Dana Center
Mathematics
PATHWAYS

Co-requisite Design

The University of Texas at Austin
Charles A. Dana Center

www.dcmathpathways.org

Mathematics
PATHWAYS

Facilitated by
Paula Talley
Charles A. Dana Center

Purpose

Support mathematics faculty in designing the structure of co-requisite courses.

Audience

Math faculty and departmental administration who are leading math pathways work.

Using this webinar

This webinar is designed to convey information and support discussion, reflection, and action.

View this webinar individually or use it with a group to structure discussion and planning. Periodically, there will be prompts for activities, including:

- Discussion/reflection
- Practice
- Plan for action

For each webinar, pause at these points as long as you wish.

Outcomes

Participants will:

- Build on the backmapping work accomplished during and after the previous webinar.
- Understand the additional steps needed in planning the support content for a co-requisite (rather than a prerequisite) support course.
- Understand and plan for the decisions that need to be made in designing the support course structures.

Dana Center Mathematics Pathways

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.

Quick Recap: Defining Content

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 to define content

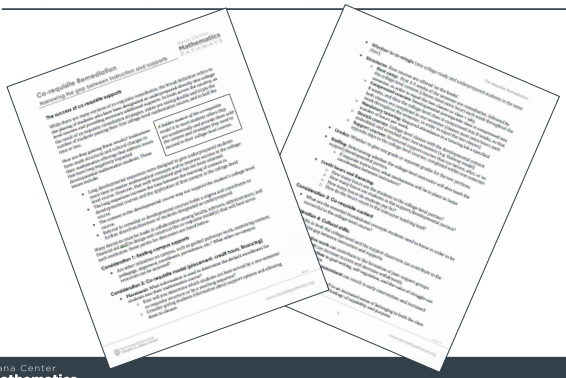
For prerequisite course structures, consider carefully which skills may need to be reinforced in the college-level course or may even be best saved for initial introduction in the college-level course.

An example from a Quantitative Reasoning course is shown below.

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**
Calculate absolute change.	Select and perform the four basic operations.	X		
Calculate relative change.	Calculate a percentage.	X		
	Interpret a percentage.	X	X	
Compare two budget categories over time.	Calculate absolute and relative change.			X

Implementing Co-requisite Supports

Implementing Co-requisite Supports



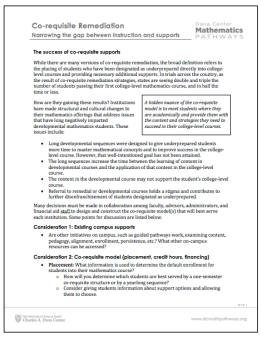
Activity: Discussion/reflection

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

What information did you find that resonates with you? What questions do you have?

When you are finished, proceed to the next section.

Implementing Co-requisite Supports


Co-requisite Remediation
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.

A hidden nuance of the co-requisite model is to meet students where they are academically and provide them with the content and strategies they need to succeed in their college-level courses.

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 (placement, credit hours, financing)

- **Placement:** What information is used to determine the default enrollment for students into their mathematics course?
  - How will you determine which students are best served by a one-semester co-requisite structure or by a yearlong sequence?
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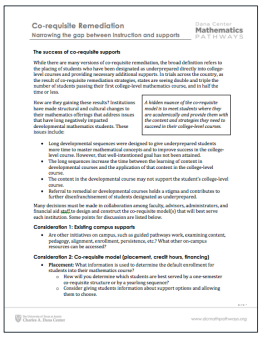
- **Consideration 1:** Existing campus supports
- **Consideration 2:** Co-requisite model
- **Consideration 3:** Co-requisite content
- **Consideration 4:** Cultural shifts

