DO THE DETAILS OF COREQUISITE SUPPORTS MATTER?

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Background

What are corequisite-supported college courses?

Every year, a majority of students entering community college for the first time are assessed as needing remediation in math or English.[1] Often, this results in students beginning college in developmental courses that are costly in time and dollars and do not accrue credits toward a degree.[2] However, students placed below college math or English are unlikely to complete the frequently long sequences of developmental courses through which remediation in math and English has been offered traditionally.[3] In a troublingly ironic twist, the developmental courses that were intended to help students successfully complete college math and English courses too often have served as a barrier to students' progress and hurt their chances of completing a college degree.[4]

Consequently, many community colleges are actively engaged in implementing reforms to reduce or eliminate the long sequences of developmental courses that have characterized many students' early college experiences. In that regard, accumulating evidence indicates that many students who have been assessed as underprepared for college math and English could succeed in gateway college-level courses in these subjects without first receiving remedial instruction.[5] Building on these findings, one of the prominent developmental reform strategies that has emerged involves placing students assessed as needing developmental assistance in math or English directly into a college-level, credit-bearing course and concurrently enrolling them in a companion course that provides tailored academic support. This *corequisite support model*, sometimes referred to as *mainstreaming* or *just-in-time remediation*, has shown promising results with respect to improving students' likelihood of completing gateway courses and persisting in college.[6]

That said, both the design of corequisite-supported college math and English courses, and the outcomes of students in these courses, vary markedly across colleges.[7] Variability in outcomes across studies may be due to differences in state context, the characteristics of the student populations or the research methodologies employed in studies. Alternatively, differences in outcomes may be driven by variability in the design and execution of the corequisite-supported college courses. Unfortunately, a lack of research on design and execution has left colleges largely in the dark about how to optimize their investment of limited resources when developing new corequisite supports or strengthening existing ones (for an exception to this generalization, see Miller et al., 2021).

To address this blind spot, we capitalized on the evolution of developmental education reforms across the Colorado Community College System (CCCS) over the past decade, and the resulting natural variation over time and across institutions in the design and execution of corequisite supports for college math and English. By merging administrative data from the CCCS with interview data that we collected from math and English instructors and department chairs at each of the thirteen community colleges of the CCCS, we constructed a novel data set that allowed us to identify the specific features of corequisite supports used in the colleges; explore how institutional context influenced their implementation; document students' exposure to different features and designs; and investigate which features were most strongly associated with students' outcomes. We draw on our findings to recommend policy and practice reforms that optimize

state and college investment in corequisite-supported college courses.

How has developmental reform unfolded in the Colorado Community College System?

Historically, developmental education in the CCCS was structured as sequences of prerequisites leading to college math and English courses,[8] similar to the designs used by many community colleges across the country. Unfortunately, CCCS students who enrolled in these prerequisite courses were unlikely to ever enroll in college-level courses.[9]

Seeking to improve student outcomes, the CCCS drew on both external financial support and statewide policy reform initiatives to spur system-wide changes, informed to some extent by early experimentation with developmental reforms in several CCCS institutions. In the summer of 2011, the CCCS convened a statewide Developmental Education Task Force (DETF), which was charged with examining the role that developmental education played in students' overall success, and then proposing curricular revisions and changes in student services across the system.[10] The DETF was comprised of representatives from all thirteen CCCS colleges[11] — developmental education faculty, department administrators, deans, vice presidents, student services staff — as well as staff from the CCCS office, the Colorado Department of Higher Education and the Denver Scholarship Foundation.

The task force committed to an 18-month process of research and discussion among staff and stakeholders to build a new system-wide perspective for developmental education and new models for developmental education delivery. The DETF examined a number of specific developmental education models, such as the Community College of Baltimore Accelerated Learning Program (ALP) model[12] and the Dana Center Mathematics Pathway (DCMP).[13] The DETF also took into consideration the unique cultures and contexts of each CCCS institution. As a result of this work, the DETF developed a comprehensive plan for addressing issues in developmental education across the CCCS that allowed for institutional flexibility, accounting for each school's specific needs and resources.[14]

The DETF plan had three major foci: testing and placement, course efficiency and student services. The plan for addressing course efficiency proposed allowing a large share of students assessed as needing developmental education to enroll directly in college-level courses by providing a systematic approach to skill remediation and just-in-time learning.

