Mathematics Pathways: The Right Math for the Right Student at the Right Time

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Outcomes

- Get an overview of the Dana Center’s work on math pathways
- Engage with materials from a reenvisioned pathway to Calculus
Introducing the Dana Center

The Charles A. Dana Center at The University of Texas at Austin seeks to increase equity and access for all students, working primarily in the fields of mathematics and science.
Guided Pathways

• Creating clearly structured, educationally coherent program pathways that lead to students’ end goals.

• Rethinking instruction and student support services in ways that facilitate students’ learning and success as they progress along these paths.

- Bailey, Jaggars, Jenkins 2015
Definition of *math pathway*

... a mathematics course or sequence of courses that students take to meet the requirements of their program of study.

The concept of math pathways applies to *all* students.
Institutions implement structural and policy changes quickly and at scale.

Mathematics pathways are structured so that:

1) All students, regardless of college readiness, enter directly into mathematics pathways aligned to their programs of study.

2) Students complete their first college-level math requirement in their first year of college.
Dana Center Mathematics Pathways Model

Institutions and departments engage continuous improvement to ensure high-quality, effective instruction.

Students engage in a high-quality learning experience in math pathways designed so that:

3) Strategies to support students as learners are integrated into courses and are aligned across the institution.

4) Instruction incorporates evidence-based curriculum and pedagogy.
Dana Center Principles for Pathways

Quick structural change

Mathematics pathways are structured so that:

1) All students, regardless of college readiness, enter directly into mathematics pathways aligned to their programs of study.

2) Students complete their first college-level math requirement in their first year of college.

Continuous improvement

Students engage in a high-quality learning experience in math pathways designed so that:

3) Strategies to support students as learners are integrated into courses and are aligned across the institution.

4) Instruction incorporates evidence-based curriculum and pedagogy.
What is the “right math”? 

2-Year College Student Enrollment into Programs of Study

- Require Calculus: 20%
- Do not require Calculus: 80%

4-Year College Student Enrollment into Programs of Study

- Require Calculus: 28%
- Do not require Calculus: 72%

Emerging National Math Pathways

**Meta-Major**
- Liberal Arts, Fine Arts, and Humanities
- Social Sciences and Social Services
- Nursing and Health Professions

**Math Pathway**
- Quantitative Reasoning Pathway
- Statistics Pathway
- Business Math Pathway
- Elementary/Middle School Teacher Math Pathway
- STEM Pathway—Calculus

Dana Center
Mathematics Pathways
End Use of Traditional Placement

Student Placement Data
- Complete College America 2014
With Co-requisite, Most in College-Level

Student Placement Data

- Complete College America 2014
Why Co-req?

1 Year Math Initiatives

- Texas, NMP Curriculum Overall: 23%
- California Acceleration Project (CAP): 49%
- Texas, NMP Curriculum with back-to-back strategies: 43%
- Statway: 51%

1 Semester Corequisite Initiatives

- 20% Traditional Developmental-to-College Level Completion in 3 Years
- 64% Indiana
- 61% 62% Tennessee West Virginia

Dana Center Mathematics Pathways
A Model Pathway

Advised and Assess

Choose Meta-major
- Social Sciences
- STEM
- Lib. Arts, Humanities

Gateway Math in 1st year
- Stats
  - Coreq
- College Algebra
  - Coreq
- QR
  - Coreq

Choose Major
- Major
- Major
- Major

Adapted from Complete College America 2016
DCMP Pathway to Calculus

• Two course sequence designed to prepare students for Calculus:

  – Reasoning With Functions I
    • Corequisite college algebra course
    • Designed for students who are intermediate-algebra-ready and provides just-in-time supports for college-level content

  – Reasoning With Functions II
    • College Precalculus course
    • Students enter directly into traditional college Calculus upon completion
Reasoning With Functions I

In-Class Activity 1.A

• Motivates the need for function notation.
• Sets the stage for a formal introduction to functions.
Debrief In-Class Activity 1.A

• What do you think about the opening question?

• What do you think about the instructor’s approach to teaching this course?

• How does this approach help students learn?
Designing DCMP’s Pathway to Calculus

Two Design Teams

- Content Team (5 members)
- Structure Team (14 members)
Content Design Team

- David M. Bressoud, Macalester College
- Helen Burn, Highline Community College
- Marilyn P. Carlson, Arizona State University
- Eric Hsu, San Francisco State University
- Michael Oehrtman, Oklahoma State University
- Stuart Boersma, Central Washington University
DCMP’s Pathway to Calculus – Content

• Identify difficult ideas/concepts/skills students encounter in Calculus and *backmap* to Reasoning with Functions

• How can we better prepare students for these?

