Mathematics Pathways: Overview of co-requisite models

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Southeast Texas Regional Mathematics Pathways Meeting

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DCMP Vision

The DCMP 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
- **Supported** and **Empowered** as mathematical learners.
Session objectives

Participants will:

• Gain a common understanding of mathematics pathways
• Discuss the shifting purpose of developmental and college-level mathematics
• Backmap support objectives from student materials
Definition of *Math Pathway*

**Noun**  |  math · path · way  |  \( \text{math} \ '\text{path-}, \text{wā} \)

**Definition:**

1: 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 both college-ready and underprepared students.*
Dana Center Principles for Pathways

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.

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.
Defining Content
Supporting the desired student experience

Defining the content of prerequisite and co-requisite courses:

• How do we take underprepared students from where they are to a level of preparedness for the college-level course?
Backward mapping to define content

1. What are the mathematical needs of the programs of study?
2. Type and content of gateway mathematics courses
3. Learning outcomes of support courses for underprepared students
Backward mapping to define content

The needs of “metamajors”

Type and content of gateway mathematics courses

Learning outcomes of support courses for underprepared students
Backward Mapping

Mathematics Prerequisites for Success in Introductory Statistics

Many students face difficulties in understanding and applying mathematical concepts in introductory statistics courses. This document outlines the mathematics prerequisites needed for success in these courses, helping students identify the necessary mathematical skills and knowledge. By addressing these prerequisites, students can enhance their understanding of statistical concepts and improve their overall performance in statistics.

Key Points:
1. **Backward Mapping**
   - Identifying the prerequisites needed for success in introductory statistics.
   - Providing a roadmap for students to strengthen their mathematical foundations.

2. **Mathematics Prerequisites**
   - Algebra
   - Basic arithmetic operations
   - Understanding of graphs and functions
   - Knowledge of basic probability concepts

3. **Resources**
   - Dana Center Pathways
   - Mathematics Prerequisites for Success in Introductory Statistics

4. **Action Steps**
   - Review and practice basic algebraic skills.
   - Work on exercises that involve graphs and functions.
   - Study probability concepts to prepare for statistics.

This document serves as a valuable resource for students aiming to succeed in introductory statistics courses, offering a clear path to prepare for the mathematical challenges ahead.
Activity: Discussion/reflection

Take a few minutes to discuss with your colleagues or reflect individually:

What information did you find that could be used in replicating this process for other courses on your campus?
Mathematics Prerequisites for Success in Intro. Statistics

- Mathematics content linked to content in the introductory statistics course that are dependent on mastery of the mathematics content.
- Grouped mathematics prerequisites into six general categories
  - Numbers and the number line
  - Operations on numbers
  - Sets
  - Equations and inequalities
  - Graphing points and lines in two dimensions
  - Reading tables and graphs and approximating areas
Justifying Mathematics Prerequisites

Example:

Represent an inequality as an interval on the number line.

Is this needed for statistics?

Why?

Calculate probabilities for continuous variables
Understand and interpret confidence interval estimates
Justifying Mathematics Prerequisites

Example
Order decimal numbers

Is this needed for statistics?

Why?
Calculate median and quartiles
Compare $P$-value to a significance level
Backward mapping to define content
Backward mapping to define content

**Mathematics pathways content:**

- What learning outcomes does each gateway math course need to serve the appropriate pathway?
- What are the readiness outcomes for each gateway course?
- What will help underprepared students achieve readiness for the college-level course?
Defining the Content: Content Backmapping Template

The content of support courses (prerequisite or co-requisite) should be selected based on the skills that students need to be successful in the college-level course. This tool is designed to facilitate the process of backmapping learning outcomes for the support course from the readiness competencies of the college-level course.

To identify learning outcomes for support courses, list the specific skills from the learning outcomes of the college-level course in the first column. In the second column, identify the competencies needed in order to successfully engage in activities that develop the skills in the first column. Those competencies become the descriptors of the learning outcomes of the pre/co-requisite course.

For prerequisite course structures, consider carefully which skills may need to be reinforced in the college-level course or may even be best saved for initial introduction in the college-level course.

An example from a Quantitative Reasoning course is shown below.

| Demonstrate procedural fluency with real number arithmetic operations. |
|---|---|---|
| In the college-level course, students will: | Therefore, they need the ability to: | These skills should be: |
| | | Taught in support course | Reinforced in college level | Taught in college level |
Backward mapping to define content

For prerequisite course structures, consider carefully which skills may need to be reinforced in the college-level course or may even be best saved for initial introduction in the college-level course.

An example from a Quantitative Reasoning course is shown below.

<table>
<thead>
<tr>
<th>In the college-level course, students will:</th>
<th>Therefore, they need the ability to:</th>
<th>These skills should be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculate absolute change.</td>
<td>Select and perform the four basic operations.</td>
<td>Taught in support course</td>
</tr>
<tr>
<td>Calculate relative change.</td>
<td>Calculate a percentage.</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Interpret a percentage.</td>
<td></td>
</tr>
<tr>
<td>Compare two budget categories over time.</td>
<td>Calculate absolute and relative change.</td>
<td></td>
</tr>
</tbody>
</table>
Activity: Practice

Tailor this example to fit your course (e.g., algebraic, statistical, quantitative, technical, business, education).

