

# GUIDANCE FOR IMPLEMENTING COREQUISITE MATH SUPPORT COURSES

The Pennsylvania State System of  
Higher Education Corequisite Math  
Work Group



## ABSTRACT

Replacing prerequisite developmental mathematics courses with corequisite courses has been shown to allow greater numbers of students to successfully complete college-level mathematics courses during the first year. This guidance is designed to assist universities in the Pennsylvania State System of Higher Education in implementing the corequisite support model.

## The PASSHE Corequisite Math Work Group

- Pennsylvania State System of Higher Ed.
  - Richard Riccardi, Asst. Vice-Chancellor for Academic Affairs
  - Donna Wilson, Vice Chancellor for Academic Affairs
- Bloomsburg University
  - William Calhoun, Mathematics, Project Director
  - Tara Diehl, Academic Enrichment
  - Kara Shultz, Interim Dean of Undergraduate Education
- Clarion University
  - Kate Overmoyer, Mathematics
  - Adam Roberts, Chair, Mathematics
- East Stroudsburg University
  - Jonathan Keiter, Mathematics
  - Christina McDonald, Director of Sponsored Projects and Research, Project Manager
- Edinboro University
  - Dawn Dillen, Assistant to the Dean, College of Arts, Humanities and Social Sciences
  - Corinne Schaeffer, Mathematics
- Lock Haven University
  - Jonathan Lindzey, Dean, College of Natural, Behavioral & Health Sciences
  - Christine Offutt, Psychology
  - Denine Simin, Mathematics
- Mansfield University
  - Cathy D'Ortona, Mathematics
  - Adrienne McEvoy, Philosophy
  - John Ulrich, Provost

## **1. Challenges in Developmental Education and Opportunities for Improvement**

In recent years, developmental education reform has received increased attention from community colleges, four-year institutions, state systems of higher education, and state legislatures across the country, particularly where mathematics learning support is concerned. Driven by a desire to enhance student outcomes, address equity gaps, improve affordability, and optimize credential pathways, successful, research-based reform efforts have been implemented (or are in the process of being implemented) in California, Georgia, New York, Ohio, Texas, and Tennessee, among other states. Such reform efforts typically focus on implementing a multiple-measures approach to the mathematics placement process, aligning foundational mathematics course requirements with the students' educational goals in the form of math pathways, and utilizing corequisite learning support as an alternative to stand-alone developmental courses that typically do not count toward the credits required for graduation.

Equity-focused reform networks such as Strong Start to Finish (SSTF) provide grant funding to support the re-envisioning of developmental education strategies, to foster collaboration among institutions and systems of higher education engaged in such efforts, and to connect institutions and state systems with technical advisors and consultants (such as the Charles A. Dana Center, the Gardner Institute, SOVA, and many others) to further support their developmental education projects.

In Spring 2020, Pennsylvania's State System of Higher Education received an SSTF grant to develop guidelines for designing and implementing corequisite learning support for mathematics courses as an alternative to traditional, stand-alone developmental-level courses that do not count toward graduation requirements. The guidelines are meant to be scalable across the system while providing sufficient flexibility for individual institutions to tailor implementation at the course level to suit the particular needs of their students and their curriculum. The grant application itself was based on work previously conducted by the State System's redesign team (from June-November 2019) charged with developing recommendations for pilot proposals for developmental mathematics education. One of these pilot proposal recommendations, based on a review of internal PASSHE data described below, was to explore corequisite learning support models for delivery of developmental mathematics instruction. Once the grant was received, a working group was formed consisting of representatives from the universities who agreed to participate in the grant application (Bloomsburg, Clarion, East Stroudsburg, and Mansfield). Once integration planning became a

reality for six of the PASSHE institutions, representatives from additional universities (Edinboro and Lock Haven) were added to the group. In consultation with SSTF, the working group selected the Charles A. Dana Center at the University of Texas to serve as technical advisor for the project. The grant's goal statement, and thus the objective of the working group, is as follows: "At the end of this grant, we will have developed evidence-based and faculty-driven guidelines (recognizing local university curricular autonomy) for co-requisite math instruction that will be adopted for implementation at the majority of universities in the PASSHE system beginning Fall 2021."

Internal PASSHE data first reviewed by the developmental education redesign team and subsequently by the SSTF working group indicate that there are opportunities for improving student success in relation to mathematics developmental education. (All data has been rounded to the nearest integer percentage.)

