Emerging Solutions

Calculus 1 Corequisite Support

The University of Texas at Austin
Charles A. Dana Center

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Institutions, regions, and states around the country have been implementing and scaling corequisite support courses for over a decade (Complete College America, 2021). While the corequisite movement initially focused on gateway college-level courses such as Quantitative Reasoning, Introductory Statistics, and (to a lesser extent) College Algebra, some institutions have decided to expand their corequisite support offerings into the traditional entry-level course for STEM programs: first semester calculus.

Research shows that calculus acts as a gatekeeper and "weed-out course" for STEM programs, with disproportionate impacts on female students, students of color, and students experiencing poverty (Chen, 2013; Gates et al., 2012; Leyva et al., 2021; Rasmussen & Ellis, 2013; Seymour et al., 2019). When considering the impacts of prerequisite course attrition, it is not surprising that institutions are looking for ways to increase the number of students placed into, and successful in, first semester calculus.

Corequisite supports for first semester calculus are still an emerging trend. As they become more widely implemented, they should be designed with fidelity to the original premise of corequisite support (Richardson, 2021): Students who would otherwise enroll in a sequence of preparatory courses enroll directly in calculus and are provided corequisite support to ensure their success in calculus in one semester.

The Need for a Common Definition

Some institutions (e.g., California State University–Long Beach, Las Positas College, Victor Valley College, and Wayne State University) offer courses that would be better termed "calculus with supplemental instruction." These models operate under the assumption that some students who place directly into first semester calculus—or who have already passed the prerequisite courses such as college algebra, college trigonometry, or precalculus—would benefit from additional support. Some of these supplemental instruction models are open to all students, while others are restricted to certain populations (e.g., the Emerging Scholars Program at Wayne State) or are primarily recommended for those students who earned a passing grade below B in the prerequisite course.

Another reform model being implemented at several institutions (e.g., Adelphi University, Harvard University, Kent State University, and The Ohio State University) is a stretch model where precalculus content is embedded in a two-semester course sequence that covers the content of a traditional one-semester, entry-level calculus course. These models do not accelerate students to earn first semester calculus credit in the same way that the one-semester corequisite support model does; they are not included in this report.

A Detailed Look at Selected Models

The table below elaborates on the nuances of several corequisite models at institutions that offer true calculus corequisites. The institutions and models were chosen to demonstrate that, even within the prior design principles for corequisite supports, a variety of structural choices and modifications can be made to ensure a model aligns with an institution's specific student population and needs. (Note: Table 1 contains only a partial list of first semester calculus corequisites offered across the United States.)

Table 1. *Selected Corequisite Models*

Institution	Type of Calculus	Cohort or Comingle*	Same or Different Instructor	Additional Credits	Grading Method	Placement
Cañada College (California)	Applied Calculus for Business	Cohort	Same	1 credit	Pass/ No Pass	All students are eligible for the calculus course and can opt in to the corequisite.
Fullerton College (California)	Applied Calculus for Business	Cohort	Same	1 credit	Letter, same as calculus grade	All students are eligible for the calculus course. Those who took trigonometry or below as their last course in high school, or those who took precalculus and have GPA below 2.6, are recommended to take the support.

* A cohort model is one in which certain sections of the calculus course are designated exclusively for students who have been assessed as underprepared. The support content may be embedded in the calculus class with extended hours or in a separate support course. A comingled model is one in which calculus-ready students and students assessed as non-calculus-ready enroll in the same calculus class sections. Students designated as underprepared are provided additional instruction in a separate support course.

Institution	Type of Calculus	Cohort or Comingle*	Same or Different Instructor	Additional Credits	Grading Method	Placement
Southwestern College (California)	Applied Calculus for Science and Applied Calculus for Business	Cohort	Same	2 credits	Pass/ No Pass	All students are eligible for these calculus courses, although some are required to also take the corequisite based on a variety of measures of preparedness. Note: There is an option where students can take a non-credit version of the corequisite for no additional charge or credits.
University of Illinois Chicago – Emerging Scholars Program	STEM	Comingle	Potentially Different	1 credit	Satisfactory/ Unsatisfactory	Students in the Emerging Scholars Program who score three points below the Calculus 1 cutoff in ALEKS PPL can enroll in calculus only if they also enroll in the corequisite support. Note: Students can register for any pair of corequisite and Calculus 1 sections.
University of Oklahoma	STEM	Cohort	Different (support is taught by an undergraduate learning assistant)	No additional credit hours for corequisite, but does include two additional 50-minute meetings billed as lab hours	Letter, same as college-level grade	Students who score between 70 and 42 in ALEKS PPL can enroll in calculus only if they also enroll in the corequisite support. Note: Students enrolled in calculus without support can opt in to corequisite sections in the early weeks of the semester if they don't do well on initial assessment in calculus.
University of Northern Colorado	STEM and Life Sciences	Cohort	Potentially Different	1 credit	Satisfactory/ Unsatisfactory	Enrollment in the corequisite course for students who score between 60 and 74 in ALEKS PPL is recommended. Students who score between 45 and 59 in ALEKS PPL can enroll in calculus only if they also enroll in the corequisite support. Note: Same corequisite course for STEM calculus and for Life Sciences calculus, despite different order of topics.
University of Texas at Austin	Science and Math	Comingle	Same	2 credits	Letter, same as calculus grade	Students in the Emerging Scholars Program who place into precalculus are allowed to enroll in calculus with corequisite support based on multiple measures metrics.

