Corequisite Mathematics Toolkit

Tools and resources for the design and implementation of equitable and effective support courses

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Every student deserves a strong start in their first year of college. This toolkit is part of a SSTF three-part series, providing resources to assist postsecondary leaders design and implement reform strategies that support equitable outcomes for students who are marginalized and racially minoritized.

The University of Texas at Austin
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This toolkit includes essential tools to help you implement corequisites in your state, system or institution.

Executive Summary

This toolkit presents nationally agreed-upon design principles for implementing corequisite mathematics and provides comprehensive tools and resources to make these principles actionable. It is intended to support faculty members, advisors and administrators in adopting corequisites that ensure college students – in particular those who are Black, Latinx, Indigenous, first-generation and from low-income communities gain access to gateway mathematics in their first year and are provided the supports they need to be successful.

Why implement corequisites?

A substantial research base shows that enrolling students directly into gateway mathematics and English courses, accompanied by aligned corequisite academic supports, results in dramatic improvements in academic success. In some cases, this corequisite approach results in more equitable outcomes—including more equitable gateway course completion and persistence rates — for students with low socioeconomic status, and students from racially minoritized and low-income communities.

Why focus on racially minoritized students?

Increasingly, postsecondary institutions are recognizing and confronting the systemic inequities in our civic and education systems that have denied social and economic opportunities to generations of individuals from racially minoritized and low-income communities. This critical time calls upon all postsecondary institutions, systems and agencies to reexamine our own policies and practices to ensure more equitable outcomes for these students.

What do we mean by "equity" in this toolkit and how does it apply to the work?

Working for equity means "ensuring equally high outcomes for all, removing the predictability of success or failures that currently correlates with any social or cultural factor, examining biases, and creating inclusive environments," according to the National Equity Project. (n.d.). Equity.

Equity in education refers to achieving parity in student educational outcomes, regardless of race and ethnicity. It moves beyond issues of access and places success outcomes for students of color at center focus, as noted by the Center for Urban Education. (n.d.). Equity and student success.

Equity-mindedness refers to the perspective or mode of thinking exhibited by practitioners who call attention to patterns of inequity in student outcomes. Practitioners who are equity minded understand that structures, policies and practices create inequities; question their own assumptions; recognize stereotypes that harm student success; and continuously reassess their practices to create change. For more information about developing a practice of equity mindedness, visit the Center for Urban Education.

Equitable practices refer to professional development practices for faculty, advisors, staff and administrators, who are working with math pathways. They are practices that result in ensuring high outcomes for all, targeting the removal of the predictability of success or failure that currently correlate with social and cultural factors.

The Center for Urban Education defines equity-mindedness as "the perspective or mode of thinking exhibited by practitioners who call attention to patterns of inequity in student outcomes." In essence, institutions and practitioners become accountable for the success of their students and see racial gaps as their institutional responsibility.

How this toolkit helps

Implementing corequisite models is complex. Education decision-makers could benefit from sophisticated guidance on how to design corequisites for scale, establish processes for continuous improvement, and build equity into each phase of the work. Policymakers and institutional leaders must carefully consider designing support models with fidelity to the evidence-based best practices that have emerged from early adopters of corequisites. At the same time, they need to adapt these models to fit the particular policy, academic and cultural context of each institution.

This toolkit is intended to help decision-makers do just that. It's designed to help individuals at all levels of an institution—from advisors to faculty to administrators—navigate the policy, design and improvement process for corequisites by articulating a set of design principles, tools and resources derived from rigorous research and the guidance of a national advisory committee of experts.

Each component of the toolkit is built to encourage equity-minded design considerations with the goal of ensuring that students who are Black, Latinx, Indigenous, first-generation and from low-income communities have equitable access to and success in corequisite supports models. In particular, the Measures of Structural Change and Assessment Rubric provide equity check-points as institutional teams work through the design, implementation and continuous improvement processes.

Applying Strong Start to Finish Core Principles

While this toolkit primarily focuses on corequisites, it is essential to note the research also shows that corequisites have the greatest impact on student outcomes when they are integrated with additional reforms, such as multiple measures placement, mathematics pathways, guided pathways and other student supports. The Core Principles for Transforming Remediation Within a Comprehensive Student Success Strategy (2020) lays out this multifaceted approach to reform, and the Corequisite Design Principles resource in this toolkit was designed to be integrated within the "Core Principles" framework.

Principles for the Design and Delivery of Corequisite Mathematics Supports

A crucial step in ensuring that the scaling of corequisite supports maximizes student learning and achieves equitable outcomes is to capture and communicate effective practices for designing, delivering and continuously improving corequisite math to faculty, instructional designers, faculty developers, college administrators, system leaders and policymakers. What follows below is a list of principles for design and delivery of corequisite supports from the design process and elements to enrollment practices and success frameworks.

Principle 1. Corequisite mathematics objective

The objective of a corequisite math program is to ensure that each student:

1.1 Enrolls in the college-level math course aligned to their chosen program of study.

1.2 Is assessed using evidence-based measures to determine their need for additional academic support.

1.3 Receives those supports through just-in-time corequisite supports.

1.4 Completes the gateway math course with the relevant skills and knowledge essential to success in their program of study.

The implementation of math pathways with corequisite supports is a component of comprehensive institutional policies and practices designed to result in students participating equitably and successfully in all programs of study. There is special attention to programs that provide opportunities for upward economic mobility and income equality.

Principle 2. Corequisite mathematics course design process

(Aligns to Core Principle #4)

Institutions that successfully implement a corequisite math course:

2.1 Identify and dismantle policy and practice barriers that deny students access to college-level math courses and result in inequitable student outcomes. Dismantling such policies and practices will ensure that each student has equal access to, and successfully engages in, high-quality college-level math courses in their first term.

2.2 Establish processes for implementing, assessing, improving and scaling corequisite courses that involve key institutional stakeholders, including administrators, faculty, instructional designers, advisors, student support services, financial aid professionals and registrars.

2.3 Understand the postsecondary experiences of students, use this understanding in design decisions, and pay particular attention to the impact of design decisions on racially minoritized communities.

2.4 Implement corequisite models that will most effectively achieve equitable access and success for each student, and that will be sustainable within their institutional context.

Principle 3. Corequisite mathematics course design elements

(Aligns to Core Principle #4)

Essential elements of effective corequisite math courses include:

3.1 Enrollment of students in the college-level math course aligned to their chosen program paths.

3.2 Sections of the college-level course with corequisite supports that are identical in content and outcomes to those available to students in non-corequisite sections.

3.3 Content in the corequisite supports course that is explicitly aligned and organized to support student learning and success in the college-level course, and prepares the student to transfer the learning into future courses in their programs of study.

3.4 Support content that is provided in a single term side-by-side or embedded within the college-level course, not as a precursor to the college-level content.

3.5 Strategies to boost academic confidence, sense of social belonging, and understanding of the relevance of the math concepts, and to achieve academic, career and personal goals.

3.6 Policy stating that successfully completing the college-level course, regardless of the grade in the corequisite supports course, is the only requirement for students to earn college-level credit and move on to subsequent courses in the math pathway and/or program of study aligned to the gateway course.

3.7 Consistent instructional practice across the college-level math course and corequisite supports course that supports each learner's need in order to achieve equitable outcomes for students, regardless of race, income, age, gender or other minoritized status.

Design elements of other corequisite math courses depend upon the needs of the student population and institutional context. Institutional teams examine available research on effective practices along with local data to make decisions on:

3.8 Assigning a single instructor or different instructors for the college–level course and corequisite course.

3.9 Determining the number of credit hours for the corequisite sections.

3.10 Co-enrolling corequisite students in college–level sections with students who do not require corequisite supports, or offering college-level sections for corequisite students only.

3.11 Scheduling corequisite sections relative to the college-level course (e.g., alternating days or same day as college-level, just before college-level, immediately following college-level).

Principle 4. Course enrollment practices

(Aligns to Core Principles #1 and #2)

Institutions that successfully deliver the instruction students need to achieve their academic goals:

4.1 Identify and enroll all students in the gateway math course consistent with their academic goals and chosen programs of study, regardless of any assessment of their preparation levels for that course.

4.2 Assess students to ensure instruction and academic support will maximize their success in the college-level math course, not determine access to the college-level course.

4.3 Assess the need for support through the use of multiple evidence-based measures to include, but not be limited to, high school GPA and high school performance in mathematics.

4.4 Make corequisite supports mandatory for students when the evidence-based measures referenced above show corequisite supports will increase the likelihood that they will pass the college-level course.

Principle 5. Integration with a comprehensive student success framework

(Aligns to Core Principles #3 and #5)

Institutions that implement comprehensive student success frameworks:

5.1 Align math pathways to other institutional pathways initiatives.

5.2 Include corequisite math support as an essential strategy for increasing the likelihood that students achieve critical first-year momentum metrics to include completion of gateway math and English, earning 30 credits and enrolling into and earning at least nine credits in a program of study in their first academic year.

5.3 Design math courses and corequisite supports to meet the specific needs of their student populations, including understanding and addressing how policies and practices impact sub-populations differently.

Principle 6. Continuous improvement

(Aligns to Core Principles #6 and #7)

Institutions that deliver an equitable, high-quality learning experience that maximizes the success of each student:

6.1 Collect, analyze and act upon disaggregated quantitative and qualitative data that measure the impact of course design, course content, instructional strategies, placement policies and other relevant institutional or state policies on the success of students by race, ethnicity, income level, gender, age or other minoritized status.

6.2 Collect qualitative data that capture the experiences of students and faculty, and examine the messaging students receive about math pathways, corequisite courses and other types of supports.

6.3 Establish clear measures of success that include the numbers and percentages of students completing a college-level math course, and establish mid- and long-term measures, such as retention, success in subsequent courses and completion of a certificate or degree.

6.4 Use data to inform a continuous improvement process to refine both the college-level course and corequisite supports and related practices, including placement and advising.

6.5 Use data to identify, understand and address the needs of students who are less well-served by the corequisite supports.

6.6 Explicitly identify, understand and address factors that either contribute to or detract from the success of students from minoritized communities in college-level mathematics courses.

Principle 7. Policy

(Aligns to Core Principles #1 and #2)

States, systems and institutions that successfully scale corequisite supports:

7.1 Adopt policies that create the enabling conditions for each student to enter directly into and succeed in a gateway mathematics course aligned to their goals.

7.2 Involve institutional leaders and faculty in the development and design of, and advocacy for, policies to support the implementation of math corequisites.

7.3 Design policies and provide resources to ensure that corequisite math courses are accessible to all students who are assessed as needing additional academic support, and address structural and systemic inequities present in entry-level mathematics programs.

Principle 8. Professional development and support of stakeholders

(Aligns to Core Principle #3)

Institutions that successfully implement and scale corequisite math and design professional development and other supports that:

8.1 Build the capacity of faculty to design, deliver and continuously improve corequisite math at their institutions with supports that meet their needs at different stages of the implementation process.

8.2 Facilitate collaboration among diverse stakeholders, including institutional researchers, administrators and student support professionals.

8.3 Result in the deployment of inclusive pedagogies and practices that maximize the success of students from minoritized communities.

8.4 Enable faculty, advisors and student services staff to maintain and build the academic mindset of students.

8.5 Inform faculty, advisors and student services staff on how students can access additional social supports.

8.6 Sustain support and engagement of all institutional stakeholders responsible for the successful implementation of corequisite math. In particular, advisors receive support on equitable practices when advising for math pathways.

Reform Phases

Carrying out a reform initiative is a cyclical process that includes phases such as getting started, planning for action, implementing the plan, and engaging in continuous improvement by analyzing results and moving through the cycle again. Read more about each of these steps in the Dana Center Mathematics Pathways (DCMP) Implementation Guide for math pathways.

Implementation Tools

Implementing corequisite models is complex. The tools below will help individuals at all levels of an institution plan, implement and establish processes for continuous improvement. Included are guiding documents, such as a readiness assessment, course design tools, an implementation timeline template and more. Many of the tools will be used repeatedly, either in different steps of the process as new data become available, or as additional stakeholder groups are brought into the work.

Readiness Assessment

- Related resource: Case-Making Webinar "Why Corequisites?"

Attrition-Throughput Equity Analysis

Implementation Timeline Template

Engaging Partner Disciplines: Multidisciplinary Discussion Tools

Course Design Tools

- Models and Case Studies Webinar
- Course Calendar Template – Instructor Version
- Course Calendar Template – Student Version
- Course Design Recommendations
- Online Corequisites Summary and Webinars

Measures of Structural Change

Assessment Rubric

Readiness Assessment

Purpose: This tool highlights important activities, structures and policies that are important to identify during planning stages of corequisite implementation and scaling. Completing this tool at the beginning of your design and implementation work will provide a framework of your current context from which to make decisions about next steps.

Users: Institutional leaders, administrators directly connected to the mathematics program (dean, chairperson, division head, etc.), corequisite coordinator, director of advising, institutional researcher.

Instructions: Respond to each item using the scale provided, seeking input from others, as appropriate. Comments should be brief (e.g., bullet points or short sentences) about any particular assets or challenges your state or region has that may influence this work.

SCALE: (1) None at this time (2) Emerging (3) In progress (4) Well developed (5) Fully implemented

Essential Action	A "5" looks like . . .	Self-Assessment
Action 1: **Establish a well-supported leadership team with clear expectations.**	• Top administrative leaders (president, provost, vice presidents, deans, etc.) have a complete understanding of and are committed to full implementation and scaling of corequisites. • A leadership team with representatives of diverse stakeholders (e.g., administration, advising and student services staff, credit-level and developmental faculty) is established with a clear charge and defined roles and responsibilities. • Team meets regularly and has a timeline and an action plan. • Team has effective processes for monitoring and evaluating progress and documenting decisions.	**Overall Rating for Action 1:** Evidence of Rating: Next Steps:

SCALE: (1) None at this time (2) Emerging (3) In progress (4) Well developed (5) Fully implemented

Essential Action	A "5" looks like . . .	Self-Assessment

Action 2:
 	
Developmental redesign efforts are positioned as part of the institution's overall strategic plan and student success and equity initiatives.
	• Implementation of corequisites is explicitly connected to mathematics pathways and other student success initiatives.
	• Individuals across the institution in a variety of roles can explain why and how the institution is implementing full-scale corequisites, and can describe their role in the implementation process.
	• Administration, faculty, staff and students have a deep understanding of and support for mathematics pathways, and understand how corequisite implementation is a critical component of this work.
	• Mathematics pathways:
	  • Are aligned to broad groups of programs or meta-majors. There is one clear default gateway mathematics course for each meta-major and program.
	  • Are aligned to program requirements of transfer and K–12 partners.
	  • Include a default pathway for undecided students based on data on the programs that students are most likely to enter.
	  • Default placement for students is into a gateway mathematics course with supports as needed. Level of support is determined by evidence-based placement practices that utilize multiple measures of readiness.
	  • Include enrolling students in a gateway mathematics course (with corequisite supports, if needed) in their first 15 hours, or in their first 30 hours if also assigned to Developmental English.
		Overall Rating for Action 2:
		
		Evidence of Rating:
		
		Next Steps:

SCALE: (1) None at this time (2) Emerging (3) In progress (4) Well developed (5) Fully implemented