PASSHE Cohort Data: Fall 2013 First-time, Full-time, Associate and Bachelor's Degree-seeking Students

- 2,132 (12%) of students in this PASSHE cohort were required to complete developmental mathematics.
- Only 46% of the students who were required to complete developmental mathematics received a credential within five years (by 2018). That means that 54% of the students invested valuable time and money toward a credential but were unable to earn it in five years.
- In contrast, 61% of PASSHE students who were not required to complete developmental mathematics earned a credential within five years.
- 50% of the 2,132 students had left their university with no credential by 2018.

PASSHE Cohort Data Over a Three-Year Period: Fall 2016, Fall 2017, and Fall 2018 First-Time, Full-Time Associate and Bachelor's Degree Seeking Students

- Over the three-year period, 15% of incoming fall PASSHE students were required to take developmental mathematics.
- Only 55% of the students required to take developmental mathematics successfully completed the requirement.
- Only 29% of the students required to take developmental mathematics successfully completed a subsequent college-level mathematics course.
- Among the African American students, 31% were required to take developmental mathematics, compared to only 11% of white students.

- African American students comprised 13% of the students, but they accounted for 27% of all students required to take developmental mathematics
- White students comprised 73% of the students, but they were only 55% of the population required to take developmental mathematics.

PASSHE Developmental Course Enrollment and DFW Rate Data from Summer 2016 Through Spring 2019:

- 11,158 students were required to complete developmental mathematics.
- There was a 30% DFW rate for developmental mathematics.

### The Definition of Developmental Course

It should be noted that each PASSHE university has a slightly different definition of “developmental course”. For the purposes of this document a developmental course shall mean a course that a student is placed into that serves as a prerequisite to another course, and that even if the initial course is successfully completed, will not allow a student to complete a bachelor’s degree at the institution. These courses often bear names such as “Basic Algebra”, “Beginning Algebra”, or “Intermediate Algebra” although this is not uniform across PASSHE.

Developmental mathematics courses and their impact on student success:

- Developmental mathematics courses typically do not carry credit toward graduation. The time and money spent on non-credit bearing classes can prevent or delay students’ graduation and can also result in a financial aid deficit at the end of their degrees.
- The students in greatest need of support and practice to achieve proficiency become discouraged when they must enroll in non-credit bearing courses and frequently do not continue to graduation. (Education Commission of the States, 2010)
- Students with grades of F or W (or D at some PASSHE universities) are required to repeat the course prior to enrolling in their gateway mathematics course, costing them more time and money.
- “Low-income students, students of color, and first-generation students are overrepresented in developmental courses, and gains in student success in these courses help close the achievement gap” (Marshall & Leahy, 2019, p.152)

- PASSHE institutions may have one, two, or more levels of developmental mathematics courses and are inconsistent as to whether Intermediate Algebra is developmental or credit-bearing.
- “The more developmental math courses students must take, the less likely they are to complete their math requirements” (Ganga & Mazzariello, 2018, p. 2).
- Students may not be able to enroll in a gateway college-level mathematics course within the first year due to multiple levels of developmental mathematics.
- Generally, traditional developmental mathematics courses are algebra based, which may or may not be aligned with the students’ career goals.
- Developmental mathematics requirements inhibit students’ ability to progress through program courses required for their majors.
- Nationally, only 35.1% of students who take developmental classes graduate with a four-year degree within six years, compared to 55.7% who are not required to take developmental classes. (Complete College America, 2011)

The benefits of corequisite support courses:

- Corequisite support enables students to enroll in a gateway college-level mathematics course in their first year. Even when the data is disaggregated by placement score or by race, more students have been observed to successfully complete a gateway mathematics course in their first year in all groups under the corequisite model. (Co-requisite Instruction in the University of Georgia, 2020)
- Corequisite support helps to close the equity gap as historically underrepresented students are more likely to be required to complete a developmental mathematics course.
- Corequisite support enables students to acquire the necessary mathematics skills without creating the hardship and adversity caused by prerequisite developmental courses.
- Corequisite support eliminates the sequence of non-credit bearing developmental mathematics courses.
- Corequisite support has been associated with statistically significant increases in four-year and six-year graduation rates at several universities. (Scaling Success: What We're Learning from Our Sites, Strong Start to Finish Learning Network Convening, 2021)

Complete College America. (2011, September). *Time is the enemy*. Washington, DC: Author. [Time Is the Enemy.pdf \(completecollege.org\)](#)

Ganga, E., Mazzariello, A., Education Commission of the States, & Columbia University, C. for the A. of P. R. (CAPR). (2018). Math Pathways: Expanding Options for Success in College Math. In *Education Commission of the States*. Education Commission of the States.

