the engagement of faculty from other disciplines who depend on mathematics for the education of their majors.
- ***Broaden conversations across institutions.*** Keep an eye on transfer students who account for a majority of Americans who obtain a baccalaureate degree in the new world of student mobility. Since many two-year college students major in "I don't know," steps must be taken to ensure that transfer is effective, not just the acceptance of credits.
- ***Link with P-12.*** It is important to engage P-12 teachers and counselors early in the process.
- ***Make effective use of data.*** Analytics really matter, particularly when the work is being done across boundaries. Better evaluation instruments are needed to tell whether or not what's being done is working.
- ***Expect higher education to take the lead.*** By signaling the pace and direction of change, postsecondary faculty and institutions are powerful forces in P-12 mathematics education reform.

Additional workshops to promote the alignment of P-16 content and instruction are presently being planned for spring 2017.

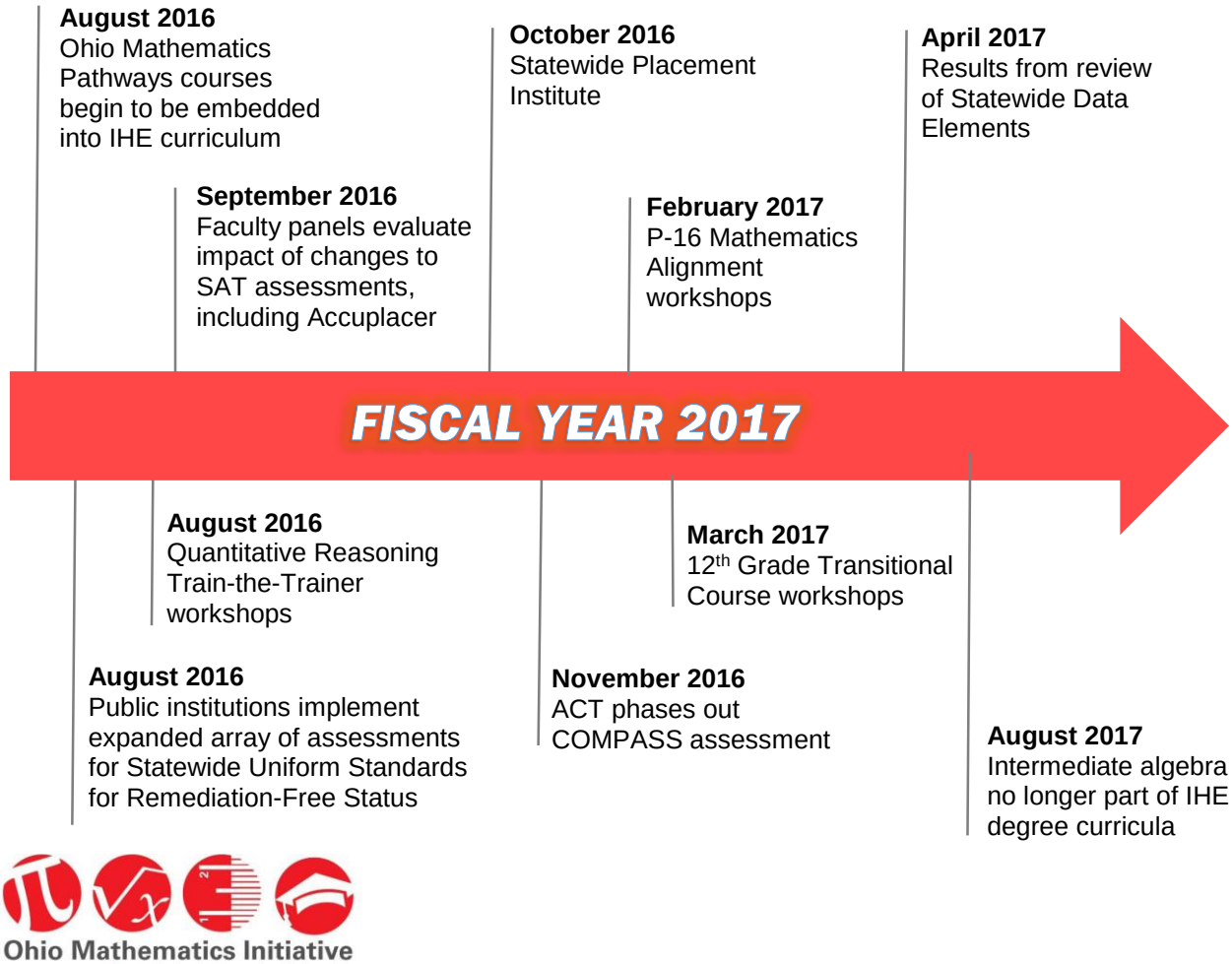
REDESIGNED GATEWAY COURSES, STRUCTURED DEGREE PATHWAYS AND CO-REQUISITE LEARNING HIGHLIGHT 2016-2017 AGENDA

The importance of the Ohio Mathematics Initiative – a work in progress – cannot be overstated. It has generated new placement strategies for students who achieve remediation-free status, high-quality gateway courses and mathematics pathways connected to coherent programs of study, assessments that include multiple measures for more accurate placement and enhanced co-curricular support for students who place below the identified benchmark.

Each of these achievements is an important component of Ohio's postsecondary success agenda. And yet, the work is far from done.

During FY 2017, the OMI's highest priority will be to support campus's efforts to think systemically and to link redesigned gateway mathematics courses and structured degree pathways with transformed remediation efforts that give students co-requisite learning opportunities – all part of a comprehensive student success strategy. This priority will be reflected in the continued implementation of Ohio's "Bridges to Success" initiative, additional Quantitative Reasoning training for faculty, training for advisors upon whom students depend for accurate and appropriate counsel, and other workshops to build faculty and administrators' capacity in order to significantly improve student outcomes.

Building on the progress documented in this work, OMI's timeline for the next academic year will include the following:



Ohio Mathematics Initiative

For more information about the Ohio Mathematics Initiative,
visit our website at ohiohighered.org/mathematics-initiative

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