Dana Center Mathematics PATHWAYS

Implementing Co-requisite Supports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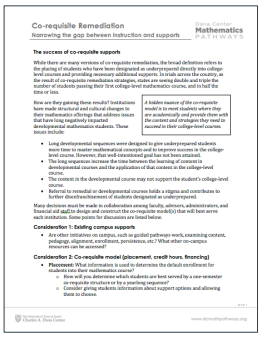
Implementing Co-requisite Supports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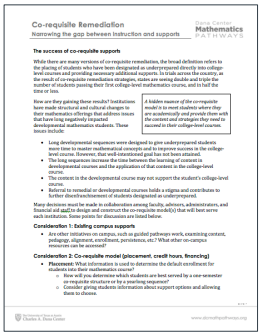
Activity: Discussion/reflection

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

- What existing campus supports do you need to learn more about? What will you need to tell them about the co-requisite support courses?
- Which cultural shifts resonate with you? Which, if any, concern you?

When you are finished, proceed to the next section.

Implementing Co-requisite Supports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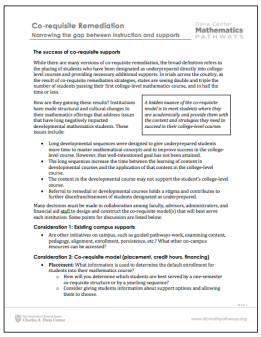
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- **Consideration 2:** Co-requisite model
  - Placement
  - Structure
- **Consideration 3:** Co-requisite content
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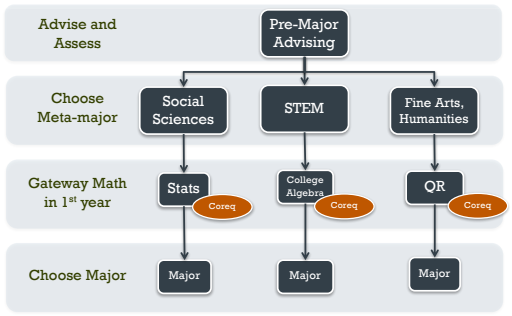
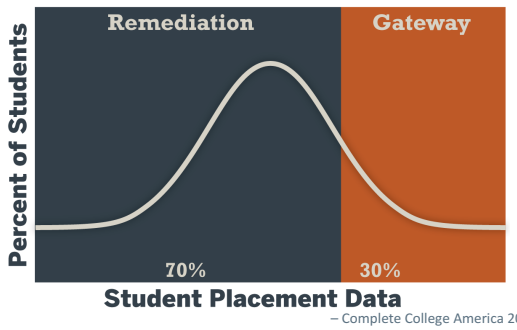
Mathematics Pathways with Co-requisites



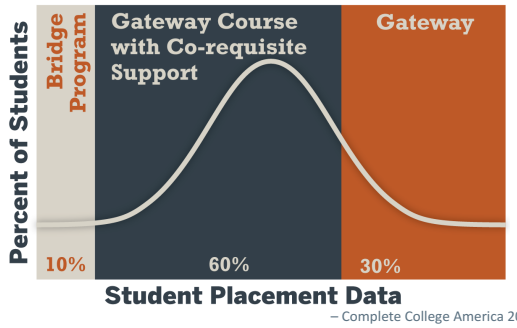
Adapted from Complete College America 2016

End Use of Traditional Placement



– Complete College America 2014

With Co-requisite, Most Students in College-Level



– Complete College America 2014

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Doubly Blended Co-requisite Model

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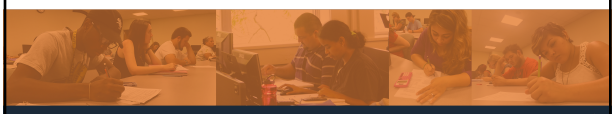
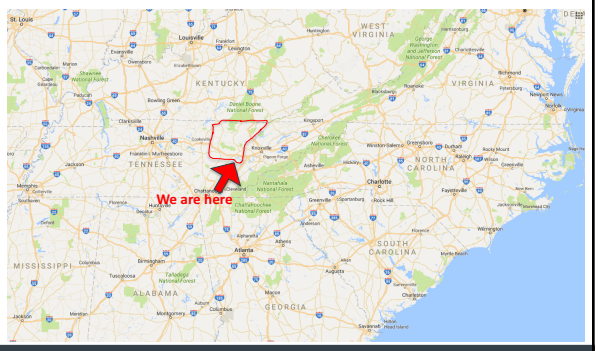
Division of Mathematics and Sciences
Roane State Community College
Harriman, Tennessee
pomperm@roanestate.edu

