



Rethinking Postsecondary Mathematics

Final Report of the Ohio Mathematics Steering Committee

Executive Summary / March 2014

The Ohio Higher Education Mathematics Steering Committee was comprised of 12 mathematics faculty members from Ohio public institutions of higher education, five ex-officio members and Ohio Board of Regents staff. It was chaired by Dr. Joan Leitzel, Professor Emeritus of Mathematics at The Ohio State University and former President of the University of New Hampshire.

The Ohio Board of Regents' charge to the Steering Committee flowed from discussions with institutional and state education policy leaders that began early in 2013 about postsecondary mathematics education in Ohio. The charge was: 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.

There are many reasons why we teach mathematics to postsecondary students and today's economic imperative is only one of the factors driving efforts to update higher education's curriculum and delivery methods. For some, it's a discipline of choice, an exciting opportunity to be part of an academic pursuit that has been called the "linchpin of twenty-first century research and technology."¹ For many others, we teach mathematics to give them the tools they need to succeed in mathematics-dependent disciplines, such as the physical and biological sciences and engineering. This constituency is growing rapidly as the mathematical sciences have become central to many of the social sciences, medicine, the environmental sciences, business and finance, advanced design and other disciplines.

At the broadest level, mathematics is advanced for its own sake – for its ways of thinking and the habits of mind and diligence required for success in this and many other fields of study. Mathematics gives students needed quantitative tools, logical reasoning, analytic and problem solving skills and a sense of the quantitative modeling that can be used to describe developments in many areas of our lives.

Yet, as the mathematical sciences' reach has become broader and their impact potentially greater, there is a growing realization Ohio's public universities and colleges need to revisit and rethink their mathematics curricula as well as mathematics' relationships with other disciplines. It is not surprising that this kind of periodic updating is needed.

¹ National Research Council. *The Mathematical Sciences in 2025*. Washington, D.C.: The National Academies Press, 2013, p. 2



But why now? Why is this the right time – a time of exceptional opportunity – to resolve these and other issues?

- Perhaps the most compelling answer is reflected in the words of the University of Maryland’s William “Brit” Kirwan, who recently called mathematics the “#1 barrier to college completion.”² For this reason, Kirwan has called for a comprehensive rethinking of how mathematics courses are structured, how they are taught and how they are connected to students’ education and career objectives.
- In recent months, mathematics faculty who are familiar with the Ohio Transfer Module (OTM) have reported increasing difficulties with current processes and criteria for course and credit transfer.
- With the state’s adoption of New Learning Standards (NLS) for K-12 students, a new generation of mathematics students soon will be entering our public colleges and universities. We must be ready to meet their needs and challenge them to succeed in their mathematics courses.
- This is the time to identify and introduce innovative teaching and learning strategies, using new instructional delivery options, new technologies and new tools to support student learning.
- Today’s online education opportunities are growing rapidly because of advances in cognitive science (i.e., we know a lot more about what imprints information on the brain), the availability of powerful software and the highly interactive, ubiquitous Internet.
- New teaching and learning strategies are urgently needed for adult learners for whom mathematics can present an insurmountable obstacle to earning a highly valued postsecondary degree or certificate.

These issues are not unique to Ohio and there is much we can learn from work in other states, just as we can find solutions in the creative practices of mathematics departments in some of our own University System of Ohio (USO) institutions. Instead of working in isolation, we can learn and benefit from those who got an early start. We can borrow and improve on their best and promising practices.

In this context, the Steering Committee’s core action strategies are structured around five “Essential Components” of the work required to meet the charge given to it by the Ohio Board of Regents (OBR).

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Strategy #1: Develop high-quality entry-level courses and pathways connected to coherent programs of study for students majoring in (1) mathematics, (2) other mathematics-intensive majors, and (3) majors that are not mathematics intensive.

College algebra – the current gateway course in most mathematics departments -- is designed to prepare students for calculus and a subsequent series of mathematics courses. Yet, very few college algebra students intend to enroll or ever do enroll in a calculus course.

Research suggests that contextualizing mathematics promotes increased student engagement and improves completion rates. This is particularly important for students who expect to major in a mathematics-intensive discipline, but also has relevance for students who expect to major in the social sciences, business or other fields. It 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.

In addition, institutional data tell us that students with low ACT scores have a low probability of success in entry-level courses, and that postsecondary remedial courses are a dead end for far too many students. But if traditional remediation isn’t the answer, what is? An alternative approach is a **co-requisite strategy** through which students who demonstrate a few academic deficiencies are placed immediately into entry-level, credit-bearing college courses **and** co-requisite support courses (or academic support services).

² Remarks at Transforming Postsecondary Education in Mathematics Panel, Joint Mathematics Meeting, Baltimore, Maryland, January 17, 2014

- **Recommendation 1.1: Improve student success in entry-level courses by aligning mathematics to academic programs of study and by improving instructional delivery mechanisms**
- **Recommendation 1.2: Develop, implement and evaluate co-requisite strategies to support underprepared students**

Strategy #2: Develop transfer policies and processes that foster effective transfer of course credits while encouraging course innovation on all public campuses.

