OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

*Improving our future by degrees*

***Math Pathways Task Force Recommendations***

***February 2017***

## Background

In October 2011, Oklahoma joined Complete College America (CCA) to increase the number of degrees and certificates earned in Oklahoma. The State Regents identified low success rates in remedial and gateway math courses as a significant barrier to student success and committed to improve the effectiveness and efficiency of remediation and freshman gateway courses.

In 2012, the State Regents held a Remedial Reform Summit and a Mathematics Faculty Conference to define and pursue these issues. Feedback from these meetings led to the formation of the Mathematics Success Group, which consists of 35 mathematics faculty, department chairs and teacher educators. They developed a strategic plan and identified the following top priorities (Math Success Initiative Status Report): (1) improve the preparation of high school students and the transition to college, (2) reform remediation, (3) improve course placement and (4) create multiple math pathways based on disciplines.

In November 2015, the Mathematics Pathways to Completion (MPC) program of the University of Texas Charles A. Dana Center selected Oklahoma to join five other states and receive support and consultation in pursuing math pathways for the State System. With a designated Dana Center liaison and structured assistance, the Oklahoma Math Pathways Task Force was established to review state data, trends, and opportunities relative to math pathways; to draft a charge for the Task Force; to develop a work timeline; to identify problems and challenges; and to develop a communication plan.

## Task Force Process

The State Regents established the Math Pathways Task Force, comprised of faculty from each of the 27 public universities and community colleges, and asked this group to (1) develop recommendations for creation, implementation and evaluation of statewide math pathways to achieve task force goals and (2) coordinate and communicate with common education, related state efforts, and other stakeholders to improve mathematics success for all students.

The Task Force convened in March, April, and September 2016. Task Force members followed a structured process to establish a consensus charge for their work, to review national and state data of gateway course enrollment and success, to define current problems that math pathways will address, to identify what is known and what additional information is needed to understand these problems and their underlying drivers, and to identify challenges to implementing math pathways. The Task Force outlined five goals and the challenges to implementation, then identified and prioritized promising solutions. In subsequent weeks, task force members solicited input from their institutions and submitted refined

documentation of proposed solutions. The Task Force organized solutions by common themes to form five key recommendations.

The September meeting was used to vet the recommendations with key stakeholders. The stakeholders encouraged to attend this meeting or send in feedback were Academic Vice Presidents, Math Department Chairs, Freshman Advisors, and Department Chairs with degree programs that require College Algebra and not Calculus. Feedback from this meeting was incorporated into the recommendations.

## From Goals to Challenges to Recommendations

Based on the process described, the Math Pathways Task Force discussed the State Regents' goals listed below, then identified the challenges for addressing these goals. Accepting that each of these challenges may need to be overcome in order to achieve the goals, the Task Force proposed and refined recommendations for action.

### Goals

The State Regents charged the Task Force to address the following five goals:

1. Improve student course completion, college retention, and degree completion by offering multiple gateway mathematics options;
2. Increase relevance of gateway mathematics courses to degree programs;
3. Ensure transferability and applicability of mathematics courses with common language;
4. Increase appreciation of mathematics for all students; and
5. Increase collaboration with partner disciplines and employers.

### Challenges

Based on their expertise and experience, the Task Force members identified the primary problems and challenges that need to be addressed to achieve these goals:

1. Lack of perceived relevance and appreciation of mathematics;
2. Lack of student preparation;
3. Lack of student progress in college mathematics;
4. Need for culture shifts; and
5. Need for faculty motivation and time to change gateway courses.

### Recommendations

The Task Force identified five promising solutions or recommendation to address these goals and challenges:

1. Establish statewide college meta-majors and corresponding math pathways, ensuring transferability across institutions;
2. Increase student engagement and the teaching of applications in gateway math classes;
3. Increase support for important academic success skills in gateway math classes;
4. Provide faculty and advisor professional development and resources; and
5. Improve student preparation, including efforts in K-12 education and remediation reform.

## Expected Challenges to Implementing Math Pathways in Oklahoma

Descriptions of the challenges provide context for the recommendations that are proposed by the Task Force.

**Challenge: Lack of perceived relevance and appreciation of mathematics**

Students often perceive gateway mathematics courses as lacking relevance to their own interests and goals and therefore develop little appreciation for the broader skills that they can acquire by studying math. Most students enroll in College Algebra, a course designed to prepare students for the algebraic modeling and manipulation required in calculus. In fact, the majority of students who pass College Algebra never take Calculus and thus do not realize significant benefits from many of these algebraic skills (Gordon, 2008 & Dunbar, 2005). Of the students enrolled in a college-level math course in Oklahoma, 62 percent at community colleges and 38 percent at universities enroll in College Algebra. Over half of these students are not in a degree program that requires Calculus.