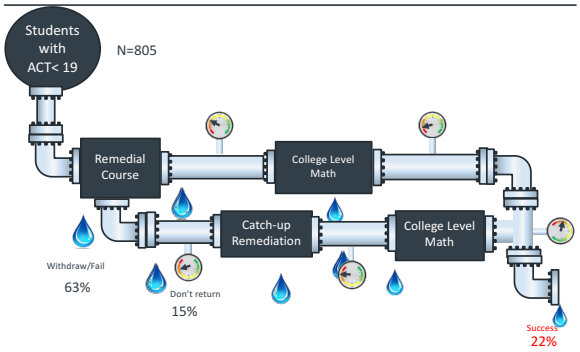


Roane State Community College

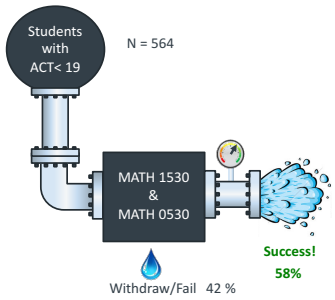


Leaky

Remediation Pipeline at Roane State prior to 2016



Revised Model: The Co-requisite Approach



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The Co-requisite Approach: Placement

- All high school students in Tennessee take the ACT test.
- This test is used for placement purposes.
- ACT Scores or <19 in math (or equivalent Accuplacer score) are required to take Co-requite course

College Course

MATH 1530 Probability and Statistics **(3 cr.)**

Co-requisite Course

MATH 1530 Probability and Statistics **(3 cr.)**
+
MATH 0530 Statistical Principles **(3 cr.)**

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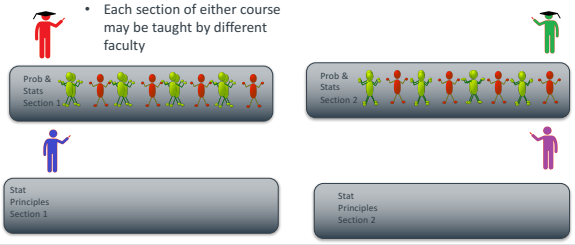
The Co-requisite Approach: Doubly Blended Model

- Each section of the **college-level "Probability and Statistics" course** contains students with and without learning support needs (*blended approach*).
- Students with remedial needs choose any section of the **co-requisite support "Statistical Principles" course** (*doubly blended approach*).
  - Each section of either course may be taught by different faculty



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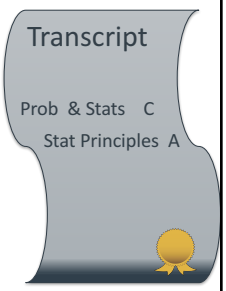
The Co-requisite Approach: Grading

Students earn separate grades in the two courses.
Each course uses different assignments.

Probability and Stats
4 Tests
1 Final Exam
Homework

Statistical Principles
Quizzes
Homework
Calculator Exercises
Class Participation



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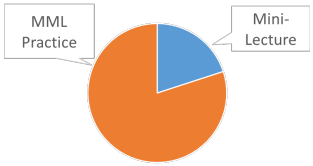
The Co-requisite Approach: Curriculum & Instruction

- The two courses proceed in lockstep.
  - A common course calendar prescribes which topics to cover in each class period.
- Topics in the Statistical Principles learning support section are timed and structured to provide the learning support exactly when needed.
- Statistical Principles instructors are provided with a lesson plan for a mini-lecture, worksheet and guided assignments in MyMathLab