Essential Action	A "5" looks like . . .	Self-Assessment
Action 3: **Plan for communication and engagement over time.**	• Leaders consistently communicate to the full institutional community a strong and clearly defined commitment to the goals and redesign efforts. • The leadership team has an established process to set short-term communication and engagement goals, plan strategies and activities to meet those goals, and then evaluate and revise periodically. • Team has effective processes to solicit and disseminate information, including measurable progress toward goals, to different stakeholders (e.g., in-person meetings, webinars, forums, website, email distribution list, blog). • Team provides tools and opportunities to practice and improve communications to prepare individuals to communicate about corequisite courses effectively.	**Overall Rating for Action 3:** Evidence of Rating: Next Steps:

SCALE: (1) None at this time (2) Emerging (3) In progress (4) Well developed (5) Fully implemented

Essential Action	A "5" looks like . . .	Self-Assessment

Action 4:
 	
Gather and review information on the current institutional landscape.
	• The leadership team has used the following data to define the problem, identify strengths, opportunities and challenges:
	  • Student data on key performance indicators, including attrition and throughput in the developmental pipeline, enrollment in and completion of gateway mathematics courses, placement, retention beyond the gateway and completion of degree or certificate. These data should be disaggregated and inspected for gaps in equitable access to and success in college-level courses.
	  • Data on faculty credentials:
	  • Which instructors are credentialed for gateway courses?
	  • Which developmental instructors are prepared to support statistics students?
	  • What is the demographic composition of the faculty?
	  • Qualitative information about institutional processes, policies and culture that impact faculty, staff and students, which may either support or hinder implementation of corequisites. Include assessment of campus climate and student sense of belonging.
	  • Research and effective practices from external sources.
		Overall Rating for Action 4:
		
		Evidence of Rating:
		
		Next Steps:

SCALE: (1) None at this time (2) Emerging (3) In progress (4) Well developed (5) Fully implemented

Essential Action	A "5" looks like . . .	Self-Assessment
Action 5: **Define goals.**	• Goals to scale mathematics corequisite courses as normative practice are defined. These goals should include student enrollment projections for the corequisite courses when full-scale implementation is achieved and when interim goals to normative practice are reached. • The goals are communicated across campus to various stakeholders. • Leaders actively and regularly monitor progress toward goals, providing guidance and support when necessary.	**Overall Rating for Action 5:** Evidence of Rating: Next Steps:

SCALE: (1) None at this time (2) Emerging (3) In progress (4) Well developed (5) Fully implemented

Essential Action	A "5" looks like . . .	Self-Assessment

Action 6:
 	
Allocate resources.
	• Leaders furnish resources to implement, scale and continuously improve corequisite supports.
	• Resources (time and funding) are identified for:
	  • Supporting the leadership team with release time, resources, professional development and collaboration.
	  • Supporting faculty as they develop and implement courses. Lead faculty are provided release time for design and development.
	  • Roles and responsibilities of advisors and other staff providing additional support are restructured to allot time for effective service.
	• Consistent and continuous professional learning for faculty and staff.
		Overall Rating for Action 6:
		
		Evidence of Rating:
		
		Next Steps:

Watch the Why Corequisites? Case-making webinar

At each stage of the process, additional stakeholders become involved. It is likely that some of those stakeholders will have lower levels of awareness, or will be skeptical, about corequisites. The Why Corequisites? case-making webinar may be useful in providing a baseline understanding of the research and rationale prior to engaging those stakeholders in a dynamic conversation on implementation.

Attrition and Throughput Equity Analysis Worksheet

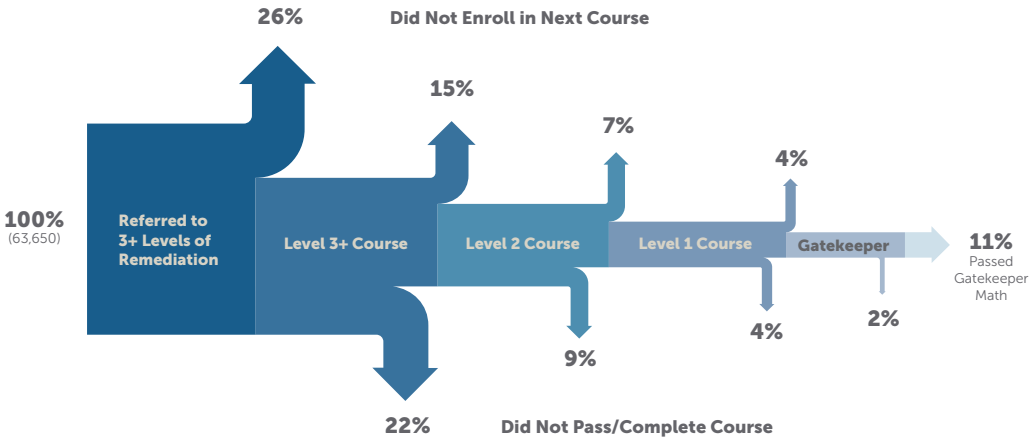
To quantify the attrition and throughput of students from cohorts of first-time, first-year (FTFY) students; to determine whether attrition varies by student group; and to develop action steps to foster equitable throughput. Attrition refers to students who exit the developmental education sequence. **Throughput** refers to the percentage of students who persist through the entire sequence to enroll and succeed in a gateway course.

Users: For data collection, Institutional Research (IR) staff and mathematics department administration. For analysis of data and development of action steps, IR staff, mathematics administration and faculty, advising and student support services staff.

Rationale: Research indicates that prerequisite developmental education is more likely to act as a barrier to college completion than as support:

- 26% of students referred to three or more levels of developmental mathematics never enrolled in the sequence.
- 26% passed at least one developmental course but did not enroll in the next course. (Top of graphic 15% + 7% + 4%.)
- 37% of students did not pass and stopped out of the sequence. (Bottom of graphic 22% + 9% + 4% + 2%.)
- Only **11% of students** who were referred to three or more levels of developmental mathematics eventually completed their credit-bearing mathematics requirement.

Student Progression Through the Developmental Math Sequence[21]



Jaggers, S. & Stacey, G. (2014). Community College Research Center, Teachers College, Columbia University, NY, NY. ERIC Number ED565668

Step 1: Choose the population of interest

Identify a course sequence that you wish to investigate, a timeframe and the student populations that you will use to disaggregate the data.

Course sequence:
Example: Students who need a credit-bearing mathematics course for their program but have been assigned to two levels of traditional prerequisite developmental education.

Timeframe:
Example: Two years may be needed to track gateway course completion of students assigned to multiple levels of traditional prerequisite developmental education.

Population group(s) of interest:
Examples: Race/ethnicity, gender, veteran status, first generation, intersectionalities such as race and gender, etc.

Step 2: Determining throughput counts for target student groups

Example:

Total = All students assigned to two levels of developmental who need a credit-bearing mathematics course.

Group 1 = Asian/Pacific Islander students assigned to two levels of developmental and who need a credit-bearing math course

Group 2 = Black/African American students

Group 3 = Hispanic/Latinx students

Group 4 = Indigenous students

Group 5 = White/non-Hispanic students

	Total	Group 1	Group 2	Group 3	Group 4	Group 5
Number of FTFY students in this category who need a credit-bearing mathematics course and placed into first course:						
1a. Number of students who never enrolled in the first course:						
1b. Number of students who enrolled in the first course:						
2a. Number of students who passed the first course, but did not enroll in the second course:						

	Total	Group 1	Group 2	Group 3	Group 4	Group 5
2b. Number of students who did not pass the first course during the timeframe:						
2c. Number of students who passed the first course and enrolled in the second course:						
3a. Number of students who passed the second course, but did not enroll in the third course:						
3b. Number of students who did not pass the second course during the timeframe:						
3c. Number of students who passed the second course and enrolled in third course:						
4a. Number of students who completed the sequence within the timeframe (throughput):						
4b. Number of students who did not pass the third course during the timeframe:						

Step 3: Determining throughput percentages for target student groups

Example:

Total = All students assigned to two levels of developmental who need a credit-bearing mathematics course.

Group 1 = Asian/Pacific Islander students assigned to two levels of developmental and who need a credit-bearing math course

Group 2 = Black/African American students

Group 3 = Hispanic/Latinx students

Group 4 = Indigenous students

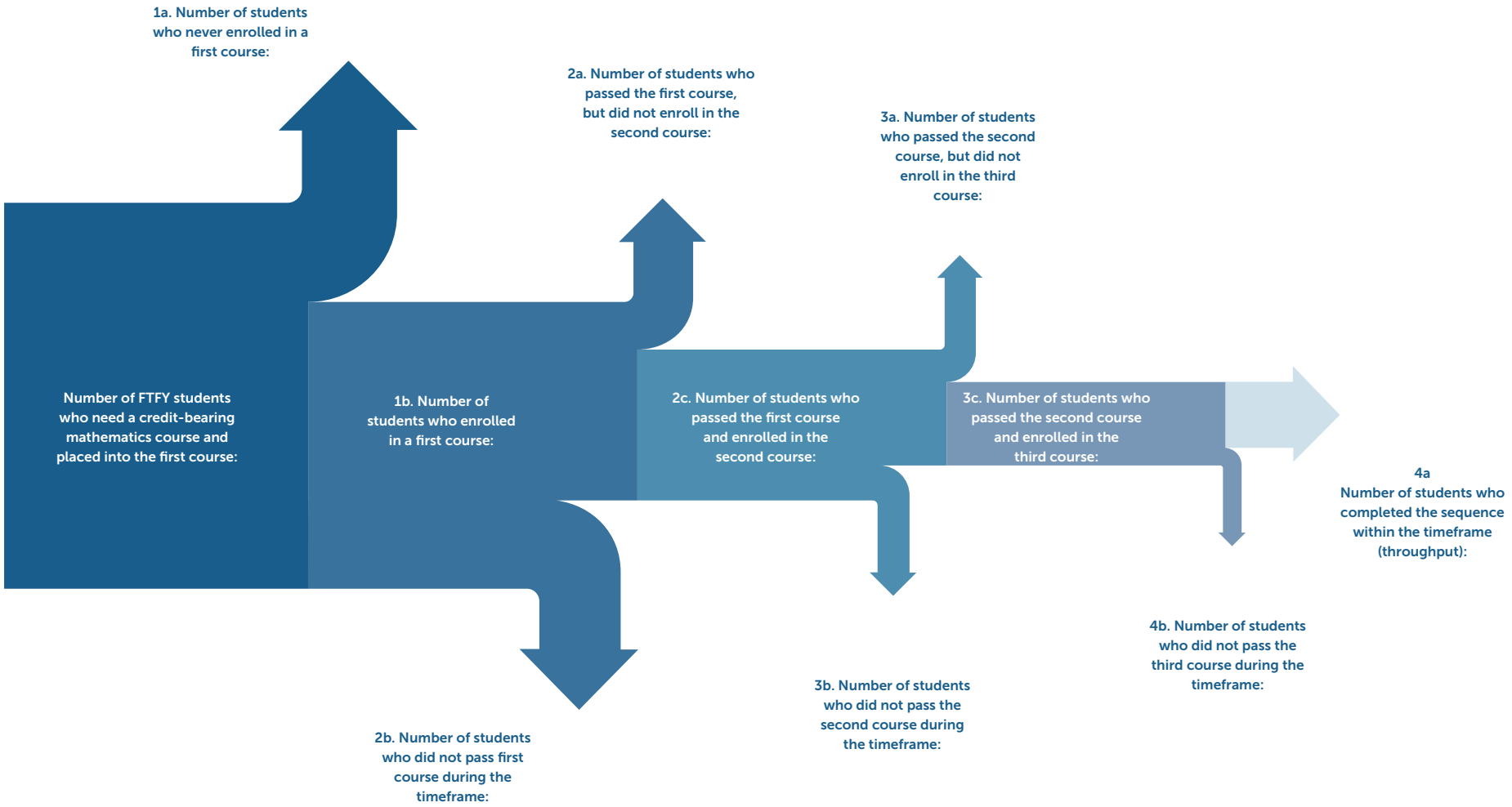
Group 5 = White/non-Hispanic students

	Total	Group 1	Group 2	Group 3	Group 4	Group 5
FTFY students in this category who need a credit-bearing mathematics course and placed into first course:	100%	100%	100%	100%	100%	100%
1a. Percentage who never enrolled in the first course:						
1b. Percentage who enrolled in the first course:						
2a. Percentage who passed the first course, but did not enroll in the second course:						
2b. Percentage who did not pass the first course during the timeframe:						
2c. Percentage who passed the first course and enrolled in the second course:						
3a. Percentage who passed the second course, but did not enroll in the third course:						
3b. Percentage who did not pass the second course during the timeframe:						
3c. Percentage who passed the second course and enrolled in the third course:						
4a. Percentage who completed the sequence within the timeframe (throughput):						
4b. Percentage who did not pass the third course during the timeframe:						

Step 4: Graph it

Using the calculations from Step 3 for the total student population, input the percentages in their appropriate box to create your institution's throughput graph. Repeat these instructions for each student population group of interest.

Total: (Repeat as needed for groups of interest.)



Step 5: Analysis

Please engage in the following questions to better understand the throughput at your institution.

1. What trends do you notice?
2. Where do you notice differences across different population groups?
3. What do you think might be contributing to these differences between groups? Consider:
    - Qualitative or survey data you've seen from your institution regarding specific population experiences, experiences in developmental education, or other relevant data.
    - Anecdotal evidence from your own personal and professional experiences.
    - Research and best practices from other institutions or published reports and articles.
4. What additional questions do these data raise for you?
5. Identify action steps in the following areas to promote equitable opportunities:
    - Explore alternate systemic structures and policies that mitigate historical inequitable opportunities (e.g., replacing prerequisite developmental sequences with corequisite supports courses; rethinking placement policies).
    - Further data to explore (e.g., seeking input from students, faculty and staff).
    - Resources and support for faculty and staff development.
    - Other.

Suggested Resources: The Center for Urban Education at the University of Southern California Rossier School of Education

When corequisites were introduced in Fall 2019, enrollment in prerequisite developmental mathematics was reduced by 78 percent. Of those who enrolled in corequisite courses, 67 percent earned college-level credit in a single term.

—DIABLO VALLEY COLLEGE, CALIFORNIA

Implementation Timeline Template

Purpose:

Once you have formed your leadership team and inspected your historical attrition and throughput data, this template can be used to organize key actions and deliverables to achieve the goals for year one of corequisite implementation.

Users: Institutional leaders, administrators directly connected to the mathematics program (dean, chairperson, division head, etc.), corequisite coordinator, director of advising and institutional researcher.

Instructions:

Use your institution's goals for year one to complete the table on the following pages. It might be most beneficial to use backward design to start with the semester right before you implement the corequisite model and work backward to the first semester of planning. The table is organized into the following sections: targets, deliverables, data collection, check-ins, adjustments and communications. In each table cell, to the right of the prompts, place information related to the prompt, including the person/group's name responsible for the action. Increase or decrease rows or columns as needed.

Examples:

- Creation of a detailed syllabus/timetable for the college-level course
- Back mapping of skills
- Design of learning support strategies
- Training of faculty
- Date of first draft of Fall Timetable
- Date for finalizing the Fall Timetable
- Deadline for ordering materials from the bookstore
- Begin of Fall registration
- Deadline to submit requests for new faculty lines to budgetary committee

	Four Terms Prior:	Three Terms Prior:	Two Terms Prior:	One Term Prior:	Implementation Term:
Targets What milestones are required to meet your institution's Year One goals?					
Deliverables What needs to be developed?					
Data collection What data will be collected? Who will be responsible for collecting them? When will the data be collected?					
Check-ins When will the responsible party review data and report progress to the implementation team and the entire mathematics department?					
Adjustments How will the implementation team decide what adjustments to make?					
Communications Who is responsible for communicating progress and celebrating success? When will the responsible party communicate this information? How will it be disseminated?					