Due to a need to cover a broad range of topics, the techniques in College Algebra are rarely taught in the context of real world situations. While serving students from a diverse range of academic programs, it is impossible to consistently make the College Algebra content relevant for each major. Also, faculties in other disciplines do not provide a consistent perspective on how math is relevant in their fields. Consequently, students frequently fail to connect mathematical concepts with issues in a particular field of study. While studying mathematics may develop other benefits such as abstraction, modeling, problem solving, quantitative reasoning, and statistical reasoning, the curriculum of College Algebra is often too focused on procedural manipulation to provide students with these broader experiences (Burdman, 2015).

**Challenge: Lack of student preparation**

Of the students coming directly from Oklahoma high schools to a State System institution, about 35 percent enroll in a remedial math course during the first year. At community colleges, the percentage is even greater, around 50 percent. In Oklahoma, students are required to take only three years of math to graduate from high school. Consequently, many students do not take math in the senior year of high school, allowing their math competency to atrophy before studying math in college.

Unfortunately, remediation is not as effective as it could be. Remedial mathematics courses are generally offered only in the form of developmental coursework instead of more customized or interactive modalities. Too often, the subject matter in developmental math is not tailored to student needs, not aligned within the developmental course sequence, and does not sufficiently support success in college credit bearing courses. At each level of remediation, only about 75 percent of students pass the course and 50 percent go on to the next level.

**Challenge: Lack of student progress in college mathematics**

Only 20 percent of first-time, full-time students at Oklahoma community colleges earn a degree within three years, 29 percent at the regional universities in six years, and 58 percent at the research universities in six years. Entry-level mathematics requirements present a major hurdle to improving these graduation rates. Many students delay enrollment in required math courses or become discouraged when required to take a series of developmental math courses. Even when students successfully complete their developmental math, they often fail to enroll in the college-level gateway course.

Only 22 percent of Oklahoma community college students needing remediation complete the gateway math course within the first two years and only 38 percent complete the gateway math course at the regional universities. Most underprepared students are required to take multiple developmental math courses, lengthening the time to degree and increasing the likelihood that life events, such as illness, personal emergencies, and financial reversals, will interrupt their studies.

**Challenge: Need for culture shifts**

The general public perception is that not everyone is or can be good at math; therefore, it is acceptable to be bad at math. Many students, parents, and some elementary school teachers have math anxiety and lack motivation to learn math. Teacher preparation programs in elementary education may require a less rigorous math curriculum than other non-STEM majors, limiting teacher resources and diminishing their self-confidence for teaching math.

**Challenge: Faculty motivation and time to change courses**

Math faculty members may resist teaching outside their "comfort zone" when their expertise and experience are not in math specialties such as quantitative reasoning or statistics. Traditionally, some courses are offered because faculty members bring unique interests or expertise and these courses may need to be replaced by other courses that will be added or will have more students enrolled as fewer students need College Algebra for their degree programs.

In addition, some math faculty members resist change out of a concern that alternatives will lack academic rigor or due to beliefs that they serve students best by teaching in the manner in which they were taught. Designing and implementing the necessary changes will require significant time and energy of highly committed mathematics faculty who must balance other time-intensive priorities with limited additional support and resources.

## Recommendations for Implementing Math Pathways in Oklahoma

### Recommendation 1: Establish statewide college meta-majors and corresponding math pathways, ensuring transferability across institutions

The primary recommendation of the taskforce is to create a small number of categories of college majors, called meta-majors, based on common mathematical needs. Each meta-major will have one or more acceptable gateway mathematics courses, called math pathways. Although entering college students may not be prepared to commit to a major, most have a broad area of interest they wish to pursue which could be accommodated by meta-majors. Gateway math courses focused on a group of similar majors can better incorporate applications of interest to individual students. With a relatively small number of meta-major options, other state systems have found that most students are able to make choices that accommodate their immediate and future interests.

The Task Force recommends adding appropriate gateway math options to degrees rather than replacing existing ones, for example College Algebra remains as an option where it is currently required. Students will still be able to apply the math credits even if they change majors within a meta-major or change from a major requiring College Algebra to one that does not. Many fewer students switch into a major requiring more mathematics or more specific mathematics courses. More applicable early college experiences with mathematics in targeted pathways may actually encourage such shifts. Students gaining experience in alternate math pathways that support statistics, quantitative reasoning, or modeling will be able to apply these skills in more math-intensive majors.