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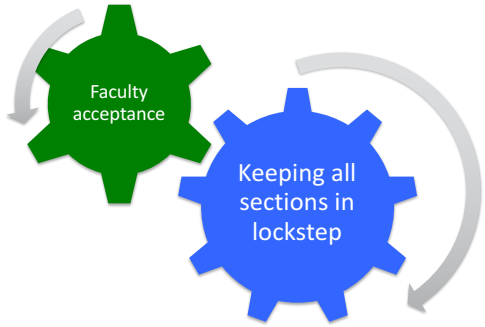
The Co-requisite Approach: Challenges



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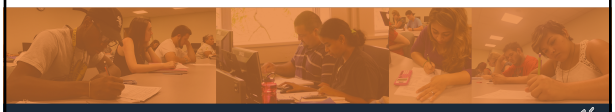
Accelerated Co-Requisite Cohort

SHARON SLEDGE
Distinguished Professor of Mathematics
San Jacinto Community College - Pasadena, Texas
SHARON.SLEDGE@SJCD.EDU



Traditional Model: No Acceleration

Fall 2015 – Fall 2016

Two Developmental Math Courses:

Introductory Algebra

Intermediate Algebra

College Algebra	Statistics	Quantitative Reasoning
3331 students	243 students	24 students
59% passing	79% passing	63% passing

New Model: Accelerated Co-requisite Cohort Approach

Fall 2015 – Fall 2016

No Independent Developmental Math Course

Accelerated College Algebra (AIM)	Accelerated Statistics (ASAP)	Accelerated Quantitative Reasoning (AQR)
920 students 74% passing	96 students 75% passing	87 students 90% passing

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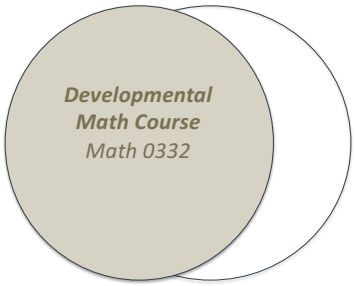
What is an "Accelerated Co-Requisite Cohort"?

Accelerated Quantitative Reasoning



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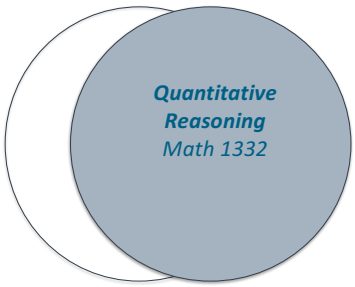

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What is an "Accelerated Co-Requisite Cohort"?

Accelerated Quantitative Reasoning

Accelerated Quantitative Reasoning
(AQR)

Two Courses – Two Teachers
(Support included "Just in Time")

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What is an "Accelerated Co-Requisite Cohort"?

Accelerated Quantitative Reasoning
(AQR)

Math 0332 & Math 1332

Developmental Students

Not College Ready
(Determined by State Placement Exam)

Complete BOTH Courses (Remedial and Academic) in ONE Semester

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Co-requisite: Accelerated Quantitative Reasoning

Curriculum and Instruction

Scissor Game
Watch/Observe
Listen
Participate
Collaborate

Course Structure
Videos/Demos
Presentations
Activities
Community

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Co-requisite: Accelerated Quantitative Reasoning

Curriculum, Instruction & Assessment

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Co-requisite: Accelerated Quantitative Reasoning

Curriculum

1. Sets & Logic
2. Probability
3. Math Finance
4. Geometry & Art
5. Statistics

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Co-requisite: Accelerated Quantitative Reasoning

Instruction

Variety of presentation types

- Presentations/Lectures/Videos – by teachers/students/internet
- Discovery lessons/flipped experiences
- Technology – Excel; Graphing calculators
- Active learning – reading writing, discussing, problem solving, experiments, etc.