Marshall, A. & Leahy, F. F. (2019) Mathematics Pathways and Equity: Gateway Course Outcomes. In Hartzler, R., & Blair, R. (Eds.), *Emerging issues in mathematics pathways: Case studies, scans of the field, and recommendations*. Austin, TX: Charles A. Dana Center at The University of Texas at Austin, 147-158.

## 2. Math Pathways - Aligning to Programs

**Each institution should define a set of Math Pathways. For example, STEM Pathway(s) for majors in STEM fields, a Quantitative Literacy Pathway for Arts and Humanities Majors, a Statistics Pathway for Social Sciences, and/or an Education Pathway.**

Once the Pathways appropriate for the institution are established, faculty can determine the appropriate gateway course(s) and appropriate corequisite support content that would be required for each pathway.

Here is a reference for designing and aligning Math Pathways:

<https://dcmathpathways.org/resources/forging-relevant-mathematics-pathways-arkansas>

**The corequisite courses should be designed to allow students who need corequisite support to finish their gateway mathematics course within the first year.**

Most students should take the appropriate gateway math course for their pathway during the first semester, with corequisite support if needed. However, staffing considerations or program requirements may make it necessary for some students to take the gateway math course (and corequisite support) during the second semester. Math placement and advisement policies should be put in place to guarantee that students take a gateway math course during the first year.

**Students in the STEM pathway(s) may be required to complete Calculus or College Algebra. If College Algebra is required, corequisite courses should be designed to allow students to complete it within their first year. If Calculus is required, corequisite courses should be designed to allow students to be prepared for Calculus in the fall of their second year.**

Each campus may design the STEM pathway{s} appropriate for their students. For majors requiring College Algebra, a corequisite could be used to give the students support in developmental algebra at the same time they are taking College Algebra. If feasible, pathways for majors requiring Calculus may be designed that allow all students to complete Calculus in their first year. A suggested plan for the Calculus pathway is for students who place into Calculus I to take it in their first semester. Students who place into Pre-Calculus take Pre-Calculus in their first semester and Calculus in the second semester. Students who need college algebra or trigonometry take Pre-Calculus with a corequisite during their first semester. If it is not feasible to implement this plan for the Calculus pathway, then the pathway should be designed so that students will be Calculus-ready during the fall of their second year.

### 3. Placement and Scaling

With the implementation of a corequisite model, fewer students will be required to start with a typical developmental course that does not offer credits towards graduation. The goal of placement in the corequisite model is for students to start their college experience with an appropriate college level math course while providing them with the necessary support. The current tools that we use to place students into developmental mathematics courses should be examined to see if they can be used to maximize the success of the students.

#### A Comprehensive Definition of Placement

The term “placement” often refers narrowly to the assignment of students to college courses according to an examination of student mathematics, reading, and writing skills. For the purposes of this brief, we recommend a more comprehensive definition of “placement” as an informed and well-rounded process that is intentionally supported by educators, advisors, and students and based upon information about student goals, prior academic experiences, outside-of-school obligations, attitudes, beliefs, and an assessment of academic skills.

[From *A Call to Action to Improve Math Placement Policies and Processes*, by L. Couturier and J. Cullinane, Dana Center, 2015]

There are many ways our universities place students into the appropriate level math courses (standardized math placement exams, ACT or SAT scores, high school GPAs, high school math courses, in house exams, etc.). With the wide range of skills and math abilities that our students bring to our campuses, it is important that they are placed in a math course where they can succeed.

To determine the course level and the amount of additional support the students need requires time, resources and coordination with administrators, faculty, and advisors. The placement tools should help provide guidance to the students and their advisors.

With the development of corequisite courses, the current assessment tools to place students into the proper math courses should be evaluated to see what, if any, changes to the system are needed. Universities may need to adapt, supplement, or replace the currently used placement tools in order to place students in the most suitable course with the appropriate support.

Multiple measures look at a collection of data on a student's performance rather than a single snapshot, such as a standardized exam score. The use of multiple measures to decide what is the best course placement allows students to be assessed in a more holistic way.

Couturier, L. K., & Cullinane, J. (2015) A Call to Action to Improve Math Placement Policies and Processes. Retrieved from <https://dcmathpathways.org/resources/call-action-improve-math-placement-policies-and-processes>

#### **4. Advising Students for Math Pathways and Corequisite Support**

- A leadership team should discuss and plan for advising students for math pathways and corequisite support. The composition of the leadership team will vary by campus. It might typically include (representatives of) the Provost, College Deans, Advising Leadership, the Mathematics Department, and possibly other Departments involved in teaching gateway courses and corequisite support courses.
- Advising programs and materials need to be updated for both students and advisors.
- The leadership team needs to communicate with advisors in all departments and offices. The communication should include both the “nuts and bolts” of how the corequisite structures work, and some of the “why”: how the structure will help students to be successful in their mathematics courses.
- All ancillary materials such as the university website, catalog, and advisor training materials need to be updated. It is important that information be correct and consistent.
- It is important that advisors discuss potential majors with incoming students and the various mathematics pathways those majors take.
- Provide math pathways informational sessions for all advisors, support staff, faculty, deans, and department chairs.
- Detailed training needs to be made available to advisors.