Engaging Partner Disciplines: Multidisciplinary Discussion Tools

Purpose

Research indicates the importance of coordinating corequisites with robust mathematics pathways implementation.[1] This resource is a collection of templates that faculty and administrators can use to prepare for and implement partner discipline discussions focused on identifying a default gateway mathematics course requirement that is most relevant for each program of study.

1. Ran & Lin, 2019

Audience

This tool is intended for use with a small group that includes mathematics faculty, partner discipline faculty and related department leadership.

The tool contains the following parts:

- Meeting Preparation Suggestions
- Mathematics Department Preparation Guide
- Sample Survey of Mathematical Skills
- Discipline Team Preparation Guide
- Sample Meeting Agenda

Meeting Preparation Suggestions

Establish roles.

- **Meeting facilitator:** This person can be someone from either the mathematics department or the partner discipline team and is responsible for organizing logistics and facilitating agendas.
- **Math lead:** The math lead should have familiarity with the learning outcomes for all college-level math courses and is responsible for bringing appropriate resources to the discussion (described later in this resource).
- **Discipline team:** The discipline team should consist of faculty members from the department that primarily supports the program(s) in consideration. They should be prepared to discuss the quantitative skills students in these programs need, and the ways in which mathematics is used in the careers most commonly pursued by individuals with the degrees in question. They should also be prepared to bring appropriate resources to the discussion and to complete the preparation described in the next section.
- **Other stakeholders:**
    - **Advising representative –** Including an advisor in the discussion leads to deeper understanding of the importance of enrolling students in the appropriate math course, rather than informing the advising department via memo.
    - **Transfer partner representative –** If a significant number of students transfer to a regional partner, invite a discipline representative to discuss mathematical needs of the program.

Mathematics Department Preparation Guide

Preparation: Describe the objectives for each of the gateway level math courses.

- Develop a survey of mathematical competencies that illustrate the content of the gateway courses offered by your math department. This should be a high-level view of the main concepts, rather than a comprehensive list of every skill for each course. A sample survey is provided in the next section.
- Take time to think about how you might explain the outcomes in the survey of mathematical skills to someone without an extensive algebraic background. For example, the term "function" is likely to be interpreted very differently by the liberal arts team.
- Convene a department team to prepare examples of contextualized mathematics problems that illustrate the outcomes in the survey of mathematical skills. When possible, include contexts and examples relevant to the partner discipline in question.

Materials: Consider bringing the following resources to the meeting to share with your partner disciplines.

- The **survey of mathematical skills** developed by your math department.
- The contextualized mathematics examples.
- Recommendations of national mathematics associations, meta-major frameworks, Program of Study briefs, etc. as available and appropriate.
    - MAA's partner discipline reports:
        - MAA (2004). *The Curriculum Foundations Project Voices of the Partner Disciplines*
        - MAA (2011). *Partner Discipline Recommendations for Introductory College Mathematics and the Implications for College Algebra*
    - Arkansas' Math Task Force Report: *Forging Relevant Mathematics Pathways in Arkansas*
    - Sample meta-major frameworks
        - Indiana
        - Texas
    - Dana Center's Program of Study Briefs – currently available are:
        - Emerging Solutions for Mathematics Education in Nursing
        - Mathematics for Business
        - Mathematics for Communications
        - Mathematics for Criminal Justice
        - Mathematics for Pre-Service Elementary (K-5) Teacher Education
        - *Mathematics for Social Work*

[Note to Math Team: The conversation should begin with a small survey (see sample) and then move to an examination of the mathematics department syllabi that most closely match the checked survey items. This sample survey is wide-ranging and is far more extensive than should be given to your partner discipline colleagues. Make sure to select a variety of topics that represent the breadth of content for each gateway course, but be careful not to make the survey too long or too technical; include two or three main topics representing each gateway course. The more in-depth conversations can happen after the partner discipline faculty complete the survey and begin reviewing the appropriate course syllabi.]

Sample Survey of Mathematical Skills

Which of the following best describe the mathematical skills students need in order to be successful in your program? Try to limit your selection to (at most) five of the main list. Then choose as many sub-descriptors as needed, if applicable.

- Read and interpret quantitative information in news reports.
- Read and interpret statistical analyses in professional journals.
- Model the real world using probability:
    - Counting.
    - Conditional.
    - Bayes' Theorem.
    - Diagrams (tree, Venn, two-way tables).
- Apply common probability distributions, such as normal and binomial distributions.
- Apply the theory of functions.
- Reason using ratio and proportions.
- Evaluate all roots of higher degree polynomial and rational functions.
- Apply right triangle trigonometry.
- Determine the validity of an argument or statement; provide mathematical evidence.
- Recognize, solve and apply systems of linear equations using matrices.
- Apply the language and notation of sets.
- Compute confidence intervals and hypothesis tests and interpret the results.
- Given a data set:
    - Choose and create an appropriate graphical display.
    - Interpret and draw conclusions.
    - Determine and interpret measures of center and spread.
- Determine the following for a variety of functions:
    - Domain and range.
    - Inverse.
    - Composition.
- Model the real world using algebraic functions. Choose all that apply:
    - Linear.
    - Exponential.
    - Higher order polynomial.
    - Radical.
    - Rational.
    - Logarithmic
- Other:
- No significant mathematical preparation is required.

Completed by:

Institution:

Name:

Title:

Department:

Discipline Team Preparation Guide

Preparation: Describe what your **students need to be quantitatively prepared** for your department's programs of study:

- What are the mathematical skills and abilities that students need in order to be prepared for upper-division coursework in your discipline? Please be specific.
    - Do you currently have a suggested or required default math course identified?
    - In general, are your students currently coming to you with sufficient and relevant mathematics preparation? Please explain.
- What do the national professional associations and accrediting bodies recommend in terms of quantitative learning outcomes for your discipline?
- What are the mathematical skills used in careers that students in your discipline pursue?
- Which **applications** of mathematics do students use most frequently in your discipline?
- Which of the following best describes how the certificates or degrees in your program connect to future credentials?
    - Our credentials are terminal. After our programs, there are no additional certifications or degrees at other institutions.
    - Our credentials could lead to additional credentials at other institutions.
- Are there any programs of study in this discipline that have mathematics requirements not shared by other programs in this discipline? Make note of any programs that have different mathematical requirements.
- Review the Program of Study Briefs for your discipline, if available. Currently available are:
    - *Emerging Solutions for Mathematics Education in Nursing*
    - *Mathematics for Business*
    - *Mathematics for Communications*
    - *Mathematics for Criminal Justice*
    - *Mathematics for Pre-Service Elementary (K-5) Teacher Education*
    - *Mathematics for Social Work*

Materials: Consider bringing the following resources to the meeting.

- Examples of the ways in which students in your program are expected to use mathematics. This may involve specific examples from a wide range of courses in the field of study.
- Examples of program-specific contexts that you would like to see incorporated into the mathematics courses, if possible.
- Guidance from national professional associations or accrediting bodies regarding the quantitative learning outcomes for the discipline.
- **If students commonly transfer to specific institutions to pursue further credentials in your program or discipline, bring those institutions' mathematics requirements.**

	Sample Meeting Agenda
5 minutes	**Set the charge.** **Identify shared goal:** • Work together toward identifying a default gateway mathematics course requirement that is most relevant for the programs of study in question. **Establish group norms:** • Recognize that everyone has expertise. • Honor requests for additional thinking time so everyone can participate. • Use specific examples and agree on definitions. • Presume positive intentions.
10 minutes	**Develop common understanding of the context.** • Math department provides background on the development of the survey of mathematical skills and the process for engagement. • Think time: Partner discipline(s) explores the survey of mathematical skills and identify questions.
30 – 40 minutes	**Develop common understanding of mathematical needs for these specific program(s) of study.** • Give partner discipline(s) an opportunity to ask questions about the Survey of Mathematical Skills, and address them as needed. • Discuss related materials, relevant applications and address other questions. • Understanding that it is not about the math department providing every mathematical skill; rather, it is about the two departments coming to an understanding of what skills are in the purview of the math department courses and what skills will be studied in the program courses.

5 – 10 minutes	**Plan future action.**
	
	Reflect on the discussion.
	• What progress has been made toward identifying a default mathematics course for the first year of the degree plan/academic map?
	• What additional information is needed to make progress on this decision?
	• When will this decision be finalized?
	
	Identify next steps.
	• Administrative support: What additional supports do you need to make this decision?
	• Communication:
	  ○ Who needs to be informed about this discussion?
	  ○ Who should be involved in future discussions?
	• Responsibility: Who is responsible for:
	  ○ Pursuing changes to degree plans/academic maps; organizing future discussions?

Course Design Tools

Models and Case Studies Webinar

This pre-recorded webinar provides an overview of the basic corequisite models, as well as some institutional examples of how the models have been adapted to suit each institution's context.

Course Calendar Templates – Instructor and Student Versions

Why: The content of support courses should be highly structured and based on the foundational skills that students need to be successful in the college-level course. In addition to the necessary mathematics, these skills should include academic mindsets instruction in growth mindset, belonging, and purpose and relevance, as well as learner strategies. For more on academic mindsets, see the Student Experience Research Network. The templates that follow are designed to facilitate the process of back mapping learning outcomes for the support course based on the college-level course.

Users: Course coordinators of college-level and corequisite courses. At minimum, mathematics faculty who share students in a college-level and corequisite course pairing should work together to create a common calendar. Ideally, the mathematics department collaborates to create a common calendar that is shared by all and facilitated by a common course in the Learning Management System.

Instructions:

1. Course design team should inspect the existing college-level course and ask:
    - Is there any missing or extraneous content, based on programs served and the next mathematics course in the sequence, if any?
    - What is the consensus on equity-focused and culturally inclusive pedagogies, procedural strategies, preferred notation, etc.?
    - Are academic mindset and learner strategy instruction needed in this course?
2. Beginning with the fourth column, create a day-by-day calendar.
3. In the last column, note the agreed-upon instructional strategies.
4. To determine the content of the support course, carefully consider the foundational skills needed for the fourth column. Schedule that content by backing up one to three days and list the support content in the second column. This column should also include academic mindset and learner strategy instruction.
5. The last column is removed to create the student-facing version of the course calendar.

Resources

Dana Center Mathematics Pathways Curriculum Design Standards
Dana Center Transition to College Mathematics Course Framework
Mathematics Foundations for Success in Introductory Statistics

Course Calendar Template – Instructor Version

Course:

Day/ Date	Support content (Math and Learner Strategies)	Day/ Date	(Course) Content	Notes on Instructional Strategies

Course Calendar Template – Student Version

Day/ Date	Support content	Day/ Date	(Course) Content

Course Design Recommendations: What to Adopt, Adapt, Avoid and Implement

Keep in mind that there is not a "best" model for corequisites; there are many successful ways to structure corequisites, depending on the student and faculty composition of your institution. However, best practices do exist.

Adopt/Adapt:

- Require structured content.
- Align content that gives students just-in-time remediation.
- Provide a sufficient number of hours of support based on student need.
- Run side-by-side or embedded remediation.
- Incorporate academic mindset and learner strategy instruction.
- Inspect data regularly.

Avoid:

- Running a traditional intermediate algebra course side-by-side with the college-level course.
- Determining hours of support based on what is easiest to schedule.
- Running an unstructured homework hour.
- Focusing solely on individual course pass rates (rather, inspect throughput).
- Offering an eight-week developmental followed by an eight-week college-level

Recommendations for Implementation

- Math faculty works together to reach consensus on each college-level course's topics and sequence, and develop a common course calendar.
- Math faculty back map from the common course calendar to achieve a common calendar for the corequisite supports activities.
- Math faculty collectively decide which academic mindset and learner strategy concepts to focus on.
- Department encourages faculty collaboration and communication.

- Department provides professional learning to faculty who previously taught developmental algebra but will now teach statistics support or quantitative reasoning support.
- Department engages in continuous improvement processes, including gathering qualitative and quantitative data from both students and faculty.
- Department works together regularly to inspect disaggregated data for inequitable outcomes and collaborates to propose and implement more equitable departmental- and classroom-level policies and practices.
- Department carefully considers whether to assign one grade or separate grades and how to address students who fail the college-level course or the support course. Be open to analyzing these decisions and changing if necessary.

Austin Community College in Texas created course notes with guided handouts and a bank of student activities to create consistency across course sections. The class starts with an activity with the students working collaboratively. If many students become stuck on the same concept or problem, the instructor brings the class together and provides an explanation.

Measures of Structural Change

Purpose

Measures of structural change assess the extent to which policies and practices create institutional conditions that yield equitable access to and experiences in corequisite mathematics for students. This guide offers a framework of defining key structural change measures that support high-quality corequisite design. The framework includes data gathering and interpretation, as well as implementation practices intended to improve student outcomes.

Users: Administrators and corequisite project leads.

What is the difference between structural change measures and student outcome measures?

The phrase "structural change" refers to the administrative policies and practices that create conditions for student success. Measures of structural change include placement policy, advising practice, multiple mathematics pathways, appropriate number of sections for corequisite courses based on enrollment projections, and proportional representation of student groups that are enrolled in corequisite math pathways courses based on overall enrollments or program of study designations.

Student outcomes are measured by indicators such as GPA, course grades, graduation rates, retention rates and social-emotional development. Student outcomes can vary as a result of structural changes, but often those improvements lag behind policy reforms.

Creating structures that attend to equitable access, opportunity and experiences may lead to equitable student outcomes that are sustainable as long as the right quantitative and qualitative data are consistently reviewed, updated, critically queried and used as the basis for action.

Each section below describes a key measure of structural change related to mathematics corequisites, along with guidance on data collection and interpretation. To determine equitable access and experiences, all data should be disaggregated by a variety of student groupings, including race/ethnicity, gender, age, socioeconomic status and other groupings relevant to the institutions' equity goals.

Structure 1: Placement policy definition

Placement policy refers to institutional structures governing the assessment of student readiness for college-level courses and the assignment to developmental supports for students assessed as

underprepared. The vast majority of those students should be provided supports via corequisite courses.[2, 3] Placement policies that are leading indicators of structural changes in support of student completion include the following:

- **Multiple measures** of readiness include high school performance indicators, such as high school GPA, high school mathematics course-taking and grades; do not privilege standardized tests.
- **Default placement** into college-level mathematics with corequisite supports for the vast majority of students assessed as underprepared.
- **A requirement to enroll** in mathematics within one year of matriculation or the first 30 credit hours in college.

Data collection for each of the placement policy areas	Notes
1. **Multiple measures:** Review state, system and institutional policy documents to determine the extent to which measures other than standardized tests are used in assessing student readiness. Student-level data from institutions/systems can be used to determine the accuracy of student placement. Multiple measures placement policies should be based on empirical evidence about the validity of measures in predicting outcomes of interest, in particular college-level course completion. All available evidence shows that high school GPA should be the primary indicator of readiness, and can be combined with test scores when appropriate. No standardized exams have validity tests that account for corequisite supports or multiple math pathways.	

2. Bahr, P. R., Fagioli, L. P., Hetts, J., Hayward, C., Willett, T., Lamoree, D., Newell, M. A., Sorey, K., & Baker, R. B. (2019). Improving placement accuracy in California's community colleges using multiple measures of high school achievement. Community College Review, 47(2), 178–211. https://journals.sagepub.com/doi/full/10.1177/0091552119840705

3. Uretsky, M.C., Shipe, S. L., & Henneberger, A. K. (2019). Upstream predictors of the need for developmental education among first-year community college students. Community College Journal of Research and Practice. DOI: 10.1080/10668926.2019.1655501

Data collection for each of the placement policy areas	Notes
2. **Default placement:** Data for this measure can be retrieved from multiple sources. Policy documents can indicate that corequisites are the default placement for the majority of students. Institutional scheduling data can be used to determine the amount of prerequisite developmental courses that are offered compared to college-level courses with corequisite supports. Finally, student-level data can be used to determine the observed instances of default placement practices. 3. **Enrollment:** Data for this measure can be accessed similarly for other measures in this category. Policy documents and student-level data can reveal the extent to which enrollment within one year of matriculation is both required and achieved.	