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Co-requisite: Accelerated Quantitative Reasoning

Instruction and Assessment

Variety of presentation types

- Presentations/Lectures/Videos – by teachers/students/internet
- Discovery lessons/flipped experiences
- Technology – Excel; Graphing calculators
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Assessments – formative and summative

- Module Projects
- Homework from textbook
- Module Exams/Final Exam
- Tickets in/out the door
- Capstone Project for the Course

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Co-requisite: Accelerated Quantitative Reasoning

Challenges

Students

- Motivation
- Learning disabilities/Math anxiety
- FT = Face-2-Face and PT = Hybrid

Teachers

- Support/Instruction – everyday
- Keep the goal of success in front – everyday
- It takes a village – so create one
- Two are better than one but not absolute necessity

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Activity: Discussion/reflection

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- What did you hear from Markus and Sharon that resonated with you? What questions do you still have?

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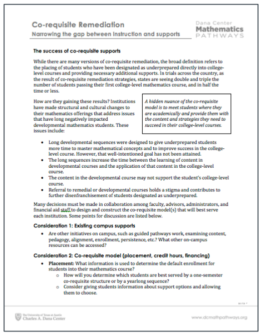
Implementing Co-requisite Supports



Co-requisite Remediation
Narrowing the gap between instruction and supports

Dana Center Mathematics PATHWAYS

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:

A hidden nuance of the co-requisite model is to meet students where they are academically and provide them with the content and strategies they need to succeed in their college-level courses.

- 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 (placement, credit hours, financing)

- **Placement:** What information is used to determine the default enrollment for students into their mathematics course?
  - How will you determine which students are best served by a one-semester co-requisite structure or by a yearlong sequence?
  - Consider giving students information about support options and allowing them to choose.

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www.dcmathpathways.org

- **Consideration 1:** Existing campus supports
- **Consideration 2:** Co-requisite model
  - Placement
  - Structure
- **Consideration 3:** Co-requisite content
- **Consideration 4:** Cultural shifts

Dana Center Mathematics PATHWAYS

Vocabulary – Student Structures

Co-mingling: Mixing college-ready and underprepared students in the same class.

Cohorting: Designating certain sections of college-level courses exclusively for underprepared students.

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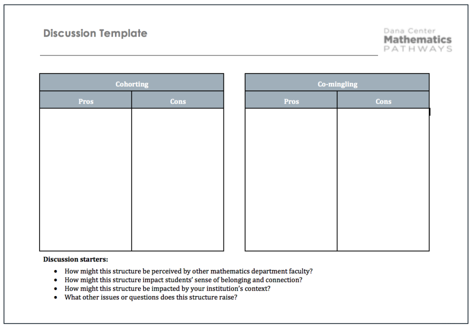
Activity: Structure Pros and Cons



Discussion Template

Dana Center Mathematics PATHWAYS

Cohorting		Co-mingling	
Pros	Cons	Pros	Cons

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?

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Activity: Discussion/reflection

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

- What are the pros and cons of creating cohorts of underprepared students?
- What are the pros and cons of co-mingling college-ready and underprepared students?

When you are finished, proceed to the next section.

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Vocabulary – Calendar Structures

Just-in-time supports

Support courses: Separate, structured support courses that run before, after, or on opposite days to the college-level courses.

Embedded supports: College-level classes with the developmental content embedded.

Mandatory tutoring: Required attendance in a tutoring lab for a specified number of hours per week.

Prerequisite supports + college-level; one semester

Boot camp: First 3-5 weeks of the semester are remediation, followed by the college-level content.

Compressed courses: Developmental prerequisite class is compressed into 8 weeks, and then the college-level class is compressed into 8 weeks, so that both classes are completed in one semester.

Just-in-time supports; two semesters

Stretch courses: College-level classes with the developmental content embedded and stretched over two semesters (e.g. Statway model).