 ➤ Four Overarching Principles
Four Overarching Principles

1. Deep understanding of the function process (contrasted with an action view of a function)
   – Thinking of a function/transformation as a complete activity (not just acting on individual points)
   – Functions are processes that can be reversed and composed with other processes.

2. Ability to apply covariational reasoning:
   – Considering how one variable changes while imagining changes in the other variable
Four Overarching Principles

1. Deep understanding of the function process (contrasted with an action view of a function)

2. Ability to apply covariational reasoning

3. Ability to communicate with functions and use function notation

4. Meaningful approaches to the development of algebraic reasoning
Structure Design Team

- John P. (JP) Anderson, San Jacinto College
- Suzette Goss, Lone Star College–Kingwood
- Debbie Hanus, Brookhaven College, Dallas County Community College System
- Lyle Oneal, Lone Star College–Kingwood
- Joanne Peeples, El Paso Community College
- Jim Roznowski, AMATYC Past President
Structure Design Team

- Colleen Berg, Texas Tech University
- Caren Diefenderfer, Hollins University
- Suzanne Dorée, Augsburg College
- Bekki George, University of Houston, Main Campus
- Marc Grether, University of North Texas
- Brian Loft, Sam Houston State University
- Debbie Pace, Stephen F. Austin State University
- Virgil Pierce, the University of Texas–Pan American
DCMP’s Pathway to Calculus - Structure

**Two courses**
- Reasoning With Functions I (5 contact hours)
- Reasoning With Functions II (4 contact hours)

**Three components**
- At-home preparation (preview assignments)
- Inquiry based in-class assignments (25 minutes)
- Instant feedback (homework platform)
DCMP Curriculum Design Standards

1. Structure and Organization of Curricular Materials
2. Active Learning
3. Constructive Perseverance
4. Problem Solving
5. Context and Interdisciplinary Connections
6. Use of Terminology
7. Reading and Writing
8. Technology
Piloting DCMP’s Pathway to Calculus

**Pilot Institutions**
- The University of Cincinnati (Ohio)
- Temple College (Texas)
- Palomar College (California)

**Evaluation**
- Formative evaluation
  - Inform revision
  - Provide support for faculty in adapting to new mode of teaching
- Summative evaluation (fall 2017 and spring 2018)
In-Class Activity 3.B

- The goal of this activity is to get students to understand that exponential growth is characterized by constant percent change.
Think-Pair-Share

As you read In-Class Activity 3.B, please think about these questions:

• Where do you think students will struggle?
• How do you think students will react to this struggle?
• What is the instructor’s role in this struggle?
Instructor Notes for In-Class Activity 3.B

• Developed to prepare instructor for class.

• They are the author’s approach to the lesson and do not represent all possible scenarios.

• Look at the Prerequisite assumptions and Background context sections!!
As you read the instructor notes, please think about these questions:

• How do the notes help instructors guide students through struggle?
• What would you add to these notes?
• How is this different than they way you currently prepare for class?
DCMP’s Approach to Active Learning

• Create a learning community
• Uses short learning episodes
• Use engaging and attainable entry questions
• Provide opportunities for students do Math!!
• Provide opportunities for productive struggle to help students understand important mathematics
Resources

Dana Center Mathematics Pathways Resource Site: http://www.dcmathpathways.org/

The Dana Center Mathematics Pathways seeks to ensure that ALL students in higher education will be:

- **Prepared** to use mathematical and quantitative reasoning skills in their careers and personal lives;
- **Enabled** to make timely progress towards completion of a certificate or degree; and
- **Empowered** as mathematical learners.

It takes coordinated action across all...

- Levels of the system (national, state, institution, classroom)
- Sectors of education (universities, colleges, K–12)
- Roles (policy, administrators, faculty, student services)

In order to...

- Redesign course and institutional structures that deter success;
- Modernize mathematics content and instruction;
- Eliminate policy barriers in placement, transfer, and applicability.
Contact information

- General information about the Dana Center: www.utdanacenter.org
- Dana Center Mathematics Pathways Resource Site: www.dcmathpathways.org
- To receive monthly updates about the DCMP, contact us at: dcmathpathways@austin.utexas.edu
- Amy Getz (implementation, state-level work): getz_a@austin.utexas.edu
- Frank Savina (Pathway to Calculus): fsavina@austin.utexas.edu
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About the Dana Center

The Charles A. Dana Center at The University of Texas at Austin works with our nation’s education systems to ensure that every student leaves school prepared for success in postsecondary education and the contemporary workplace.

Our work, based on research and two decades of experience, focuses on K–16 mathematics and science education with an emphasis on strategies for improving student engagement, motivation, persistence, and achievement.

We develop innovative curricula, tools, protocols, and instructional supports and deliver powerful instructional and leadership development.