Since implementation began, the number of students with access to college-level math in their first year in college grew from 47 percent in 2014–15 to 95 percent in 2018–19.

— ROANE STATE COMMUNITY COLLEGE, TENNESSEE

Interpretation for each of the placement policy areas	Notes
1. **Multiple measures:** Moving from traditional placement policies (e.g., using standardized tests and firm cut scores) to modernized placement policies (prioritizing high school GPA and additional measures of readiness) are key signals of structural changes. The success of these changes should be measured by the number and proportion of students that gain access to college-level courses compared to the prior system, and the rate at which students placed under new measures successfully complete college-level coursework. In addition, placement measures can be reviewed annually and updated to improve the accuracy of placement for future cohorts. Finally, data from student and family surveys can be examined in conjunction with the accuracy of placement measures to determine whether changes in policy practice are warranted. 2. **Default placement:** This measure helps identify which policies permit students to enroll in certain courses, and what exceptions may exist to the default practice of enrolling students in gateway classes with corequisite supports. 3. **Enrollment**: Research shows that completing key gateway courses in programs of study within one year of enrollment helps students gain momentum toward degree completion[4]. Policies that require students to enroll in gateway courses early in their academic career increase the likelihood that students will go on to complete a degree or to transfer. This is particularly important in mathematics, as many students have anxiety or limited self-efficacy in math and frequently delay completing these courses.	

4. Belfield, C. R., Jenkins, D., & Fink, J. (2019). Early momentum metrics: Leading indicators for community college improvement. CCRC Research Brief. https://ccrc.tc.columbia.edu/media/k2/attachments/early-momentum-metrics-leading-indicators.pdf.
Wang, X. (2017). Toward a holistic theoretical model of momentum for community college student success. In Paulsen, M. B. (Ed.) Higher Education: Handbook of Theory and Research, Volume 32 (pp. 259–308). Cham, Switzerland: Springer International Publishing.

Structure 2: Advising practices definition

Advising practices consist of interpersonal practices, such as advisors counseling students into corequisite supports rather than prerequisite developmental courses. They also include tools and resources that inform students and families of options and offer advice such as informational media and self-advisement tools. Media and other communications should consistently and predictably advise students on the processes for developmental education assessment, enrollment in corequisite courses and identifying the appropriate mathematics pathway (see Structure 3).

Data collection for advising practices	Notes
Collect data through reviews of advising media, interviews with advisors, and data from students and families who were identified as in need of developmental education. Consult advisors and review advising resources to determine if and how advisors use multiple measures to identify students in need of developmental education. Survey, interview and/or conduct focus groups with advisors to get a deeper understanding of how advisors inform and engage students and families.	
Interpretation of advising practices data	**Notes**
Advisors should consistently and equitably use all measures and rules for identifying students for developmental education and placing students in corequisite courses. If advisors are not doing so, a revision of policies, advising processes and practices, and training of advisors may be necessary. Use feedback from students to determine students' experiences with advisors, including what advisors tell students, what media advisors make accessible to students and families, etc.	

Structure 3: Multiple mathematics pathways definition

This measure captures the degree to which an institution has aligned relevant mathematics courses to programs of study. Traditionally, at many institutions, college algebra has been the default gateway course for all students. However, professional associations of mathematicians recommend that college algebra only be required for students enrolled in programs of study that also require calculus. Instead, mathematics courses such as statistics, quantitative reasoning and mathematical modeling are more relevant for programs that do not require calculus. The appropriate default course should be defined by faculty in the program of interest, along with recommendations for the appropriate professional associations. Additionally, departments in related fields (meta-majors) should collaborate to determine a common default course. If an institution has a large number of programs, consider beginning this process by focusing on the top 10 programs of study based on total student enrollment.

Data collection for mathematics pathways practices	Notes
Collect data by reviewing degree plans or academic maps to determine whether a single mathematics course has been identified as the default gateway course for each degree or credential program. Review student and course enrollment data to determine whether students are completing the default mathematics course. Check for over-representation of students in college algebra compared to the proportion of students in programs that require college algebra (i.e., students are taking college algebra when their program requires a different mathematics course).	
Interpretation of mathematics pathways practices data	**Notes**
Focusing on the top 10 programs of study as the starting point for alignment gives institutional decision-makers a limited set of programs to target initially, while ensuring that large numbers of students gain access to relevant gateway courses. At most institutions, the top 10 programs of study vary in terms of quantitative skills required; many STEM programs, for example, require calculus, while most programs in non-STEM areas do not. The frequency of each gateway course can be counted. If all 10 programs require college algebra, then it is unlikely that students are taking the most relevant gateway course for their academic and professional needs. Given this framework, the vast majority of students should be required to take statistics, quantitative reasoning or modeling courses if their programs do not ultimately require calculus.	

Structure 4: Sufficient corequisite course offerings definition

This measure captures the degree to which institutions are effectively operationalizing corequisite courses by offering sufficient numbers of corequisite course sections in each mathematics pathway. They must also create the conditions for students to access those courses by offering them at a variety of times and in a variety of modalities to meet students' needs. Additionally, consider the appropriate maximum number of students that may be enrolled in each section. This measure focuses on establishing enough sections of gateway mathematics courses, with aligned corequisite supports, to enable all students to enroll within one year of matriculation.[5]

Data collection for course offerings practices	Notes
Review the number of first-year, first time (FYFT) students enrolled in each program of study to determine the number of seats needed in each gateway mathematics course. Review the number of students assigned to developmental education enrolled in each program of study to determine the number of seats in corequisite courses needed. Use the enrollment caps to determine the number of sections needed. Compare results with actual course offerings. If first-year enrollment in mathematics has not been the norm, offerings will need to increase to include returning students who have not yet completed their mathematics requirement.	
Interpretation of course offerings data	**Notes**
Based on enrollment caps and the number of students in each program of study, determine if the institution offers the appropriate number of sections for corequisite and gateway courses. For example, if class sizes are capped at 25 students, and 97 students have declared a major that requires a statistics course, at least four sections of statistics should be offered. If sufficient sections of corequisite or gateway courses in each math pathway are not offered, the institution may not be meeting students' needs. This may be an indication that faculty need to teach more course sections, the number of adjunct faculty needs to increase, and/or the institution needs to engage in creative mechanisms to ensure students have equitable access to the courses they need to take.	

5. Robles, S., Gross, M., & Fairlie, R. W. (2020). The Effect of Course Shutouts on Community College Students: Evidence from Waitlist Cutoffs. (EdWorkingPaper: 20-314). https://doi.org/10.26300/xkck-3b89

Structure 5: Ensuring proportional representation definition

Student groups should be proportionally enrolled in corequisite courses based on proper identification for developmental education. The goal is to consistently and equitably identify students' needs and place them in courses that lead to their success. Racially minoritized student groups should not be disproportionately assessed as needing or assigned to developmental education.

Data collection for proportional representation practices	Notes
Collect student-level demographics on the number of FYFT students who were assigned to developmental education and who were enrolled in corequisite courses. Obtain this value for the following student groups: • Race/ethnicity • Gender • Socioeconomic status • Age • Intersectionality (e.g., Black males) By dividing the number of FYFT freshmen assigned to and enrolled in corequisite courses by the total number of FYFT freshmen assigned to developmental education courses, the rate of enrollment in corequisite courses will be obtained. By obtaining percentages by student group, over- or under-representation of student groups enrolled in corequisite courses will be obtained.	
Interpretation of proportional representation data	**Notes**
When student groups are under- or over-identified as enrolled in corequisite courses, this may be a signal that inequities exist in policies and/or practices. Race/ethnicity and other demographic identifiers should not be factors that determine student enrollment in corequisites. Institutions may need to examine resource allocations, course offerings, staffing, etc., if students cannot be enrolled in corequisite courses based on criteria that indicate they should be enrolled.	

Assessment Rubric

Rubric for Design and Delivery of Corequisite Math

Purpose:
Use this rubric to assess your college's status in implementing each principle for design and delivery of corequisite mathematics instruction.

Users:
Implementation team members.

Instructions:
Rate your institution on a scale using the categories Advanced Practice, In Progress or Emerging Practice. The rubric includes a description of the evidence that indicates progress within each category. You will not be asked to provide this evidence, but use it in your own determination.

"As a department, we had started to see corequisite data from other places, and it was a no-brainer to move away from what we were doing—it wasn't working."

—CHRISTINE BENSON, THEN-CHAIR OF THE MATH DEPARTMENT, NORTHWEST MISSOURI STATE UNIVERSITY

Corequisite Principle 1: Corequisite Math Course Objective

The objective of a corequisite math program is to ensure that each student:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
1.1 Enrolls in a college-level math course aligned to their program of study within the first year of enrollment.	At least 80% of students are intentionally advised into the appropriate math pathway based on their program of study.	Fifty to 79% of students are intentionally advised into the appropriate math pathway based on their program of study.	Less than 50% of students are intentionally advised into the appropriate math pathway based on their program of study.	Student enrollment in mathematics pathways courses (statistics, college algebra, quantitative reasoning, business math, teacher math, other). Comparison of student enrollment in programs of study to college-level math course enrollment.
	At least 80% of first-year, first time (FYFT) students are enrolled into a gateway mathematics course.	Fifty to 79% of FYFT students are enrolled into a gateway mathematics course.	Less than 50% of FYFT students are enrolled into a gateway mathematics course.	
1.2 Is assessed using evidence-based measures to determine their needs for additional academic support.	At least 80% of students are advised using multiple measures for mathematics placement.	Fifty to 79% of students are advised using multiple measures for mathematics placement.	Less than 50% of students are advised using multiple measures for mathematics placement.	• Use of multiple measures for student placement and advising. • Advising protocols.
1.3 Receives those supports through just-in-time corequisite supports.	At least 80% of students with developmental placements are intentionally advised into college-level mathematics courses with corequisite supports.	Fifty to 79% of students with developmental placements are intentionally advised into college-level mathematics courses with corequisite supports.	Less than 50% of students with developmental placements are intentionally advised into college-level mathematics courses with corequisite supports.	• Corequisite course offerings. • Student enrollment in corequisite courses. • Student passing rates for corequisite courses, disaggregated by preparation level and demographic group.

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
1.4 Completes the gateway math course with the relevant skills and knowledge essential to succeed in their program of study.	At least 70% of FYFT students pass a gateway mathematics course within one year of enrollment.	Fifty to 69% of FYFT students pass a gateway mathematics course within one year of enrollment.	Less than 50% of FYFT students pass a gateway mathematics course within one year of enrollment.	• Student gateway math completion in one year. • Student gateway math completion in two years. • Persistence rates. • Degree or certificate completion. • Transfer rates.
	Mathematics requirements for the institution align with recommendations from professional organizations.	Mathematics requirements for the institution weakly align with recommendations from professional organizations.	Mathematics requirements for the institution do not align with recommendations from professional organizations.	
1.5 The implementation of math pathways with corequisite supports is a component of comprehensive institutional policies and practices designed to result in students' greater enrollment and success in programs of study, with special attention to programs that provide opportunities for upward economic mobility and income equality.	For example, populations of racially minoritized students are enrolled in corequisite courses at significantly higher rates than they enroll in non-credit bearing prerequisite courses.	For example, populations of racially minoritized students are enrolled in corequisite courses at higher rates than they enroll in non-credit bearing prerequisite courses.	For example, there is a clear underrepresentation of racially minoritized student populations enrolling into corequisite courses compared to the rate at which they enroll into non-credit bearing prerequisite courses.	• Disaggregated data* by student ethnicity, gender, SES (using Pell eligibility), age, part-time/full-time status and other categories, as well as intersectionalities of these categories. • Overall enrollment. • Developmental determinations. • Corequisite course enrollment. • Corequisite course completion.
	Students from all demographic groups pass corequisite courses at high and equal rates.	There is variation in corequisite pass rates among different demographic groups.	There is wide variation in corequisite pass rates among different demographic groups.	
	Except for students who require calculus for their program of study, populations of racially minoritized students enroll in mathematics pathways courses at significantly higher rates than they enroll in intermediate algebra or college algebra courses.	Except for students who require calculus for their program of study, populations of racially minoritized students enroll in mathematics pathways courses at higher rates than they enroll in intermediate algebra or college algebra courses.	There is a clear underrepresentation of racially minoritized student populations enrolled in mathematics pathways courses.	
	Populations of racially minoritized students enroll into STEM and other programs that provide upward economic mobility at the same rate as they enroll into the college or university.	Populations of racially minoritized students enroll into STEM and other programs that provide upward economic mobility at the same rate as they enroll into the college or university.	There is a clear underrepresentation of racially minoritized student populations enrolling into STEM and other programs that provide upward economic mobility compared to the rate at which they enroll into the college or university.	

Corequisite Principle 2: Corequisite Math Course Design Process

Institutions that successfully implement a corequisite math course:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
2.1 Identify and dismantle policy and practice barriers that deny students access to college-level math courses and result in unequal student outcomes. Doing so will ensure that each student has access to, and successfully engages in, high-quality, college-level math courses in their first term.	See Rubric Items 7.1–7.3 At least 80% of FYFT students enroll in a college-level mathematics course in their first academic year rather than a non-credit bearing course.	Fifty to 79% of FYFT students enroll in a college-level mathematics course in their first academic year, rather than a non-credit bearing course.	Less than 50% of FYFT students enroll in a college-level mathematics course in their first academic year, rather than a non-credit bearing course.	See Rubric Items 6.1–6.6 • Student enrollment in college-level courses over time. • Enrollment in corequisite courses.
2.2 Establish processes for implementing, assessing, improving and scaling corequisite courses that involve key institutional stakeholders (e.g., administrators, faculty, instructional designers, advisors, student support services, financial aid professionals and registrars.)	A leadership team is in place and it includes administrators, faculty, instructional designers, institutional researchers, student support services, financial aid professionals and registrars. The leadership team has created a plan for moving from implementation to scaling corequisite courses with clear processes and responsibilities. This plan has been shared with key stakeholders.	A leadership team is in place and it includes administrators, faculty and support services (advisors). A plan is in place for beginning to implement corequisite courses with assigned responsibilities. The plan has been shared with involved parties.	One or two individuals make the key decisions for this initiative. The individuals in charge of implementing corequisite courses have an informal plan.	See Rubric Item 7.2 • Leadership team membership. • Implementation plan. • Scaling plan.

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
2.3 Understand the postsecondary experiences of students, use this understanding in design decisions, and pay particular attention to the impact of design decisions on racially minoritized communities.	See Rubric Items 6.1–6.6			See Rubric Items 6.1–6.6
2.4 Implement corequisite model(s) that will most effectively achieve equal access and success for each student and ensure these models are sustainable within their institutional context.	Equity was a key consideration for the leadership team when choosing a corequisite model.	Equity was a factor when choosing a corequisite model.	Equity was not considered when choosing a corequisite model.	• Artifacts representing the leadership team's considerations of equity and sustainability, including strategic plans, communications materials, advising materials, presentations, policies, etc.
	Sustainability was a key consideration for the leadership team when choosing a corequisite model.	Sustainability was a factor when choosing a corequisite model.	Sustainability was not considered when choosing a corequisite model.	