Summary of Variations Between Highlighted Models

The selected corequisite models show several areas where campuses can make implementation decisions based on their unique student populations and needs. These decisions may be impacted by state-funding models, legislation or policy requirements, or other local factors.

Additional Credits

The majority of the models require students to take one or more additional credits compared to the traditional Calculus 1 course. These credits are generally college-level; any may be listed as either lecture, lab, or recitation hours.

Placement Procedures

Three dominant placement procedures can be observed in the models listed in the table: (1) all students are eligible for the corequisite; (2) there is a predetermined range of eligibility for the corequisite support; and (3) there is a predetermined range that is very close to the requirement for calculus. The third method is predominant in the traditional mathematical calculus course, while the other two relate to students enrolling in applied calculus courses.

All Students Eligible

Some of the corequisite models are open to all students. These courses are generally applied calculus courses, such as business calculus or calculus for life sciences. For example, Cañada College allows all students to register for the corequisite course and does not require a placement exam. Applied calculus is generally considered a gateway college math course in California, and AB705 prohibits prerequisites for such courses as well as placement via an exam. There are numerous institutions in California that offer business calculus with optional corequisite support—three of which are included in the table.

Range of Eligibility

Some of the models have a wide range of eligibility that still has some lower limit. For example, University of Northern Colorado has a recommended and a required threshold for enrolling in the life sciences calculus course. If students who are part of the Emerging Scholars program score between 60 and 74 on the ALEKS placement test, it is recommended that they take the corequisite. If students score between 45 and 59, they are required to take the corequisite course. At The University of Texas at Austin, Emerging Scholars students who place into precalculus but meet a range of other multiple measures metrics are allowed to enroll in calculus with corequisite support.

Small Range of Eligibility

Some of the models allow the enrollment of students who barely missed the requirement to enroll in traditional Calculus 1 (they are often referred to as “bubble” students). For example, at the University of Oklahoma, for students to place in traditional calculus, they must score 75 on the placement exam. To enroll in calculus with corequisite support, they must score between 70 and 74 on the placement exam.

Research and Learnings

While many institutions have not yet published quantitative data about the efficacy of their corequisite first semester courses, the majority have seen sufficient initial success to persist in offering the courses. The University of Illinois Chicago found that corequisite students passed

their STEM Calculus 1 course at a slightly higher rate than the non-corequisite students (about 1.5 percentage points higher) (Ross, 2022). The University of Northern Colorado found that students in the calculus corequisite were as likely as their non-corequisite peers to pass the course (Pierce, 2019). More qualitative research needs to be performed and published on course success rates, subsequent course success rates, and retention and graduation rates for students who take a calculus corequisite.

Several institutions highlighted here offered advice to math departments of other institutions that are considering implementing a first semester calculus corequisite course. They recommended that the course design be intentional and attend not only to the math content but also to the affective domain (e.g., belonging, community, growth mindset) and college success skills (e.g., study strategies, help seeking).

Individuals who were involved in the implementation of these courses at their respective campuses emphasized the importance of ongoing, regular communication between advisors and the corequisite course instructors—especially when a student was struggling. They also encouraged that type of communication between the calculus and corequisite instructors if different instructors were teaching the courses. Many also indicated that faculty training was crucial as many of the courses incorporated non-traditional instructional strategies, such as active learning and noncognitive skills, as key elements.

Recommendations for Future Work

While there are several institutions offering first semester calculus corequisites, the characteristics of a successful calculus corequisite (or, indeed, corequisites for most preparatory courses leading to calculus) have not been analyzed and published. To ensure that students are being supported as effectively and equitably as possible, future research should focus on the differences between the pathways to calculus courses, which are critical for STEM fields, and the quantitative reasoning/statistics pathways, as well as the resultant ways that corequisite support should be modified to support students .

The characteristics of success may also be found to vary based on the type of calculus, the type of institutions and respective student body (e.g., community college, state college, liberal arts college, R1 university), instructor characteristics (e.g., full-time, part-time, personality, teaching load), and available campus resources (e.g., advising staff, graduate students, credits). Research on which characteristics are most important when designing a calculus corequisite model to fit a particular institution should be done, allowing for a wide variety of experimentation so that best practices and policies can be identified.

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About this resource

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