- Begin by establishing guidelines between disciplines and identify a contact person to be the lead moving forward. This lead could be through the math department, ASC (academic success coordinators), or another department responsible for faculty/advisor training (ex. Center for Faculty Excellence – Edinboro)
- Provide formal and informal training on math pathways during new faculty advisor orientation, regular departmental meetings, and check-in meetings with the training leadership. Training topics may include:
  - The corequisite model and math pathways
  - Multi-disciplinary program requirements
  - Advising tools
  - Strategies to mitigate implicit bias

References for advising and communicating Math Pathways:

Advising:

[Multidisciplinary Discussion Tools .docx | Powered by Box](#)

[7-Creating Effective Advising Tools \(dcmathpathways.org\)](#)

[Advising and Multiple Math Pathways \(video\) | Dana Center Mathematics Pathways \(dcmathpathways.org\)](#)

Communication:

[Effective Messaging in Promoting Math Pathways final 2017 04 10.pptx \(dcmathpathways.org\)](#)

## **5. Structures, Models, and Scheduling of Corequisite Support Courses**

The following points are primarily drawn from *Co-Requisite Courses: Narrowing the gap between instruction and supports*, Dana Center Mathematics Pathways.

[https://dcmathpathways.org/sites/default/files/resources/2018-07/Co-req\\_Supports\\_2018\\_07\\_24.pdf](https://dcmathpathways.org/sites/default/files/resources/2018-07/Co-req_Supports_2018_07_24.pdf)

The recently released *Corequisite Mathematics Toolkit*, The Charles A. Dana Center at the University of Texas at Austin, 2021 provides additional detail and guiding principles. The Toolkit, which is a recommended supplement to this document, is available at [Corequisite Mathematics Toolkit | Strong Start To Finish](#) .

- The PASSHE universities need not adopt a single model for corequisite mathematics support. Each university may determine the model(s) that best fit that university.
- Two successful options for the structure of corequisite mathematics support courses are (a) Comingling: mixing college-ready and underprepared students in the same college-level class. Underprepared students are provided additional supports during separate sessions. Comingling provides flexibility in scheduling. (b) Cohorting: designing certain sections of college-level courses exclusively for underprepared students. Additional supports may be embedded in or separate from the sections for underprepared students.

	Co-mingling of prepared and underprepared students	Cohort of only students designated as underprepared
Embedded supports in extended hours (e.g., 5 or 6 contact hours)	Not possible	Need one instructor for the full time
Separate courses (e.g., 3 credits + 3 credits)	Can be same instructor or different instructors	Can be same instructor or different instructors

Source: *Co-Requisite Courses: Narrowing the gap between instruction and supports*, Dana Center Mathematics Pathways.

- Options for scheduling include (a) Support courses: Separate, structured courses that run before after or on opposite days to the college-level courses during the same semester. (b) Embedded supports: College-level classes with the developmental content embedded. (c) Mandatory tutoring: Required attendance in a tutoring lab for a specified number of hours per week. For support classes, skilled instructors or tutors are essential. Computer-based instruction by itself has not been found to be effective for underprepared students.
- Staffing: In scheduling options (a) and (c) the instruction/tutoring in the support class could be done by the instructor of the college-level course or by a different instructor. Research suggests that having the same instructor teach both classes is effective. However, it may not be possible to staff both classes with one instructor. If there are separate instructors, mechanisms should be in place to foster coordination between the instructors. For instance, detailed calendars for both courses could be worked out in

advance to ensure that the topics in the support course will be presented just-in-time to support the topics taught in the college-level course. A system for regular communication between the two instructors should be part of the plan.

- Consideration should be given to the professional development time that needs to be spent training instructors for the new model and the credentials that will be required for each part of the course.
- Supplemental Instruction and tutoring can be utilized to provide additional peer-based learning support to students in the corequisite classes. However, peer-based learning support alone is not likely to be sufficient.
- Credit Hours: Successful implementations have added two or three hours of support to a three-hour college-level course.
- Other considerations, depending on the type of support offered, are the number of credit hours students will pay for. The Collective Bargaining Agreement will govern how the hours count in the instructor's teaching load.