Corequisite Principle 3: Corequisite Math Course Design Elements

Essential elements of effective corequisite math courses include:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
3.1 Enrollment of students in the college-level math course aligned to their chosen program path.	See Rubric Item 1.1			See Rubric Item 1.1
3.2 Sections of the college-level course with corequisite supports that are identical in content and learning outcomes to those available to students in non-corequisite sections.	The content of the college-level course with corequisite supports is exactly the same as the standard college-level course.	The content of the college-level course with corequisite supports is similar to the standard college-level course, but some content has been added or removed.	The content of the college-level course with corequisite supports is substantially different from the standard college-level course.	• Syllabi for college-level course with corequisite supports. • Syllabi for standard college-level course.
3.3. Content in the corequisite supports course that is explicitly aligned and organized to support student learning and success in the college-level course.	The content of the corequisite supports course aligns exactly with the content of the college-level course.	The content of the corequisite supports course is somewhat aligned to that of the college-level course, with some areas that are not supported.	The content of the corequisite course is either not explicitly specified or focuses on general skills.	• Syllabi for corequisite supports courses.
3.4 Support content that is provided in a single term side-by-side or embedded within the college-level course, not as a precursor to the college-level content.	The corequisite supports course has curriculum that is designed to provide just-in-time support for the college-level course within a single semester.	The corequisite supports course runs concurrently with the college-level course, but either does not have an explicit curriculum or has a curriculum that is not well-aligned with the college-level course.	The corequisite supports course is completed before the college-level course begins (8-week/8-week model or 4-week/12-week model).	• Syllabi for corequisite supports courses.

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
3.5 Strategies to boost academic confidence, sense of social belonging, and understanding of the relevance of the math concepts and to achieving academic, career and personal goals.	Student success strategies and social emotional content are embedded in the curriculum of the mathematics courses.	Services outside of the classroom promote social belonging and strategies to boost academic confidence.	Student success strategies and social emotional content are not available for students.	• Syllabi for corequisite supports courses. • Syllabi for college-level course with corequisite supports.
3.6 Policy stating that successfully completing the college-level course, regardless of the grade in the corequisite supports course, is the only requirement for students to earn college-level credit and move on to subsequent courses in the math pathway and/or program of study aligned to the gateway course.	A policy is in place that states that passing the college-level course is all that is required to receive full credit and be eligible to move on to the next math course.	Individual instructors make decisions on whether or not students must pass their corequisite supports course to receive full credit for their college-level course.	Students are required to pass both the corequisite supports course and the college-level math course to receive full credit.	• Advising protocols. • Advising policies. • Mathematics department course policies.
3.7 Consistent instructional practice across the college-level math course and corequisite supports course that supports each learner's needs in order to achieve equal outcomes for students, regardless of race, income, age, gender or other minoritized status.	Common instructional practices are evident in the college-level math course and the corequisite course. Equity: See Rubric Item 1.5	Instructional practices in the college-level math course and the corequisite course are similar with some small differences.	Instructional practices in the college-level math course and the corequisite course are distinctly different. As an example, the corequisite support course may be offered as a self-guided computer module.	See Rubric Item 1.5 • Classroom observations. • Instructor surveys. • Student surveys.

Other corequisite math courses design elements depend upon the needs of the student population and institutional context. Institutional teams examine available research on effective practices and local data to make decisions on design elements. The Corequisite Structure Decision Schema supports this process.

Corequisite Principle 4: Course Enrollment Practices

Institutions that successfully deliver the instruction students need to achieve their academic goals:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
4.1 Identify and enroll all students in the gateway math course consistent with their academic goals and chosen program of study, regardless of any assessment of their preparation level for that course.	See Rubric Items 1.1, 1.3			See Rubric Item 1.3
4.2 Assess students to ensure instruction and academic support will maximize their success in the college-level math course, not determine access to the college-level course.	See Rubric Items 1.3, 4.3			See Rubric Item 1.3
4.3 Assess the need for support through multiple evidence-based measures, including, but not limited to, high school GPA and grades in high school mathematics.	Listed in Rubric Item 1.2 Advisors use multiple measures, including high school GPA, with all students when determining if a student requires corequisite supports courses.	Advisors use multiple measures, including high school GPA, to determine corequisite placement for students who have tested "on the bubble."	Advisors use multiple measures, including high school GPA, only in rare circumstances.	• Advising protocols.
4.4 Make corequisite supports mandatory for students when the evidence-based measures referenced above show corequisite supports will increase the likelihood that they will pass the college-level course.	Corequisite courses are mandatory for all students with a developmental placement, and at least 80% of students with a developmental placement enroll into college-level courses with corequisite supports.	All students are advised into college-level courses, and corequisite support courses are optional for students with a developmental placement.	Not all students are advised into college-level courses, and corequisite courses are not available to all students with a developmental placement.	• Advising protocols. • Course catalogues.

Corequisite Principle 5: Integration with a Comprehensive Student Success Framework

Institutions that implement comprehensive student success frameworks:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
5.1 Align math pathways to other institutional pathways initiatives.	Leaders of math pathways initiative have aligned the work with other pathways initiatives taking place at their institution.	Leaders of math pathways initiative are aware of other pathways initiatives taking place at their institution and are moving toward alignment.	Leaders of math pathways initiative have not taken into account other pathways initiatives at their institution.	• Institutional pathways documentation (where applicable).
5.2 Include corequisite math supports as an essential strategy for increasing the likelihood that students achieve critical first-year momentum. Metrics to include: completing gateway math and English, earning 30 credits, enrolling into and earning at least nine credits in a program of study in their first academic year.	Corequisite math supports are listed as an essential strategy for achieving first-year momentum metrics.	Corequisite math supports are informally seen to be important to achieving first-year momentum metrics, but they are not officially listed as a part of the work.	Corequisite math supports are not seen as relevant by those working to achieve first-year momentum metrics at the institution.	• Momentum metrics. • FYFT gateway math course completion, longitudinal. • FYFT persistence. • FYFT enrollment in programs of study or meta-major.
5.3 Design math courses and corequisite supports to meet the specific needs of their student population. Understand and address how policies and practices impact subpopulations differently.	Math courses at this institution are designed with an equity lens.	Math courses at this institution are designed to serve all students, without taking any particular groups into account.	Math courses at this institution are not designed with equity or the needs of particular groups in mind.	• Disaggregated course enrollment data in corequisites. • Disaggregated course completion data (A, B, C, CR) in corequisites. • Description of the course design process.
	Stakeholders at this institution understand how policies and practices impact subpopulations differently.	Stakeholders at this institution are beginning to investigate how policies and practices might impact subpopulations differently.	Stakeholders at this institution do not consider how policies and practices might impact subpopulations differently.	

Corequisite Principle 6: Continuous Improvement

Institutions that deliver an equitable, high-quality learning experience that maximizes the success of each student:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
6.1 Collect, analyze and act upon disaggregated quantitative and qualitative data that measure the impact of course design, course content, instructional strategies, placement policies and other relevant institutional or state policies on the success of students by race/ethnicity, income level, gender, age or other minoritized status.	See Rubric Items 6.2–6.6			See Rubric Items 6.2–6.6
6.2 Collect qualitative data that capture the experiences of students and faculty, and examine the messaging students receive about math pathways, corequisites and other types of supports.	Qualitative student data have been gathered and analyzed to better understand what messages students are receiving about math pathways and corequisite supports.	Plans for gathering and analyzing qualitative student data are in place.	There are no plans in place for gathering and analyzing qualitative student data.	• Faculty interviews. • Student interviews. • Open-ended survey responses.
	Faculty understanding of math pathways and corequisite supports has been analyzed using qualitative data.	Plans for gathering and analyzing qualitative faculty data are in place.	There are no plans in place for gathering and analyzing qualitative faculty data.	

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
6.3 Establish clear measures of success that include the number and percentage of students completing a college-level math course and mid- and long-term measures, such as retention, success in subsequent courses and completion of a certificate or degree.	The institution has set clear goals and benchmarks for all of the following: • College math course completion in one year. • College math course completion in two years. • Student retention between semesters. • Student success in subsequent courses. • Certificate completion in two years. • Degree completion in two or four years, depending on sector. • Transfer in two years.	The institution has set clear goals and benchmarks for some of the following: • College math course completion in one year. • College math course completion in two years. • Student retention between semesters. • Student success in subsequent courses. • Certificate completion in two years. • Degree completion in two or four years, depending on sector. • Transfer in two years	The institution has not yet set clear goals and benchmarks for student success.	• Gateway course enrollment. • Gateway course completion in one year. • Gateway course completion in two years. • Transfer in two years. • Transfer in four years. • Semester to semester retention rates. • AA degree completion in two years. • AA degree completion in three years. • Bachelor's degree completion in four years. • Bachelor's degree completion in six years. • Certificate completion in two years.
6.4 Use data to continuously improve and refine both the college-level course and corequisite supports and related practices, including placement and advising.	Faculty and staff have a strong understanding of how to use data for continuous improvement and might have some experience doing this work.	Faculty and staff have some understanding of how to use data for continuous improvement.	Faculty and staff are not aware of how data are involved in continuous improvement.	See Rubric Item 6.3
	Institutional leadership is gathering data that will be used to identify areas for positive change.	Institutional leadership has data on the success of these initiatives and is planning to make change, but is not sure how the two connect.	Institutional leadership is not planning to make further refinements to the college-level course and corequisite supports.	

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
6.5 Use data to identify, understand and address the needs of students who are not well served by the corequisite supports.	Data have been disaggregated in a variety of ways to determine if there are any groups who are not well served by corequisite supports.	Data are being used to determine the overall efficacy of corequisite courses and for general course improvement.	Data are not currently available or there is limited capacity for analysis.	• Disaggregated student enrollment data. • Disaggregated student corequisite course enrollment data. • Disaggregated student corequisite passing data with A, B or C.
	Data are being used to make decisions about what additional supports should be made available for students.	Data are being used to re-enroll students who did not pass their college-level math courses.	Data are not being used to address student needs.	
6.6 Explicitly identify, understand and address factors that contribute to the success or struggles of students from minoritized communities in college-level mathematics courses.	Data have been disaggregated in a variety of ways to determine if there are any minoritized groups who are not well served by corequisite supports.	Data have been used to determine the overall efficacy of corequisite courses and for general course improvement, but not with an equity lens.	Data are not currently available or there is limited capacity for analysis.	See Rubric Item 6.5

Corequisite Principle 7: Policy

States, systems and institutions that successfully scale corequisites:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
7.1 Adopt policies that create the enabling conditions for each student to enter directly into and succeed in a gateway mathematics course aligned to their goals.	Explicit written policies exist that require faculty and advisors to enroll students into the gateway mathematics course aligned with their program of study.	Informal policies exist around gateway course placement.	There is no clear policy around gateway course placement.	• Advising protocols. • Math department course policies.
	Explicit written policies exist that require advisors and faculty to enroll all developmental students into gateway math courses with corequisite supports.	Informal policies exist around corequisite course placement.	There is no clear policy around corequisite course placement.	
	All advisors are aware about policies surrounding math course placement.	Most advisors are aware of the policies around math course placement.	A majority of advisors do not know the policies around math course placement.	
7.2 Involve institutional leaders and faculty in developing, designing and advocating for policies to support the implementation of math corequisites.	Institutional leaders are a part of the leadership team and/or planning process around math corequisites.	Institutional leaders have been vocal in their support of math corequisites.	Institutional leaders have had limited or no involvement in math corequisites.	• Leadership team membership.
7.3 Design policies to ensure that corequisite math courses are accessible to all students who are assessed as needing additional academic support, and to address structural and systemic inequities present in entry-level mathematics programs.	See Rubric Item 7.1			• Advising protocols. • Advising policies. • Math department course policies.

Corequisite Principle 8: Professional Development and Support of Stakeholders

Institutions that successfully implement and scale corequisite math, and design professional development and other supports:

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
8.1 Build the capacity of faculty to design, deliver and continuously improve corequisite math at their institution, with supports for different stages of the implementation process.	All math faculty involved in designing corequisite math courses are given professional development and/or support. Funding or release time is provided.	Support in designing corequisite math courses is available to faculty who seek it out. Funding or release time is provided.	Faculty can seek out professional development on designing corequisite math courses with their own time and funding.	• Professional development attendance records. • Professional development evaluations.
	All math faculty, including adjunct faculty, are given professional development to implement corequisite mathematics courses. Funding or release time is provided.	Support in implementing corequisite math courses is available to faculty who seek it out. Funding or release time is provided.	Faculty can seek out professional development on implementing corequisite math courses with their own time and funding.	
	All math faculty, including adjunct faculty, are given professional development and/or support to improve coreq-uisite mathematics courses. Funding or release time is provided.	Support in improving corequisite math courses is available to faculty who seek it out. Funding or release time is provided.	Faculty can seek out professional development on improving corequisite math courses with their own time and funding.	
8.2 Facilitate collaboration among diverse stakeholders, including institutional researchers, administrators and student support professionals.	Institutional researchers, faculty, administrators, advisors, registrars, financial aid professionals and student support professionals are embedded in the decision-making around math pathways and corequisite implementation.	Institutional researchers, faculty, administrators, advisors, registrars, financial aid professionals and student support professionals are consulted occasionally in the decision-making around math pathways and corequisite implementation.	One or two individuals make the key decisions around math pathways and corequisite implementation without consulting other stakeholders.	• Leadership team membership.

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
8.3 Deploy inclusive pedagogies and practices that maximize the success of students from racially minoritized communities.	At least 80% of instructors use inclusive pedagogies throughout their courses.	Fifty to 79% of instructors use inclusive pedagogies throughout their courses.	Less than 50% of instructors use inclusive pedagogies in their courses.	• Disaggregated college-level math course completion data. • Disaggregated corequisite course completion data. • Classroom observations.
8.4 Enable faculty, advisors and student services staff to maintain and build the academic mindset of students. Faculty and advisors receive support on having a growth mindset about students.	The institution offers staff training on academic mindsets to all faculty, advisors and student services staff.	The institution encourages faculty, advisors and student services staff to seek out training on academic mindsets with some economic incentive.	The institution recommends that faculty, advisors and student services staff attend training on academic mindsets.	• Professional development attendance records. • Professional development evaluations. • Faculty, advisors and student services staff surveys. • Student mindset surveys for a sample population, pre- and post. • Student interviews or focus groups.
	At least 80% of faculty, advisors and student services staff have been trained in academic mindsets.	Fifty to 79% of faculty, advisors and student services staff have been trained in academic mindsets.	Less than 50% of faculty, advisors and student services staff have been trained in academic mindsets.	
8.5 Inform faculty, advisors and student services staff of how students can access additional social supports.	Extensive student social supports are available on campus.	Some student social supports exist on campus.	Student social supports are not available on campus.	• Survey of student support staff (financial aid, testing, tutoring, registrar, advising). • Student survey.
	Advisors are given clear information on how students can access social supports.	Some advisors are aware of available social supports for students.	Advisors are not aware of any available student social supports.	
	Faculty are given clear information on how students can access social supports.	Some faculty are aware of available social supports for students.	Faculty are not aware of any available student social supports.	