Easy credit transfer and accelerated student mobility are the cornerstones of the USO. Yet, the current practice of requiring OTM course criteria and processes to include a set of specific topics and techniques is restrictive and stifles innovation. It forces faculty panels to reject courses from OTM consideration because course descriptions do not contain the entire prescribed list of topics, even when the course may accomplish the goal of preparing the student to continue learning.

Generally speaking, entry-level course prerequisites should be those that are needed to provide a foundation for student success in that course. The course description and learning outcomes of a mathematics course should, therefore, identify the prerequisite level of mathematical literacy, skills and knowledge necessary for successful completion of the course.

- **Recommendation 2.1: Redesign OTM course criteria and processes to focus on student learning outcomes**
- **Recommendation 2.2: Increase departmental flexibility in determining prerequisite courses and credit hour requirements for OTM courses**
- **Recommendation 2.3: Define what distinguishes a course as “college-level”**

Strategy #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.

Change demands leadership – and when that change involves complex issues and requires concerted activities by individuals, organizations and systems that lack a strong history of collective action, that demand is especially strong. For this reason, the Steering Committee called for the building of an Ohio mathematics community capable of leading change.

In many respects, department chairpersons are well-positioned to provide this leadership. Yet, for those who chair USO institutions’ mathematics departments, there is no infrastructure for timely, meaningful cross-institution communication about matters of common concern, which might include but not be limited to dual enrollment programs, New Learning Standards (NLS), K-12 assessments that build pathways to college and career readiness and remediation-free standards.

In addition, faculty and staff who have regular, direct interaction with students need information about both institutional and state-level policies and practices affecting mathematics instruction, alternative mathematics pathways and innovative mathematics programs. Too often, this and other relevant information is not readily available and students’ opportunities for success can be compromised.

- **Recommendation 3.1: Establish a statewide network of mathematics chairpersons**
- **Recommendation 3.2: Improve communication among mathematics faculty and stakeholders across institutions**
- **Recommendation 3.3: Encourage and promote mathematics faculty participation in meetings of professional groups**

Strategy #4: Develop high-quality measures for improving mathematics course offerings and instruction; and collect, analyze and share relevant data.

Not all mathematics departments collect objective, comparable data to determine whether offered courses are effective and appropriate for students – both mathematics majors and non-majors – and for other departments/disciplines whose students are expected to acquire advanced quantitative skills. Also, the OBR lacks a centralized data collection system to evaluate either student performance or course effectiveness.

- **Recommendation 4.1: Develop quality measures for improving student success in mathematics; then collect, analyze and share relevant data**

Strategy #5: Improve student success in college-level mathematics courses by aligning postsecondary expectations and high school practice.

With the implementation of Ohio's NLS, the gap between high schools' mathematics performance standards and the expectations of USO institution's gateway mathematics courses will be narrowed – some say substantially. Ideally, new secondary standards will give mathematics education greater focus and, potentially, make more coherent the relationships between the K-12 and higher education sectors.

Yet, changing secondary standards – and even implementing Ohio's College Credit Plus program – will not, by themselves, produce alignment. That kind of coherence will only be achieved when faculty and administrators (particularly those with curriculum responsibilities) on both sides of the education “divide” understand higher education's expectations for entry-level mathematics courses **and** secondary education's mathematics content and practice standards. This understanding and appreciation are incomplete today.

In the Steering Committee's view, what is needed is a series of actions that clarify for secondary faculty higher education's expectations for what students should know and be able to do in entry-level mathematics courses, while fully engaging university and college faculty in the implementation of Ohio's NLS.

- **Recommendation 5.1: Strengthen collaboration and communication between K-12 and higher education on mathematics curriculum and instruction**
- **Recommendation 5.2: Share best practices and begin a consultation through which all USO institutions as well as faculty and advisors/counselors from Ohio high schools explore (a) new approaches to the placement of entering postsecondary students in mathematics courses, and (b) implementation of Ohio's remediation-free standards**

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Most of the responsibility for implementing these recommendations will fall on mathematics department chairpersons and their colleagues in USO institutions across the state. But they will not be working alone. They will have the support of an emerging statewide “mathematics community,” developed largely through the chairpersons network. In addition, they will be working in partnership with administrators on their own campuses and the Ohio Board of Regents, which will assist by facilitating the development of the mathematics chairpersons network.

The OBR also will: (a) help USO campuses as they rethink and reshape their entry-level mathematics courses; (b) assist in the redesign of OTM course criteria and processes to focus on student learning outcomes; (c) provide support in collecting, assimilating and analyzing course- and student-level data that can be used to assess, and ultimately improve, campuses mathematics course offerings; (d) lead efforts to identify and secure grants and the foundation funding needed to fully implement these changes at the campus and statewide levels; and (e) work collaboratively with the ODE to promote improved alignment between secondary and postsecondary mathematics content and instruction, and support implementation of both College Credit Plus and the state's new remediation-free standards.

To read the full report, see <https://ohiohighered.org/sites/ohiohighered.org/files/uploads/math/Math-FINAL.pdf>