To facilitate transfer between institutions, OSRHE should establish guidelines for the constitution of statewide meta-majors and corresponding gateway mathematics courses, and the task force recommends that each institution should strive to offer at least three of the meta-major options. Universities and community colleges will need to collaborate to implement consistent math pathways that serve the majority of transfer students.

Strong advising is critical to the successful implementation of math pathways. Most students, faculty, advisors, and parents presume College Algebra as the only or best entry-level mathematics course. Most

students will not be aware of more suitable math requirements for their degree program, know how such courses transfer to other institutions, or how math courses will apply to other degrees if they change majors. Many students may also not understand the purpose of meta-majors or how to select one appropriate to their interests.

Each institution should ensure that all advisors are aware of the meta-major options and math pathways offered at the institution and are trained to help students select appropriate options. Advising checklists or flowcharts documenting options, applicability, and transferability of available math pathways should be used to assist in the enrollment process and made easily available to all advisors and students.

The task force recommends that OSRHE publicly promote the purpose and availability of new math pathways when they are available. A press release to local media, State Department of Education officials, and professional associations should describe math pathways and explain how they address the challenges identified by the Task Force.

Next Steps

- Offer State System Meta-Majors meeting representing Task Force members, Math Department Chairs, Statistics faculty and Chairs of key Non-STEM disciplines at the universities to define meta-majors and identify the required gateway math courses other than College Algebra.
- Offer State System one-day "Designing Math Pathways Workshop" facilitated by the Dana Center for institutional teams. The purpose of the workshop is to begin and/or deepen work to develop and implement math pathways at scale. Output includes specific action steps to launch new efforts or to further current work.
- Share and discuss transfer patterns of students from community colleges to universities by major
- Create Transfer and Applicably Transfer Group consisting of Council on Instruction and Math Pathways Task Force members.
- Propose a minimum (3 or 4) for meta-majors that will transfer, such as General Education, College Algebra (Pre-Calculus), modeling or non-STEM prerequisite for business and others, and Statistics.

**Recommendation 2: Increase student engagement and teaching of applications in gateway math classes**

By placing students in gateway math courses specifically designed for relevance to their career interests, course designers and instructors have increased opportunities to incorporate relevant applications. Applications should be designed to drive meaningful interpretation, problem-solving, and argumentation involving the mathematics to be learned. In an applied task, mathematical expressions and representations refer to real-world objects and quantities that can be described and imagined to aid in reasoning. Equations and models should describe meaningful relationships that can be explored, justified, and questioned, supporting higher-order reasoning skills. Applying appropriate procedures can convert mathematical models into new forms to reveal previously unseen structure or results, illustrating their power and relevance. Productive engagement in modeling real-world problems with mathematical tools should provide students with greater opportunities to understand that content, rather than viewing the mathematics as meaningless strings of numbers and letters and memorized rules to manipulate them.

Professional organizations are increasingly noting a need to attend to meaningful student engagement in mathematics classes (CBMS, 2016). Within math pathways, faculty could leverage increased relevance of course content to career paths and promote student-centered learning. A straight lecture is easily viewed by students as replaceable by web video-clips or looking up procedures in the textbook. Students are more likely to see that their participation in class is beneficial when more class time is devoted to engaging,

high-demand activities which emphasize and train student problem-solving, modeling, and argumentation skills. Class activities should be designed to engage students in non-routine tasks which require meaningful problem-solving, and drive student activity that reflects the structure of the mathematical content to be learned. When shifting from teacher-centered to student-centered class activities, faculty should help students develop greater responsibility and autonomy over their own learning.

In order to incorporate meaningful applications of mathematics, math faculty need to collaborate with faculty from other disciplines. Mathematics departments should facilitate dialogue with faculty in other disciplines in determining the mathematical learning outcomes necessary for success in their discipline and explore different mathematics course requirements that would best meet those outcomes. This dialogue needs to begin at the institutional level and extend to the system level and to the business community. Increased collaboration with other departments can increase coherence of degree programs through sharing content between math and other disciplines, team-teaching targeted content, connecting interrelated courses, and committing class time to bridge one course to the next course.

Next Steps

- Offer State System professional development for math faculty on implementing math pathways.
- Develop student learning outcomes for all math gateway courses using the State Regents' Course Equivalency Project.