Design Principle	Advanced Practice 3	In Progress 2	Emerging Practice 1	What Evidence Can be Used to Indicate Level of Implementation?
8.6 Sustain support and engagement from all institutional stakeholders responsible for the successful implementation of corequisite math. In particular, advisors receive support on equitable practices when advising for math pathways.	Stakeholders meet more than once per semester to evaluate progress and plan for the future.	Stakeholder groups meet at least once per semester to evaluate progress and plan for the future.	Stakeholder groups meet at least once per year.	• Stakeholder meeting attendance. • Professional development attendance records. • Professional development evaluations. • Disaggregated student population data in each pathway and/or program.
	All advisors are given professional development in equitable practices (e.g., mindsets instruction, moving from a needs-based to a strengths-based model, identifying implicit biases) when advising for math pathways.	Advisors have received training in advising for math pathways, but without an equity lens.	Advisors have received no training in equitable advising or in advising for math pathways.	

Policy Typology

State and higher education system policy is an increasingly important factor driving the adoption and scale of corequisite mathematics. In a national survey from 2019, researchers at MDRC asked respondents to identify the most influential factors driving their institutions' decision to adopt corequisites.[6] The results found that, on average, state policy is cited less frequently than other factors. However, in states that have strong mandates for corequisites (such as Tennessee, Georgia and Texas) policy is identified as an essential driver for scaling reforms.

Since state- and system-level policies have the power to define what counts as "corequisite mathematics" and establish the rules for how institutions scale student supports, it is imperative that policies account for the evidence-based best practices identified in the Corequisite Design Principles. To that end, this typology uses policy-relevant criteria derived from the Corequisite Design Principles to evaluate whether or not state policies establish standards for high-quality, equitable corequisite structures. There are more than a dozen states and systems included in the analysis, each of which is funded by SSTF.

The analysis primarily considers official documents, such as state legislation or administrative rules, that explicitly mandate that institutions of higher education adopt corequisite mathematics. Since many of the states and systems that we reviewed are voluntarily adopting corequisite math supports in the absence of a policy mandate, there are relatively few examples of policies that meet the high standards established in the Corequisite Design Principles. However, the examples that do exist can offer valuable lessons for policy leaders to consider while formulating corequisite mathematics policies.

The sections below offer a summary of the key findings from the state policy scan. The full dataset can be found here.

Rutschow, E. Z., Cormier, M. S., Dukes, D., & Zamora, D. E. C. (2019). The Changing Landscape of Developmental Education Practices: Findings from a National Survey and Interviews with Postsecondary Institutions. Center for the Analysis of Postsecondary Readiness.
Retrieved from https://www.mdrc.org/publication/changing-landscape-developmental-education-practices.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
1. Objective	The policy articulates that the goal of the reforms are to: • Increase student success in college-level math courses in their first academic year. • Enroll students in college-level math courses that are aligned to a student's program of study. • Deliver corequisite supports that would increase the likelihood of students completing the college-level course.	Policies intended to scale corequisite math should include language that specifically articulates objectives identified in the criteria. Policies that do not include a clear statement of purpose run the risk of having institutions designing interventions that may focus on only some of the essential elements of a corequisite strategy, employ corequisites without fidelity to the primary objective, or focus on entirely different objectives altogether. Among the policies examined, very few met all three components of the established criteria. Consequently, implementation and results achieved may not be aligned with the benefits of the intervention. Without the policy focusing on enrolling students in college-level math courses aligned to their academic goals, institutions may engage in advising and registration practices that could track students into programs of study misaligned with their goals. This creates the possibility for inequitable access for Black, Latinx and other racially minoritized communities. Without expressly articulating that corequisites should be implemented to support students who require additional academic support, students may still be placed into either prerequisite remedial courses or other interventions that don't have the evidence base to support student success.	The Colorado Commission on Higher Education Approved Policy, Section 1, Part E articulates that the objective of the state policy to implement corequisite supports and multiple measures for placement is to increase student success in college-level math courses in the first academic year, and to deliver corequisite supports to increase the likelihood that students complete a college level course. The policy does not specifically articulate the objective to make sure students are placed in the appropriate gateway course aligned to a student's program of study. As a result, it is possible that students could be placed into math courses that are not aligned to a student's postsecondary goals.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
2. Design Process	The policy: • Makes clear that traditional pre-requisite remediation models are ineffective and have a disproportionately negative impact on Black, Latinx, Indigenous or other students from minoritized communities. • Eliminates the use of ineffective and inequitable prerequisite remedial courses. • Defines scaled implementation as placing students in the college-level math course aligned to their program of study and/or the corequisite supports that will maximize their likelihood of completing the college-level math course in their first academic year. • Clarifies when an institution should fully implement reforms. • Expects implementation to result in both improved and equitable outcomes for students.	In order to make the case for reform, policies should articulate the evidence-based rationale for change and provide actionable guidelines for implementing, scaling and evaluating the policy. In particular, research demonstrating how traditional prerequisite remediation contributes to educational inequity for racially minoritized students needs to be made clear to those responsible for implementation. Likewise, the strong evidence in support of corequisite supports, above all other interventions, suggests that policies that allow for other interventions without a similar evidence base risk not maximizing the impact of the interventions. There are several excellent examples of specific design process components, but no states fully met the criteria. Most fall short by not being clear about their definition of scale. Some still allow for some prerequisite remedial education, while others don't guarantee access to the college-level course in their program of study or that the goal is to complete the college-level course in the first academic year. Finally, the policies did not expressly set a goal of achieving more equitable outcomes.	The University System of Georgia's Corequisite Learning Support Manual clearly articulates that because of the ineffectiveness traditional remedial education, the system will end the practice of prerequisite remedial education and implement corequisite supports. The policy also makes clear that the result of the reforms will be improved and more equitable outcomes. The policy does not specify that students should be placed into the course aligned to their program of study.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
3. Elements	The policy: • Clearly defines a corequisite course as enrolling students in college-level courses and providing just-in-time academic support while the student is enrolled in the college-level course. • Articulates design elements for corequisites that are consistent with research and evidence-based practice. • Allows for varied implementation based on institutional capacity, institutional resources and the students they serve.	Policies should strike a balance between a clear definition of the term "corequisite" to include the implementation of evidence-based practices that have proven to improve student success, while allowing flexibility for faculty to implement corequisite supports within their particular context — mindful of constraints such as institutional resources and student enrollments. Most of the policies had clear definitions requiring corequisite supports to occur in the same semester as a student enrolls in a college-level course. Some of the definitions were either unclear or explicitly allowed academic support to precede delivery of the content in the college-level course. As a result, some policies allow for models that permit several weeks of remedial content to be delivered, followed by the college-level content. Many of the policies did not meet that standard. Very few policies articulated evidence-based design elements; but those that did made sure to outline the number of credits for a corequisite course, and in some cases made clear how to align instruction between the college-level course and the corequisite.	California State University System Executive Order 1110 provides a clear definition of a corequisite course as enrolling a student in college-level courses and providing just-in-time academic support while the student is enrolled in the college-level course. The policy articulates design elements that are consistent with research and evidence-based practice, but also provides for varied implementation by institutions.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
4. Enrollment	The policy: • Ensures students have access to the college-level math course aligned to their program of study. • Uses assessment to design and deliver instruction that will maximize the likelihood of student success in the college-level math course. • Articulates the use of multiple measures to include high school GPA and/or high school performance in math courses to determine whether enrollment in corequisite supports will increase the likelihood that students will pass the college-level course. • Mandates corequisite supports when evidence-based measures demonstrate they will increase the likelihood that a student will pass the college-level course.	Course enrollment practices should focus on ensuring that students have equitable access to college-level math courses aligned to their chosen program of study. Assessment policies should not focus on finding precise measurements to "accurately" place students into prerequisite remedial education. Because no single measure or combination of measures can precisely determine whether or not a student should be placed into a college-level course, institutions should use assessments to assist students in their choice of a program of study. Institutions can enroll them in the college-level course for their chosen program of study and design instruction that will maximize their likelihood of passing the college-level course. Most of the policies implemented some form of multiple measurement system using high school performance to assess readiness in college-level courses. However, most did not clarify that the assessment data would be used to ensure access to college-level courses aligned to their program of study. None of the policies articulated that assessment data should be used to design and deliver instruction.	Nevada System for Higher Education Co-Requisite and College-Ready Gateway Policy clearly articulates that institutions should use multiple measures to include high school GPA to determine placement in corequisite supports. The policy also mandates the use of corequisite supports for students who do not place directly into the college-level course. The policy does guarantee access to a college-level math course, but not necessarily the math course aligned to a student's program of study. The policy does not require assessment data be used to design and deliver instruction.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
5. Student success	The policy: • Clarifies that corequisite supports in college-level courses should be implemented along with multiple math pathways that are aligned to programs of study at the institution. • Outlines that corequisite supports should be implemented in a manner that complements and/or encourages the adoption and implementation of other evidence-based student success strategies.	Given that the goal of policy is to ensure access and equitable success in gateway math courses, math pathways and other student support strategies should be aligned to the implementation of corequisite math. Institutions should design a comprehensive success strategy to include math pathways. Once math pathways are established, institutions must advise students on choosing a program of study; enrolling them in the appropriate gateway math course; providing clear degree maps; and engaging in ongoing advising to ensure students make progress toward completion. Policy should clarify that implementation of multiple measure assessment and placement practices and corequisite supports may increase access and success in gateway math, but other support structures should be designed to assist students with both choosing and progressing through their program of study. Few of the policies examined included language connecting assessment and placement or corequisite supports to broader student success strategies. Those that did make reference to other student support strategies emphasized the necessity of combining corequisites with math pathways and the importance of connecting choice of a gateway math course to their chosen program of study.	Texas Administrative Code, Chapter 4, Subchapter C for the Texas Success Initiative clarifies that the implementation of multiple measures placement should be combined with the implementation of other student success strategies to include math pathways, career advising, student support services, degree plans and proactive advising.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
6. Continuous improvement	The policy: • Articulates that institutions will collect and/or report data on student enrollment in gateway math courses and corequisite courses. • Articulates that institutions will collect and/or report success in gateway math courses in student's first academic year, disaggregated by students who receive corequisite supports and those who do not receive corequisite supports. • Requires the state system, state higher education executive officer or other designated state entity to issue a report on the implementation of state/system policy and outcomes achieved. • Articulates that data collected and reported by institutions and systems should contribute to continuous improvement efforts.	State and system policies should establish common metrics for institutional data collection and reporting in order to evaluate the impact of the policy. In the case of corequisite math implementation, data systems should track student enrollment and completion of college-level math without supports, with corequisite supports, and with prerequisite developmental math. Policy should require public reporting of data to a primary governing body. However, it is equally important that the policy articulate the need for data to drive continuous improvement practices at institutions. Many of the policies studied had data collection and reporting requirements, outlined regular reporting, and, most importantly, articulated the importance of using data to drive continuous improvement.	Nevada System of Higher Education Corequisite Implementation Task Force Corequisite Implementation Action Plan - Part 2 articulates that institutions will collect and report data on student enrollment in college-level and corequisite courses, success in gateway courses in the first academic year that is also disaggregated by students who receive corequisite supports and those enrolled directly in college-level courses. The plan also makes clear that the Nevada System of Higher Education will produce a report on the implementation of the policy and that data should drive continuous improvement efforts.

Corequisite Design Principle	Policy Criterion	Analysis	State Example
7. Equity	The policy: • Requires all data that is collected and/or reported to be disaggregated by race/ethnicity, Pell status, age and gender. • Sets expectations for institutions to develop plans for addressing any inequities in access to college-level courses or student success in college-level courses.	Given the disproportionately negative impact that developmental education has had on Black, Indigenous, and other racially minoritized student populations, policies should emphasize that reforms will address historic inequities generated from previous developmental education policy. New policy should require that institutions report student-level data that is disaggregated by as many demographic categories as feasible for meaningful equity analysis. In addition, policy should support institutions in using the data to engage in continuous improvement practices to ensure equity of impact across student groups. The policies that were examined often articulated the importance of disaggregating data by race/ethnicity, age, gender and other student demographics, but few required institutions to use data to develop plans for ensuring equity.	Tennessee Board of Regents Fundamental Features of Co-requisite Remediation does not explicitly require the disaggregation of data by race/ethnicity, gender, age or Pell status, but makes clear that institutions should develop plans to ensure that reforms will generate equitable outcomes.
8. Professional development	The policy: • Outlines the obligations of postsecondary systems and institutions to support professional development or other support for faculty and other stakeholders responsible for implementation of policies.	As institutions shift from the delivery of traditional prerequisite remedial instruction, faculty will need professional development opportunities to support the design and implementation of corequisite courses. In some cases, faculty who had previously taught remedial courses may require additional learning in order to meet accreditation requirements for teaching college-level courses. Policy should articulate the obligations of the system and institutions to ensure faculty receive the professional development needed to implement corequisite reforms by utilizing evidence-based instructional practices. While many of the policies examined were silent on the question of professional development, several articulated clear obligations and plans for ensuring faculty are supported as they transition to a new instructional model.	Developmental Education Strategic Roadmap from Minnesota state specifically articulates that improving student success in developmental education will require investments in professional development for faculty, staff and administrators.

Practice Profiles

This section provides readers with concrete examples of corequisite implementation in practice. These short profiles spotlight colleges and universities that are doing exceptional work in improving student access to and success in college-level courses. They are achieving these results by utilizing a variety of structures and models (sometimes several within one institution) in order to best meet the needs of their students within their local context.

Austin Community College

An "express" model that blends college-level and pre-college material

A two-pronged approach

Corequisites are nothing new at the Austin Community College (ACC) system, so there's a lot to learn from their experiences. The ACC mathematics faculty launched its first pilots in 2017, the same year the Texas state legislature passed a bill requiring all public institutions to scale corequisite approaches.

The ACC mathematics faculty were not caught unprepared by these legislative mandates.

Unlike most other colleges in the United States, ACC offers two levels of corequisites for three of its five gateway math courses: College Algebra, Contemporary Mathematics and Elementary Statistics.

At the time of this writing, readiness for college-level mathematics in Texas is typically determined by the state exam. For students assessed as needing more support (e.g., those who might have taken two semesters of developmental math in the past), ACC implemented "Express" courses that cover pre-college through college-level topics.

Students who are nearly ready for college-level courses have a different option. For College Algebra, such students are enrolled directly in the college course with a concurrent two-hour support course. For Contemporary Math and Elementary Statistics, students who are just below the placement cut score for college readiness are enrolled in a seamless four-hour course where the aligned support content is added where needed.

- **Located in Central Texas**
- **11 campuses**
- **75,000+ students enrolled; 41,000 in credit courses**
- **Students in credit courses are 42% white, 38% Latinx, 8% Black, 6% Asian/Pacific Islander, 6% other, 4% two or more**

Strategies for success

Developmental content offered by ACC math instructors is not distinct from the college-level content. The curricula for these courses are back mapped from the college-level content and fully integrated or "spiraled." These six- or seven-hour courses feature two instructors who simultaneously team teach and who use active learning strategies, facilitating for the majority of class time rather than lecturing. Each teacher has a specific set of responsibilities: One oversees the support portion of the course, and the other ensures that the students learn the college material.

Student progression data was crucial to gaining support from the college's advisors — the people who help students choose and enroll in courses. Course completion data was already commonly shared, but the administration made changes to allow departments to easily access longitudinal student data. Campus math contacts were appointed to meet regularly with advisors and share data showing how students were performing in the corequisite courses compared to traditional developmental sequences. The math department also developed an FAQ list designed specifically for the advising staff.

Support from the college administration played an important role. For example, resources were provided for visits from faculty from other Texas colleges who were having some success with corequisites. Release time was given to ACC faculty to examine the math curriculum in detail and to redesign the developmental sequences.

