PROJECT EMBER
Technology-Enabled Curriculum

What is the Challenge?
- Despite many calls for mathematics teaching to take advantage of technology to support and enhance teaching and learning, many instructors still use "chalk and talk" instructional strategies with no use of technologies. The reasons for this can range from individual (the instructor lacks the knowledge and training to incorporate technology) to institutional (classrooms not being equipped to allow instructors to use technology in their classrooms).
- Nearly every job entails using technologies, so mathematics should be helping students learn how to effectively use technologies.
- College students today are "digital natives" who are adept at using technologies but often require training and support to make the most of technologies used in academic spaces.
- People need to understand how to use technologies to do mathematics, particularly to be able to engage in sensemaking and reasoning to discern errors.
- The goals of technology-enabled curriculum include: preparing students to be career-ready, improving equitable student outcomes, and using appropriate tools strategically.

Solution

Use technology enabled curriculum in mathematics courses to enhance teaching and learning.

What is the Innovation?
- Technology enabled curriculum takes many forms. Some common forms include:
  - Online course materials, including ALEKS as well as open educational resources (OER), free online textbooks, that can operate more dynamically than paper textbooks, such as adding simulations, videos, and posing questions that students can ponder before revealing the solutions;
  - Computer algebra systems that can perform computations, create graphs, and connect tables, graphs, and equations, such as Wolfram Alpha, Desmos, Mathematica, graphing calculators, MATLAB, and even the Google search bar;
  - Learning Management Systems that help instructors monitor student learning, such as Teacher Desmos, Canvas, Blackboard, D2L;
  - Online homework systems that automatically grade student answers, providing students with immediate feedback; may have algorithmically-generated parameters, giving students multiple attempts at similar problems, such as those in WeBWorK, MyMathLab; and
  - Automatic grading systems like GradeScope that allow scanned work to be autograded in batches with rubrics & comments.

How Does this Connect to Diversity, Equity and Inclusion?

- Technologies can help students go deeper into math and engage in authentic problem solving with real numbers (not just integers designed for mental math);
- Technologies can provide just-in-time support for students who have gaps in understanding of prerequisite topics (e.g., ALEKS, YouTube videos such as Khan Academy);
- Instructor grading across sections can be highly inconsistent (and thus inequitable); using rubrics and automated grading can provide more consistency and also more actionable feedback for students;
- Active student engagement is better for learning; technologies can allow students to engage in *doing* mathematics, not just watching the instructor demonstrate mathematics.

How Does this Play Out Across the System?
- All levels: commitment to diversity, equity, and inclusion; use of and sharing data
- Institution: provide resources to purchase technologies that have costs (e.g., GradeScope), install enough bandwidth for students to all be online in classrooms simultaneously, and offer professional learning opportunities for instructors to learn how to use various technologies effectively
- Department: abolish no-calculator/no-technology policies; offer and encourage opportunities for instructors to learn how to effectively use math-specific technologies; establish course coordination; adopt OER/online textbooks, homework systems, grading software
- Course-Level: technology-enabled curriculum connects to all of the key levers: high quality curriculum, corequisite supports, course coordination, assessment practices, and student monitoring and intervention; instructors collaborate to share expertise and to share the start-up load for using some technologies (e.g., creating item banks in WebWorK has a larger initial cost of people time and less to maintain it), common grading of common assessments
- Classroom-Level: instructors use technologies in mathematics teaching and learning

How Can You Learn More?
- Number one place to learn more is the MAA's best practices statement (#2 technology use**)**
  https://maa.org/resource/best-practices-statements/
- Explore teacher.desmos.com
- Open Stax has many OER materials
- Explore OER at the University of Nebraska-Lincoln: https://mathbooks.unl.edu/
- **I want to connect with others engaged in this same innovation**
  - Zulip Network for Teaching-Focused Faculty
  - MAA Connect