**Recommendation 3: Increase support for academic success skill in gateway math classes**

Targeted instruction can effectively complement math pathways to support student development as successful and independent learners. Separately, or as part of the curriculum, faculty should explicitly address what math is and what learning math requires. Such efforts could cover study skills specifically relevant to learning math, persistence in difficult problem-solving, self-assessment, checking for sensible results, practicing and checking work, and critical thinking.

A particularly effective approach is to promote a growth mindset about learning, specifically that one's ability to do math is not fixed, that mathematical ability can and must be learned, and that struggle is an essential part of doing mathematics, even for professionals, and is not an indication of lack of ability. Effectively addressing these academic success skills would be enhanced by the acquisition of methods to assess the targeted learning skills.

Next Steps:

- Develop student learning outcomes for all math gateway courses using the State Regents' Course Equivalency Project.
- Offer State System professional development for math faculty on implementing math pathways.

**Recommendation 4: Provide professional development and resources for faculty and advisors**

Especially as new gateway math options are introduced, successful implementation of math pathways will require professional development opportunities for mathematics faculty teaching gateway courses. Faculty primarily need time and support to learn about new gateway courses, how they support disciplines in meta-majors, increased incorporation of applications, increased student-centered activity, and supporting academic success skills. Mathematics faculty from community colleges and universities need increased opportunities to communicate and collaborate, especially across institutions with strong transfer patterns. These opportunities should be designed to increase ways in which participating faculty get input from and bring information back to other faculty who are unable to attend the professional development.

Appropriate incentives and rewards should be established for faculty participating in new course design, statewide alignment and transfer, implementation, and professional development. Incentives may include financial compensation, service credit, professional recognition, administrative support, release time, or leave time.

Academic advisors need support to help incoming students understand and select a broad meta-major, to know the most current information on what gateway math courses are allowed and preferred for each degree program, to know how gateway math courses transfer to institutions state-wide and regionally, and to enroll students in the most appropriate gateway math course for their intended program of study.

Next Steps:

- Offer State System professional development for math faculty on implementing math pathways.
- Offer State System training for advisors and administrators on implementing math pathways.
- Coordinate information with the Oklahoma Academic Advising Association (OACADA).

**Recommendation 5: Improve student preparation, including efforts in K-12 education and remediation reform**

A significant factor in student success in college mathematics is pre-college preparation. The Task Force recommends increasing engagement of higher education faculty in support of K-12 mathematics instruction. Mathematics faculty should be encouraged to become involved in teacher training, professional development, and state policy about requirements, standards, and assessment. Departments and faculty can directly support secondary students through bridging activities such as 12th grade or summer opportunities, concurrent enrollment, math camps, and test preparation seminars. Offering flexible and supportive placement programs such as Assessment in Learning in Knowledge Spaces (ALEKS) allows students to identify and address gaps in their preparation and enter college courses farther ahead and better prepared. Statewide licenses to such technology may reduce costs for and recover the investment through increased student success, retention, and graduation.

A particularly promising strategy to improve student preparation and complement implementation of math pathways is replacing developmental math sequences with corequisite remediation. In the corequisite model, students who are not prepared for a gateway course are placed into a college-level course with required additional support to address gaps in preparation, especially focusing on aspects of that background that becomes necessary to succeed in the gateway course. Efforts to develop and offer corequisite remediation will need to align with any new math pathways. An Oklahoma Corequisite Reform Task Force is currently working in parallel to the Math Pathways Task Force (See Corequisite at Scale Guidance, June 2016 ), and the two efforts will need to be tightly coordinated and mutually supportive. The co-chairs of each Task Force also serve on the steering committee of the other and several faculty serve on both Task Forces.

Some faculty members express reluctance to proceed on corequisite work without defined pathways, fearing futile effort developing a College Algebra corequisite. The Task Force notes that a STEM pathway will involve College Algebra and Pre-calculus, and any early efforts to develop these programs will maintain long-term relevance.

Next Steps

- Implement Corequisite Remediation at Scale with continued support of Complete College America (CCA).
- Coordinate with the State Regents' K-12 Conversations and College Transitions Work Team of the Math Success Initiative that is charged with preparing students for a smooth transition from

high school to college with an emphasis on defining and measuring the variables that will create a system for student success where remediation of traditional students is not required.

- Support the offering of math courses in the senior year of high school.
- Improve course placement by implementing State Regents' policy to use multiple measures.

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