Another key tactic was closely monitoring student outcomes. When the data showed corequisites were enabling students to earn college math credit more quickly, ACC scaled up these courses. By spring 2019, 70 percent of developmental math students were enrolled in corequisites, which increased to over 75 percent in fall 2019.

Results show five-fold increase in completion rates

ACC's corequisite models have led to clear and consistent results. One example: The success rate for Algebra Express is about five times the rate for completion of the traditional two-course developmental sequence followed by College Algebra.

Before corequisite implementation, students who were referred to developmental math could not access college courses. Just under one-quarter of all first-time-in-college (FTIC) students

"We went full-scale faster than we thought for certain courses because the differences in outcomes were so dramatic. Why would we not go full-scale?"

—CAROLYNN REED, ACC MATH DEPARTMENT CHAIR

— including those who were not referred to remediation — were able to enroll in a college-level math course during the 2014–15 academic year. By 2018–19, nearly 40 percent of FTIC students had accessed a college-level math course. These gains were even more significant among Latinx and Black/African American students.

Meet Kimberly

Kimberly, an Austin college student, had two previous failures in college mathematics before attempting the corequisite format. Communicating to an advisor that she didn't feel comfortable in mathematics and needed more help, she was recommended for Contemporary Mathematics Express.

Kimberly described the course as a "mixture of all math, in a way. They didn't do one math, they did a little bit of statistics, this and that, it was real-world problems, probability. They put a lot of different kinds of math in there, and it was helpful, not just one kind of math. Things I wish I was taught in high school, earlier in life. They filled in some gaps." She also said, "I second-guess myself a lot, and the professor said I have to stop doing that. They helped me with understanding the steps and then doing it on my own." Kimberly, who said, "I'm not good at math," completed the course with an A.

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Diablo Valley College

A direct path to college credit, with integrated supports

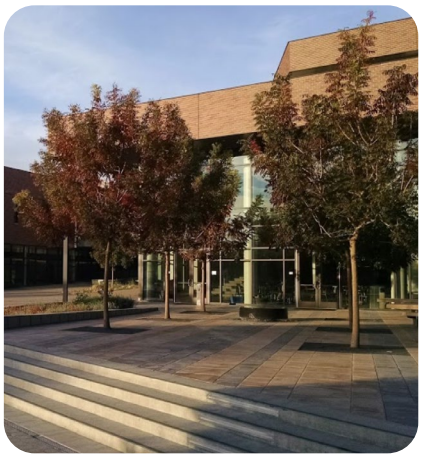
Diablo Valley College offers corequisites with developmental content carefully interwoven into a single course.

Starting with a new approach to placement

In 2017, the California state legislature passed a bill requiring colleges to maximize the probability that all students can enroll in and complete transfer-level math and English in a single year. Although Diablo Valley College (DVC) did not offer corequisites at the time, it had paved the way for their implementation by adopting multiple measures placement, investing in faculty professional development and using Statway, a two-term statistics course that provides additional mathematics support for students who need it.

DVC launched corequisite math courses during the 2019-20 school year for each of the entry courses in its math pathways: college algebra, trigonometry and statistics. Despite the COVID-19 pandemic disrupting in-person learning that spring, students who enrolled in these corequisite courses showed strong success

- **Located in Northern California (San Francisco Bay area)**
- **18,000 students enrolled from 10 municipalities**
- **Launched corequisite math courses in 2019**
- **Of those who enrolled in corequisite courses, 67 percent earned college-level credit in a single term**



Integrated counseling helps students engage

DVC adopted a model in which a multiple measures placement tool requires students with lower GPAs to enroll in a section of the college-level math class with an integrated corequisite supports course. These students join others in corequisite-supported transfer-level math courses that enable them to build skills, confidence and community with their peers and the instructor.

Most instructors do not separate out the corequisite supports. In these classes, students who are enrolled in a college-level course along with a support course experience the class as a single integrated course taught by a single instructor, with developmental content carefully

interwoven throughout. This approach "reduces student resistance to the support aspects of the course and helps ensure that students engage in both the support and college-level content throughout the entire course," according to math professor Read Vanderbilt.

Individual support goes beyond the classroom. Roughly two-thirds of all math faculty teaching courses with corequisites have chosen to integrate counseling and tutoring support into their classes. Counselors and tutors connect with the instructor to discuss the needs of the class and meet individually with the students to provide guidance or recommend student services.

DVC established credit and contact hours to account for the additional time needed to cover the combined college-level and support materials. The four-credit statistics and three-credit trigonometry courses taught with corequisites are each augmented with a one-unit developmental support course (two hours, 15 minutes contact hours per week and about one hour of out-of-class study). The four-credit college algebra course taught with a corequisite is augmented with a two-unit developmental course (four hours, 30 minutes contact hours per week and two hours, 15 minutes out of class study).

Most students earn college-level credit in a single term

Less than two years in, the new corequisite program shows very promising outcomes. Prior to the reform efforts, just 12 percent of DVC students who placed into developmental math completed their gateway course in one year and only 20 percent completed it within two years. When corequisites were introduced in fall 2019, enrollment in prerequisite developmental mathematics was reduced by 78 percent. Of those who enrolled in corequisite courses, 67 percent earned college-level credit in a single term.

When corequisites were introduced in fall 2019, enrollment in prerequisite developmental mathematics was reduced by 78 percent. Of those who enrolled in corequisite courses, 67 percent earned college-level credit in a single term.

DVC continues to offer a six-credit, two-term stretch sequence for students requiring additional support. The results are impressive, with 82 percent of these students earning college-level credit in a single year. Instructors believe this approach is particularly well suited for students with high levels of math anxiety or with learning disabilities, given the additional time devoted to the concepts and the unique instructional design.

Even more impressive is that students in the corequisite courses performed comparably to students who were taking the same college-level courses without the corequisite supports.

"Because the students placed in coreqs have the lowest placements, one might expect their course results to be much lower. But so far, their results have been consistent with or just slightly lower than outcomes of students in the college standalone courses," said Despina Prapavessi, the mathematics dean.

As the college continues the corequisite implementation, it aims to further reduce enrollment in developmental courses, address equity gaps, and increase the success rate of corequisite courses.

Roane State Community College

Removing the roadblocks to a degree

Roane State Community College uses corequisites to build crucial momentum toward students' intended area of study.

Helping students get un-"stuck"

For many years, Roane State required some students to take up to three semesters of developmental math. Following a state requirement, the college previously offered emporium-style labs for developmental math — a self-paced, modularized model that lacks a traditional instructional model. Students could theoretically complete all of their developmental math in one semester and quickly move on to take their general education college-level course.

But there was a problem. Few students actually progressed. According to the college, only 20 percent of students requiring developmental education completed their prerequisite modularized math and a college-level statistics course within one academic year (including the summer term). "We especially heard from faculty in areas like allied health that students continued to be 'stuck' and couldn't reach their program courses," said Elizabeth Weaver, a math professor at the college.

Roane State's challenges were not unique. In 2014, recognizing that modularized math did not ultimately help students succeed, the Tennessee Board of Regents mandated the elimination of prerequisite math developmental education in the state's community colleges by fall 2015. The state moved to a corequisite model and developed policy guidelines for corequisite courses. Roane State received a $13,500 grant to support instructors in designing them.

Pacing and coordination are key

Roane State designed its approach to corequisites with the goal of helping students find early success in college math and gaining critical momentum toward their degree.

- **Eastern Tennessee**
- **Nine campuses across eight counties**
- **5,000 students**
- **Primarily rural and suburban**
- **60 percent Pell recipients (First time in college)**
- **Started offering corequisites in 2015-16**
- **The number of Pell-eligible students who passed a math course increased by 69 percent in the first few years after implementation**

The statistics gateway course and its corequisite each meet twice per week for 80 minutes and both carry three credit hours. Due to scheduling challenges, students have different professors for their corequisite and statistics courses, and corequisite students in the same gateway course do not all enroll together in the same corequisite course.

Because students do not stay together, the college carefully designs the corequisite learning support class so that its pacing consistently syncs with and complements the content that students are learning in their college-level statistics course. The goal is that students will see the value and connections between the two, rather than feeling as though they're taking two separate math courses.

This approach means working diligently and frequently across the math department to create detailed curricula and pacing guides. The guides ensure that instructors are reinforcing statistics content taught in the gateway course at the right time and are using consistent pedagogical activities. There is a lead faculty member at Roane State whose role is to communicate with full-time faculty and adjunct faculty across the college, coordinate curricular revisions and organize professional development activities that keep faculty and other staff up to date.

The corequisite course does not use a textbook. Instead, it presents structured activities to support the learning objectives in the statistics course as well as meet some of the corequisite's own learning objectives. For example, the college recently revised its corequisite course to embed more targeted algebraic concepts. This change ensures that, in addition to succeeding in statistics, students are prepared to succeed in program courses, such as chemistry, that they may take in the future.

Less math fatigue

Faculty at Roane State report that having more students attain college math credit at the beginning of their college experience has been a real benefit. "It's a huge change, and students are so grateful," said Weaver.. "We also see less math fatigue because students are moving more quickly into their programs of study."

The data enforce those sentiments. Fifty-four percent more students completed college-level math within a year in 2018–19 compared to 2014–15, the last year before corequisites were implemented. Within two years, there was a 34-percent rise. Among Pell-eligible students, the increase was even greater: 69 percent within one year and 43 percent within two years.

While all of these numbers represent significant gains, the positive outcomes are particularly noteworthy for students from low-income families.

Within two years of corequisites being implemented, there was a 34-percent rise in students who completed college-level math within a year. Among Pell-eligible students, the increase was even greater: 69 percent within one year and 43 percent within two years.

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University of Wisconsin

Regular contact keeps math students on track

How corequisites helped one institution narrow racial disparities and retain more students.

When math course sequences leave students behind

The University of Wisconsin-Milwaukee (UWM) took the first steps toward reforming its mathematics program back in 2014, when it adopted an active instructional model and implemented math pathways for both a STEM-focused algebra path and a quantitative reasoning math literacy path called Quantway.

Success rates for gateway courses rose dramatically, but deeper analysis revealed a problem. The math department was losing roughly 20 percent of its students between the developmental-level first term and the college-level second term.

- Main campus + two branch campuses
- 25,000 students enrolled
- Forty percent of first-year students need mathematics support
- 81 percent average corequisite success rate

Enter corequisites. By fall 2020, UWM had replaced nearly all of its developmental math courses with single-term corequisite courses, enabling all but STEM majors testing two levels below college algebra to enroll directly in college-level math. UWM continues to improve on these courses and is currently testing whether the Quantway corequisite plus a one-credit algebraic skills course can prepare these lowest-placing STEM majors for college algebra.

The results are striking, particularly when it comes to narrowing disparities between Black and white students. Prior to the implementation of corequisites, the success-rate gap between these two groups was 20 percentage points for college algebra and 32 percentage points for quantitative reasoning. After the introduction of corequisites, those gaps have narrowed to 12 percentage points and 5 percentage points, respectively.[7]

7. Data are from fall 2017 through spring 2020. The quantitative reasoning corequisite began spring 2018, and the college algebra corequisite began fall 2018.

After the implementation of corequisites, the gaps between Black and white students for college algebra narrowed to 12 percentage points, from a baseline of 20 percentage points.

Supportive by design

An important element of UWM's design is the course structure. The Quantway corequisite course meets four days per week, 75 minutes for each session. It alternates days for the support content and the college-level content, ensuring equivalent time spent on each. Students earn three developmental math credits and three college-level credits upon completion.

While a six-credit course demands sacrifice on the part of students, the time investment has significant benefits. Meeting four days per week allows students to practice math almost every day and have regular access to their instructor and peers, resulting in less chance of falling behind.

Instructor Kelly Kohlmetz described how this structure impacts her teaching approach as well: "I get to know my students better, so I know when they're struggling. Because I'm seeing them four days a week, I can see sooner when they're having an issue."

Social-emotional supports are built into the corequisite curriculum for both quantitative reasoning and algebra. These supports, collectively known as Productive Persistence, help students build confidence and strategies to persist through challenging content, while also fostering an inclusive community where students feel they can make mistakes and grow as learners. Key routines and activities nurture positive mindsets, productive study skills and a sense of belonging for each student in the class.

Another strategy is making the curricula distinctly relevant and of interest to students. For example, the Quantway curriculum presents math literacy content and concepts using themes that are relevant to non-STEM students — citizenship, personal finance, medical literacy and social justice. Similarly, the algebra corequisite content is designed to serve the needs and interests of STEM students.

UWM leadership has supported instructors throughout the transition to corequisites. Since 2017, the UW system has provided grant funding to support instructors in the planning, design and development of the corequisite courses. The math department provides ongoing support for professional learning and the continuous improvement of the courses and the student learning experience. UWM instructors also engage in periodic class visits and hold weekly meetings to learn from one another about what is working so that they can continuously improve their approach.

Single-term success

By taking two career-aligned pathways focused on active learning with structured social-emotional learning supports, and redesigning them as corequisites, UWM is helping more students than ever succeed in earning their transfer-level math credit in a single term.

UWM's average corequisite success rate is 81 percent, demonstrating that substantially more students are achieving transfer-level math credit in less than a year and advancing toward their goals.

Between spring 2018 and spring 2020, UWM enrolled 373 students in its quantitative corequisite course with an average success rate of 86 percent. This is a 13 percent improvement from the previous two-term quantitative reasoning sequence and a 30 percent increase compared to the university's original approach to remediation.

UWM's algebra corequisite has served 528 students since fall 2018 and has achieved an average success rate of 77 percent, a 22 percent gain compared to the original developmental approach. While not significantly higher than the previous pathway sequence outcomes, the algebra corequisite is preventing the student attrition that took place between terms and enabling students to achieve college credit in just a single term.

Meet William

When William enrolled in UWM's quantitative reasoning with corequisite supports in spring 2020, he knew he was taking a leap. "When the word math comes up, I'm terrified. I've been fearful of math since I was a kid."

A 58-year-old veteran, William was returning to school to get his B.A. in social work to help him advance toward a career in Veterans Affairs. He received his GED while in the military, which was the last time that he encountered anything related to a math course. While pursuing his AA, he had kept math on the back burner, but to complete his degree at UWM, he could not afford to ignore it any longer.

When UWM's placement policies suggested that William could benefit from additional math support, he was encouraged by his UWM advisor to consider quantitative reasoning with a corequisite. The credit load seemed daunting, but the opportunity to enroll in a math course that would count toward his degree was the deciding factor.

William was unsure whether he'd be successful in the course, but ultimately he not only passed, but he also earned an "A." He attributes his success in part to the high contact hours. Regularly meeting in class or online with his group mates and the instructor helped him form bonds with his peers and kept him engaged throughout the course. "[The schedule] actually worked out to my benefit. I go to school full-time and work part-time at night. I needed to have such a schedule to stay on track." In addition to the schedule, he found the corequisite supports to be very helpful in preparing him for the college-level lessons on the alternating days. He also credits the availability and encouragement of his instructor in helping him persevere, especially as the course shifted online due to the COVID-19 pandemic.

Considering his previous experience with math, this outcome was quite profound. "My final grade was an A in math," William recalled. "For me to end up with such a great grade, to do well on the exam and to be comfortable doing the exam … was extremely helpful to me." Beyond the course grade, another important outcome for William is his sense of confidence in his math skills — skills that he now finds himself sharing with the kids at the youth home where he currently works. William, having avoided a long cycle of remedial coursework, completed his college math requirement in a single term and is on track to graduate in May 2021, as planned.

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Northwest Missouri State University

Partnering with faculty in other disciplines to better serve students

Northwest Missouri State University created new math pathways with corequisites based on feedback from instructors in other subject areas.