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Activity: Discussion/reflection

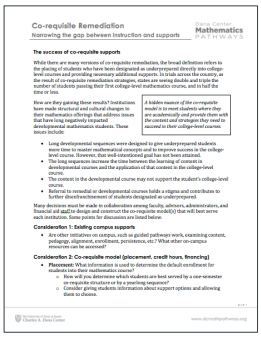
Take a few minutes to discuss with your colleagues or reflect individually:

- What are the pros and cons of each calendar structure?

When you are finished, proceed to the next section.

Dana Center Mathematics Pathways 51

Implementing Co-requisite Supports



Co-requisite Remediation
Narrowing the gap between instruction and supports

Dana Center Mathematics Pathways

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- **Consideration 1:** Existing campus supports
- **Consideration 2:** Co-requisite model
- **Consideration 3:** Co-requisite content
- **Consideration 4:** Cultural shifts

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.

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**
Calculate absolute change.	Select and perform the four basic operations.	X		
Calculate relative change.	Calculate a percentage.	X		
	Interpret a percentage.	X	X	
Compare two budget categories over time.	Calculate absolute and relative change.			X

Planning Co-requisite Content

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

Day	Co-requisite Notebook Topics	On-line Lab	*Essentials of Statistics* Triola 5th ed.		MyLabs Plus Assign-ment
0	Orientation, study skills, time management	0		Orientation	0
1	Whole numbers: place value, rounding, estimating, problem solving, variable expressions	1	1.1 – 1.2	Orientation; introduction to statistical terms and statistical thinking	1
2	***Must have TI-83/84 Calculator!*** Exponents, square roots, fractions, order of operations	2	1.3 – 1.4	Types of data; collecting sample data	2
3	Decimals, ratios, percent, conversions	3	2.2 – 2.3	Frequency distributions; histograms	3
4	Applications of percent	4	2.4	Graphs that enlighten and graphs that deceive	4
5	Operations on real numbers, scientific notation	5	3.2	Measures of center	5
6	Review of types of data, sampling methods, types of graphs	6	3.3 – 3.4	Measures of variation; measures of relative standing and boxplots	6
7	Review of measures of center and variation	7	Practice Test 1		
8	Comprehensive review of chapters 1 – 3 & basic skills	8	**Test 1**		

Activity: Discussion/reflection

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

- What do you notice about the Roane State calendar?
- What questions do you have?

When you are finished, proceed to the next section.

Planning Co-requisite Content

15	Area of a rectangle, lower/upper boundaries of regions, identify specified area under a curve, shade the area representing a percentile	15	6.2 – 6.3	Standard normal distribution; applications	11
16	Uniform distribution, standard normal curve, find z-scores, find critical values, determine type of problem	16	6.5	Central Limit Theorem	12
17	Probability/proportion/percent, calculate critical values, deconstruct intervals, identify parts of proportion problems	17	7.2	Estimating a population proportion	13
18	Find the best point estimate, calculate CI estimate for proportion, determine the required sample size	18	7.3	Estimating a population mean	14
19	Review of normal probability distributions and confidence intervals	19	Practice Test 3		
20	Comprehensive review: chapters 6 – 7 and basic skills	20	**Test 3**		
21	Coordinate system, intercepts, graph lines, compare & round decimals	21	8.2	Basics of hypothesis testing	15
22	Slope from graph & points, average rate of change, $\hat{p}$, x *and* n	22	8.3	Testing a claim about a proportion	16
23	Concepts of slope and analyzing linear relationships	23	8.4	Testing a claim about a mean	17
24	Scattergrams and concepts of linear equations	24	10.2 – 10.3	Correlation; regression	18

Activity: Plan for action

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

- Move forward to address the four considerations and the subcategories within each.

When you are finished, proceed to the next section.

Resources available

The Dana Center Mathematics Pathways Resource site, www.dcmathpathways.com:

- Learn About: Essential ideas and resources targeted for essential stakeholders
- Take Action: Action steps and resources for institutional and classroom implementation
- Resources:
  - *The Case for Math Pathways*
  - *The Program of Study Briefs*
  - Videos of student and faculty sharing their experiences

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

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.

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