## **6. Classroom Level Considerations - Curriculum, Development & Training for Faculty**

### Curriculum and Schedule Recommendation

The interconnectedness between the college-level course and the support course must be both intentional and transparent.

- a. The Mathematics department creates student learning outcomes and a common course calendar for the college-level course.
- b. Once that is complete, the department creates student learning outcomes for the support course and back maps a support course calendar from the common course calendar.
- c. If possible, student placement exam data is used to adjust classroom content so that the support course may be focused on the topics most helpful to the students.

### Grading Recommendation

The math department should carefully consider whether to assign one grade or separate grades for the college-level course and the support course.

- a. Although a letter grade is recommended for the college-level course, the math department should explore whether to use a letter grade or Satisfactory/Unsatisfactory grade for the support course.
- b. Faculty and administration should plan to address situations in which students fail either the college-level course or the support course.
- c. Lastly, be open to reviewing these decisions and making changes, as necessary.

As a sample, the table below illustrates how Roane State Community College in Tennessee handled the grading issue.

		Parent Course	
		Pass	Fail
Support Course	Pass	Gen Ed requirement is satisfied. Unless other math courses are needed, remediation is satisfied.	Student repeats parent course. Repetition of support is optional.
	Fail	Gen Ed requirement is satisfied. Unless other math courses are needed, remediation is waived.	Student repeats both courses. Student is likely to lose Tennessee Promise Scholarship.

Source: *Co-Requisite Courses: Narrowing the gap between instruction and supports*, Dana Center Mathematics Pathways

### Faculty Development

Mathematics faculty engaged with delivering courses in a corequisite model will need training focused on meeting students where they are, cultivating growth mindsets, and strategies for supporting student success. Training should be ongoing to occur not only in advance of teaching a corequisite course but also with additional support mechanisms scheduled throughout the semester.

## 7. Evaluating the Program and Engaging in Continuous Improvement

Collecting and analyzing data will allow PASSHE universities to assess the efficacy of the shift to the corequisite model and will suggest avenues for improving the implementation of corequisite support in mathematics. The attached spreadsheet and Coding Guide provide a

template for uniform collection of data utilizing PASSHE specific coding. As such, the spreadsheet is designed to allow the importing of much data from Institutional Research offices or through use of scripts at each university or from PASSHE. Data that are not tracked by PASSHE will need to be entered manually and may require funding for data entry persons (e.g., Graduate Assistants) at each university. However the data are entered, all PASSHE universities shall report the data in the format indicated by the spreadsheet to facilitate system-wide data analysis.

In evaluating the efficacy of the shift to the corequisite model, it is important to consider that the goal is to raise the percentage of university students who successfully complete a gateway mathematics course, preferably in the first year. Therefore, the primary statistics to consider are the percentage of students who eventually successfully complete a gateway mathematics course, and the percentage of students who successfully complete a gateway mathematics course during their first year at the university. Under the prerequisite model, significant numbers of students never take a gateway mathematics course. So, shifting to the corequisite model may raise the percentage of students who successfully complete a gateway course even if the success rates in the gateway courses stay the same or decrease.

Analyses using the data can be conducted to compare the percentages of students successfully completing gateway math courses between past prerequisite developmental course preparation and current/future corequisite support models. Significant differences in mean student grades between different approaches to corequisite support (e.g., separate support classes; extended hours as part of the gateway class; mandatory tutoring; cohort versus comingle approaches) can be assessed. Results of these assessments will inform future corequisite support efforts.

Currently, there is much variation in how universities have determined the need for developmental prerequisite or corequisite support in math courses. Examination of math placement practices (e.g., SAT & ACT math scores; ALEKS; in-house math placement exams; high school GPAs or high school math grades) can be conducted to determine placement approaches that will maximize the likelihood of student success under a corequisite rather than prerequisite developmental model. Results will not only inform decision-making about math course placement and support, but might also aid in decision-making about university admissions criteria.

Any and all statistical analyses can be conducted with an eye toward bridging well-documented performance gaps based on race, ethnicity, gender, first generation status, traditional age/adult learner, and different levels of preparation based on math placement scores. Comparisons based on these characteristics will again inform corequisite support practices that will maximize the potential for student success in math gateway courses.

It will also be possible to correlate gateway math course success with other measures of student success such as retention and graduation rates. Because many factors affect overall academic success, significant relationships among these measures cannot be interpreted as causal; however, difficulty completing mathematics requirements are one reason some students fail to graduate. As such, universities nationwide have reported improvements in retention and graduation when they implemented the corequisite model for mathematics support.