Pivoting from emporium model to corequisites

Like other institutions, Northwest Missouri State University was already in the process of reforming its mathematics program prior to the implementation of corequisites. This began in 2014, when the university moved from traditional developmental courses to emporium-style delivery using computer-based instruction. Unfortunately, students continued to struggle. "We knew there had to be a better way. We were failing our students," said Csilla Tasi, a math professor at the university.

A couple years later, administrative and faculty leaders switched gears. They decided to implement a math pathways effort along with corequisites, at scale, across all of the university's math gateway courses. "As a department, we had started to see corequisite data from other places, and it was a no-brainer to move away from what we were doing—it wasn't working," said Christine Benson, then-chair of the math department. Full implementation of the new pathways and corequisites began in fall 2016.

Today, all students at Northwest Missouri have access to college-level math. In 2014, before corequisites were implemented across the institution, just 42 percent of students had access. In fall 2014, only nine students who took a developmental math course earned college credit. By fall 2019 — after corequisite implementation — that number had risen to 57, a dramatic increase.

- 7,000 students
- Rural and mostly white
- Roughly half first-generation college students
- Fifty-seven students who enrolled in corequisite math earned college credit in fall 2019, compared to only nine the fall before corequisites were introduced

Gathering input from other departments

Math faculty at Northwest Missouri began their efforts to align math with majors by reaching out to faculty in other

disciplines, first through a survey asking program faculty to identify the specific math competencies their students need. The survey broke down math competencies by subject areas — rather than by courses — in order to move away from default mindsets and expectations about what courses students need. Faculty in the math department analyzed survey results and shared initial recommendations with program faculty about the right math classes for their students.

"We learned that faculty in other program areas didn't think their students were taking the wrong math, but they were aware that students were often leaving their major, or the campus, because of math-related barriers," said Brian Haile, math department chair. Following the survey, math faculty held multiple discussions with program departments to inform their math pathway decisions.

This campus wide work led to the creation of four math pathways, resulting in far fewer students taking College Algebra as their starting point. For example, business and agriculture students enroll in Statistics as their first math course, and business students subsequently take a second mathematics course, Mathematical Modeling, which is a newly developed course to provide the specific algebraic and modeling content they need.

Corequisites focus on forming new mindsets around math

The university no longer offers prerequisite developmental math courses. If required, students enroll in a corequisite "strategies" section that accompanies the entry-level college course for their math pathway. The university calls the corequisites "strategy classes" because they include instruction on making better habits and forming new mindsets around math — not just learning math content. More specifically, the corequisites include structured activities that teach time management, study skills and critical thinking.

For most entry-level courses, administrators consider both GPA and test scores for determining whether students will take a corequisite. Using GPA as a placement tool aligns with evidence that using multiple measures, such as a student's high school GPA that combines many variables, leads to more students earning more college-level credits more quickly compared to using test scores alone.

Students who are required to take a corequisite are in the same college-level course sections as those who do not require the additional support. Corequisite sections meet for two hours per week; they do not carry credit that counts toward graduation requirements. All math faculty rotate to teach a corequisite section, as the department believes faculty should be familiar with the needs of underprepared students. Departmental planning ensures corequisites keep pace with topics taught in the college-level courses.

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Definitions

Corequisite supports/models

Corequisite, as in corequisite supports or models, typically refers to the practice of placing students who have been designated as underprepared directly into college-level courses and providing necessary additional supports to effectively engage with the college-level coursework. Corequisite courses are most commonly used with gateway English and mathematics courses, but are also used in other disciplines and to accelerate sequences (e.g., precalculus, the calculus sequence).

Calendar structures

See the "Corequisite Models" webinar.

Just-in-time supports; one semester

- **Support courses:** Separate structured class sessions specifically designed to provide instruction on the developmental content needed for success in the associated college-level courses; offered in parallel with the college-level course and completed within one semester.
- **Embedded supports:** Educational intervention in which the needed developmental content is embedded into the college-level class with additional contact hours.
- **Mandatory tutoring:** Required attendance in a tutoring lab for a specified number of hours per week.

Prerequisite supports + college-level; one semester

- **Boot camps:** During the first three to five weeks of the semester, the instructor provides prerequisite material. The rest of the semester, the instructor delivers the college-level content (classes meet for extra hours each week throughout the semester).
    - Caution: Research indicates that boot camp effects are short-term and generally have "trivial negative to moderate positive" effects.[8]

Just-in-time supports; two semesters

- **Stretch courses:** College-level classes with the developmental content embedded and stretched over two semesters.
    - Caution: Research shows that transition points lead to attrition.[9] If this model is utilized, consider strategies to ensure students enroll in the second semester prior to completing the first semester.

8. Hodara, 2013.
9. Jaggars & Stacey, 2014.

Multiple Measures Assessment/Placement

Multiple Measures Assessment is a general term that refers to moving away from a reliance on standardized test scores to assess student readiness for college-level coursework, and moving toward the use of additional data to determine the level of support that a student needs in order to be successful in college courses. Common measures include high school grade point average, highest math course taken in high school, the course grade in the highest math course and measures of non-cognitive factors. The two examples given below show the use of multiple measures to fully scale corequisites. All students are placed into transfer-level courses; the assessment measures are used to determine whether they also receive additional supports.

Cuyamaca College, California

Uses HSGPA and course-taking only; no testing. HSGPA is self-reported.

Path	Measures	Placement
Algebraic	Grade of C in High School Algebra II and GPA ≥ 3.3	Transfer-level
	A or B in Algebra II and GPA ≥ 3.0	Transfer-level
	A or B in PreCalculus and GPA ≥ 3.0	Calculus I
	C in PreCalculus and GPA ≥ 3.0	Calculus I
	All others (including NO Algebra II)	Transfer-level with support
Stats & QR	GPA ≥ 2.8	Transfer-level
	GPA < 2.8	Transfer-level with support

Southern Arkansas University

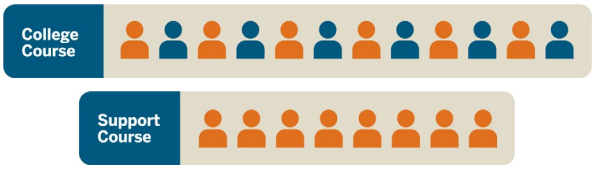
Example: Mathematical Literacy path. High School GPA within five years

		Unweighted GPA		
		<2.51	2.51–2.99	3.00+
Math ACT or Equivalent	22+	MATH 1053 Mathematical Literacy & MATH 0051 Math Literacy Lab	MATH 1053 Mathematical Literacy	
	18–21	MATH 1053 Mathematical Literacy & MATH 0051 Math Literacy Lab		MATH 1053 Mathematical Literacy
	<18	MATH 1053 Mathematical Literacy & MATH 0051 Math Literacy Lab		

Student structures – see the "Corequisite Models" webinar

Cohorting: Designating certain sections of college-level courses exclusively for students who have been underserved in the past and therefore designated as underprepared. The support content may be embedded in the college-level class with extended hours or in a separate support course.

Co-mingling: Enrolling college-ready and students assessed as non-college-ready in the same college-level class. Students designated as underprepared are provided additional instruction in a separate support course.



Throughput rate

The proportion of a cohort of students who persist through the entire developmental sequence to enroll and succeed in a gateway course within a given time frame. For example, what proportion of students who enrolled in fall 2016, and were assessed at the third level of developmental mathematics, completed their gateway math course within two academic years?

Frequently Asked Questions

What is a corequisite course?

A corequisite course is designed to provide additional supports for students who have been underserved in the past, with a goal of enrolling in and completing their gateway mathematics requirement in one term. Rather than placing students in prerequisite developmental courses, institutions enroll these students directly into gateway courses and provide necessary supports in a just-in-time fashion. Multiple measures should be employed to determine the level of support students need. Depending on need, the supports may be two, three or more additional hours per week. Many corequisite courses also include instruction in academic mindsets and learner strategies.

What are considered "fully scaled" corequisite supports?

The definition of fully scaled corequisite supports may vary slightly by region or state. In general, it is when an institution has eliminated all Beginning Algebra, Intermediate Algebra, Pre-Statistics, etc. developmental courses and enrolls all students who previously would have been placed in those courses directly into gateway courses with additional supports.

What is the best model for corequisite supports?

There is no research that endorses one best model, as it depends on your institutional context. In fact, many institutions utilize more than one model depending upon various constraints, including financial, staffing, room capacities and availability, or initial course structures. For example, you may choose the cohort model with one instructor for your algebraic pathway but use the co-mingled model for other pathways. See the "Corequisite Models" webinar.

What is the best way to assign grades in the corequisite courses? What if the student passes the support course but fails the gateway course? What if the student drops or stops attending the support course?

Similar to there being no best model for everyone, the answers to these questions vary based on institutional context. If students fail the gateway and pass the support course, some institutions require those students to retake both courses, while other institutions simply require students to retake the gateway course. Below are some responses from institutions that have addressed these issues:

- "We keep the two grades completely separate."
- "Students won't take the support course seriously if you don't tie the grade to the gateway course in some way."
- "The support course is required. If students don't attend, they are dropped from both courses."
- "If students can pass the gateway course without passing (or even attending) the support course, then we don't penalize them. The point is to pass the gateway."
- "The grades are separate and the support portion of the course is graded on a Pass/Fail system, whereas the college-level course is traditionally graded."

The development team should consult with the college's Financial Aid Director, as some directors have a very rigorous understanding of what constitutes a separate course. Such a rigorous interpretation may require the college to base the support course grade on assignments that are made only in the support course not tied to the assignments in the gateway course. In order to ensure effective implementation, it is important to involve all student support departments (financial aid, advising, registration, etc.) in design discussions. These partners are often able to identify structural issues that need to be overcome while designing and implementing corequisite supports.

What if a student transfers into or out of our institution? How will corequisites impact them?

If the student has received college-level credit for a course that already has approved transferability or approved learning outcomes from the receiving institution, there should be no impact on transfer. The grading options mentioned above can impact transfer. In general, if the student receives credit for the support course, they are considered to have completed their developmental requirement. Include your usual transfer partners in these discussions.

How do you maintain rigor and integrity of the college-level course?

The members of the mathematics department must work together to ensure transparency and maintain rigor in their courses. One effective strategy is to have common course materials and some common assessments, including the final exam, for all sections of the gateway courses.

Is there a bottom threshold below which the corequisite model is less effective?

Students at the upper end of the placement scale generally perform better than students at the lower end of the scale. However, even students at the lower end are more likely to earn college-level credit via a corequisite course than they would be if they had to persist through multiple levels of prerequisite courses first. There is no existing research that identifies in advance which students are unlikely to be successful in the corequisite.

Should there be a reading requirement? What about Emergent English Learners?

For students assigned to developmental education in both math and English, some institutions focus on English in the first semester and math in the second semester. If students are in corequisite supports for both courses in the same semester, the combined hours can fill an entire schedule. Concentrating on one subject at a time allows the student to also take some courses in their major, which is important for their sense of purpose.

What if students designated as college-ready want to come to the support course?

Many institutions allow students designated as college-ready to occasionally attend or enroll in the support course if they choose; depending on variables such as room capacity and instructor preference. Some institutions place all students into the support course as the default and allow students to challenge their placement if they want to opt out of the support course. This is another area in which to consult the financial aid director.

Can corequisite courses be delivered as online classes?

Some institutions do not allow students in corequisites to take online classes. However, consider carefully whether or not offering an online option is worth the potential loss of some students. Many other institutions do offer corequisite courses online, but that option calls for careful structuring of support, including technology and non-content related skills particular to the online setting, and ongoing communication between instructors and students.

When institutions transition to the corequisite model, will faculty lose their jobs if they are not credentialed to teach the college-level course?

Most institutions who have transitioned to fully implement the corequisite model have maintained most faculty positions. The success of the transition depends on the model chosen, credentialing requirements and the faculty pool in the region.

- Under a corequisite model, many entering students will be enrolled in five to six hours of mathematics, requiring additional sections of the gateway courses—and therefore more faculty to teach them.
- In a cohort model, faculty who are credentialed to teach gateway level will teach both the gateway and the support content. Faculty who are not credentialed to teach gateway level will need to get credentialed.
- In a co-mingled model, faculty who are not credentialed to teach gateway courses can teach the support course.

Can corequisites be offered if we have separate departments for developmental and college-level math?

Yes, many institutions have successfully implemented corequisites with separate departments. The two departments must collaborate on structures and communication strategies to ensure alignment of content so that students are receiving the necessary supports at the appropriate time.

What are psychosocial factors?

Evidence shows that many students are not familiar with all of the skills necessary for success in college. Faculty teaching developmental courses often include instruction in psychosocial factors, such as growth mindsets, persistence, time management, stress management, study strategies, etc. When implementing a corequisite model, instruction in these areas will need to take place in the gateway and/or support course.

What about classes on campus that have our developmental classes as a prerequisite?

Include those departments in the planning discussions. Often, the requirements were put into place because the content required that the student be designated college-ready or enrolled in a college-level math class (e.g., introductory chemistry requiring students to have some algebraic understanding). With corequisites, students are in a college-level math course and usually do just as well in the math class as students designated as college-ready.

What are the necessary and sufficient conditions for corequisite implementation?

- Institutions offer robust mathematics pathways that direct students toward the math course best aligned with their programs of study, and provide additional supports for those students who need it.
- There is institutional capacity to collect and analyze data to make data-driven decisions for initial implementation and for ongoing scaling and continuous improvement.
- Institutions have sufficient faculty with appropriate credentials to meet the demand in the first few years of implementation.
- Careful attention must be paid to aligning content, especially if the gateway and support courses have different instructors. We recommend a department-wide common course calendar. Some portion of each support course may be used to answer homework questions, but the majority of each class meeting should be dedicated to preparing the students to engage successfully in the next gateway class meeting.
- The advising community must be included in the conversations in order to ensure their understanding of the difference between corequisite courses and traditional prerequisite developmental courses.

Resources and References

Resources

Dana Center Mathematics Pathways Curriculum Design Standards

Dana Center Transition to College Mathematics Course Framework

Mathematics Foundations for Success in Introductory Statistics

Toward Better College Placement: A Guide to Launching a Multiple Measures Assessment System

Multiple Measures Placement Using Data Analytics: An Implementation and Early Impacts Report and https://ccrc.tc.columbia.edu/publications/multiple-measures-placement-using-data-analytics.html

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About This Toolkit

The development of this toolkit was guided by the advice of a national advisory panel made up of experts who have worked deeply with corequisites across a variety of roles and contexts. The panel includes researchers, policymakers, faculty members, equity advocates and curriculum experts who collectively articulated a consensus statement on the foundational core of this toolkit, the "Corequisite Design Principles" document and vetted the associated resources.

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About The Charles A. Dana Center

The Dana Center works to dismantle barriers in education systems to ensure all students—especially those who have historically been underserved—have equitable access to and success in an excellent math and science education. Our higher education work focuses on strategies and tools that support faculty and institutions in creating more seamless transitions from high school to and through gateway mathematics courses.

About Strong Start to Finish

Strong Start to Finish is a network of policy and research partners, institution and systems leaders, and foundations advancing system reforms in developmental education, so every student can succeed in their first year of college. In particular, we support college success for Black, Brown, Asian American, Indigenous students, adult learners, and students with low incomes, who have been underserved by the education system for too long. We work to scale the use of proven, proactive strategies that remove barriers that typically impede these students from earning essential college credits in English and Math courses in their first year. Education Commission of the States is the host of the Strong Start to Finish network.

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