<table>
<thead>
<tr>
<th>Choose, create, and use models for bivariate data sets.</th>
<th>In the college-level course, students will:</th>
<th>These skills should be:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Therefore, they need the ability to:</td>
<td>Taught in support course</td>
</tr>
<tr>
<td>Create a graphical display.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyze data to determine appropriate model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create the model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use model for prediction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What background skills would prepare students to engage successfully in activities related to this SLO?
Activity: Plan for action

Create a plan for defining the content of support courses for underprepared students. Plan for how you will:

• Move forward to define a comprehensive set of SLOS for the support course at your institution.
Planning Co-requisite Content
# Planning Co-requisite Content

## Introduction to Statistics and Co-requisite Support Course Sample Timeline
Adapted from and with thanks to Roane State Community College

<table>
<thead>
<tr>
<th>Day</th>
<th>Co-requisite Notebook Topics</th>
<th>Online Lab</th>
<th>Essentials of Statistics Triola 5th ed.</th>
<th>MyLabsPlus Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Orientation, study habits, time mgmt.; converting between fractions, decimals, percentages; finding a percentage of a number</td>
<td>1</td>
<td>1.1 – 1.2 Orientation; introduction to statistical terms and statistical thinking</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Rounding; estimating; calculating means,</td>
<td>2</td>
<td>1.3 – 1.4 Types of data; collecting sample data</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Decimals, ratios, percent, conversions</td>
<td>3</td>
<td>2.2 – 2.3 Frequency distributions; histograms</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Applications of percent, squares, square roots; order of operations</td>
<td>4</td>
<td>2.4 Graphs that enlighten and graphs that deceive</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Operations on real numbers</td>
<td>5</td>
<td>3.2 Measures of center</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Review of types of data, sampling methods, types of graphs</td>
<td>6</td>
<td>3.3 – 3.4 Measures of variation; measures of relative standing and boxplots</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Review of measures of center and variation</td>
<td>7</td>
<td>Practice Test 1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Comprehensive review of chapters 1 – 3 &amp; basic skills</td>
<td>8</td>
<td>Test 1</td>
<td></td>
</tr>
</tbody>
</table>
Implementing Co-requisite Supports
Implementing Co-requisite Supports

Co-requisite Remediation (Draft)
Narrowing the gap between instruction and supports

The success of co-requisite supports

While there are many versions of co-requisite remediation, the broad definition refers to the placing of students who have been designated as underprepared directly into college-level courses and providing necessary additional supports. In trials across the country, as the result of co-requisite remediation strategies, states are seeing double and triple the number of students passing their first college-level mathematics course, and in half the time or less.

How are they gaining these results? Institutions have made structural and cultural changes to their mathematics offerings that address issues that have long negatively impacted developmental mathematics students. These issues include:

- Long developmental sequences were designed to give underprepared students more time to master mathematical concepts and to improve success in the college-level course. However, that well-intentioned goal has not been attained.
- The long sequences increase the time between the learning of content in developmental courses and the application of that content in the college-level course.
- The content in the developmental course may not support the student’s college-level course.
- Referral to remedial or developmental courses holds a stigma and contributes to further disenfranchisement of students designated as underprepared.

Many decisions must be made in collaboration among faculty, advisors, administrators, and financial aid staff, to design and construct the co-requisite model(s) that will best serve each institution. Some points for discussion are listed below.

Consideration 1: Existing campus supports
- Are other initiatives on campus, such as guided pathways work, examining content, pedagogy, alignment, enrollment, persistence, etc.? What other on-campus resources can be accessed?

Consideration 2: Co-requisite model (credit hours, placement, financing)
- Whether to co-mingle (mix college-ready and underprepared students in the same class).
- Structures: How courses are offered ‘on the books’
  - Boot camp: First 3-5 weeks of the semester are remediation, followed by the college-level content (classes meet extra hours each week throughout the semester, in order to equal the two classes or class + lab).

Consideration 3: Co-requisite content

Consideration 4: Cultural shifts
Implementing Co-requisite Supports

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**Consideration 2: Co-requisite model (credit hours, placement, financing)**

- Whether to co-mingle (mix college-ready and underprepared students in the same class).
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Implementing Co-requisite Supports

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• Consideration 1: Existing campus supports
• Consideration 2: Co-requisite model
  - Placement
  - Structure
• Consideration 3: Co-requisite content
• Consideration 4: Cultural shifts
Mathematics Pathways with Co-requisites

Advising and Assess

Choose Meta-major

Social Sciences

Pre-Major Advising

STEM

Lib. Arts, Humanities

Gateway Math in 1st year

Stats

College Algebra

QR

Choose Major

Major

Major

Major

Adapted from Complete College America 2016
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
## Activity: Structure Pros and Cons

### Discussion Template

<table>
<thead>
<tr>
<th>Cohorting</th>
<th>Co-mingling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pros</td>
<td>Pros</td>
</tr>
<tr>
<td>Cons</td>
<td>Cons</td>
</tr>
</tbody>
</table>

**Discussion starters:**
- How might this structure be perceived by other mathematics department faculty?
- How might this structure impact students’ sense of belonging and connection?
- How might this structure be impacted by your institution’s context?
- What other issues or questions does this structure raise?
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

• Connie Richardson
  cjrichardson@austin.utexas.edu

• Jeff Shaver
  jmshaver@austin.utexas.edu
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.