In math, the DETF recommended replacing the developmental sequences with two stand-alone developmental education courses: 1) Quantitative Literacy for non-STEM and non-transfer programs of study, and 2) Pre-algebra for STEM and other algebra-based programs of study. More relevant to this study, the DETF recommended the development of a series of corequisite support courses covering most of the gateway college math courses, and then mainstreaming students who were assessed as needing modest developmental assistance with the requirement that they enroll in a corequisite support course.[15]

In English, the DETF recommended replacing the three-course developmental sequences in reading and composition with a single stand-alone developmental English course, College Composition and Reading (CCR). In addition, like math, the task force recommended the development of several corequisite supports for college English, including one that linked a subject matter course and the CCR support.[16]

In February 2013, these recommendations were accepted by the governing board of the CCCS and subsequently by the state legislature. Colleges were given some latitude for the rollout, but all colleges were required to have full implementation by fall 2014.[17] Holistically, there was widespread buy-in to the recommendations by the colleges. Yet, the particular design and execution of corequisite supports varied markedly across institutions. Throughout the period of time addressed by this study (2014 to 2021), colleges experimented significantly and developed approaches specific to their resources and the needs of their students.[18]

Evidence of the effects of corequisite supports and other developmental education reforms in the CCCS have been promising. Students tend to enter college math and English courses more quickly, have higher grades and are more likely to persist than they did before CCCS implemented developmental reforms, although outcomes vary across the colleges.[19] The observed variation in outcomes may stem from different implementation timelines, differences in the characteristics of the students served or differences in the design and execution of corequisite-supported college courses.[20] The latter is the focus of this study.

In what ways do corequisite supports tend to differ in design and execution?

Nationally, there is considerable enthusiasm about the use of corequisites as a strategy for supporting the success of students assessed as being underprepared for college coursework. In a 2016 survey of community colleges, 16% reported that they offered corequisite-supported college courses in math, and 35% offered them in English and writing.[21] By 2021, corequisite-supported courses were recommended or required at all community colleges in at least nine states.[22]

However, despite the interest in corequisite supports, there has been surprisingly little investigation of how the design and execution of the corequisites bear on students' outcomes (for an exception, see Miller et al., 2021). In other words, we know little about the particulars of design and execution that tend to maximize students' success.

In fact, corequisite supports have been implemented in myriad ways, shaped by administrative costs, available resources and other aspects of institutional context. The details of how colleges execute corequisite supports may have consequences for students' success. For instance, corequisites differ in the *instructional format* (e.g., lecture, individualized tutoring). Likewise, the *scheduling* of the corequisite can vary; the course and corequisite support can be scheduled consecutively with the corequisite either immediately before (anterior) or after (posterior) the college course, or they may be scheduled on different days of the week. Colleges sometimes seek to foster something akin to a learning community by grouping students into *cohorts* who attend the same support lab and college course together, and by having the *same instructor* teach both the lab and the college course.[23] In addition, the *appointment* of the instructor assigned to teach the corequisite can differ, with some support courses taught by full-time instructors and some by part-time instructors. Finally, the *enrollment size* of the corequisite courses varies. Variations in any of these features may contribute to differences in students' outcomes. In the remainder of this section, we describe the corequisite design features investigated in this study.

Instructional format

As noted, corequisites can differ in the *instructional format* used. They can be offered as lectures

that are an extension of the college-level course, as targeted just-in-time support in which instruction is tailored to students' questions about course material or as individualized tutoring sessions.[24] Just-in-time and individualized tutoring are similar to other developmental reforms, such as modularization or emporium models and supplemental instruction. Like just-in-time and individualized tutoring formats, modularization and supplemental instruction aim to provide additional instruction tailored to each student's academic needs using either adaptive computer modules or collaborative learning techniques, respectively.[25]

Adaptive computer modules can be expensive for institutions to purchase, and providing individualized instruction likewise can be cost-prohibitive.[26] Furthermore, shifting instructional format can be labor-intensive for instructors who are accustomed to teaching in a lecture style.[27] It is unclear whether the costs of these instructional forms yield meaningful benefits in terms of students' outcomes. Indeed, there are few rigorous studies of the academic benefits of instructional format in developmental education courses. In one study that may inform expected outcomes for differing corequisite designs, students who received modular instruction as part of a randomized control trial were similarly likely to complete their developmental coursework as those in conventional, lecture-style courses.[28]

Course scheduling

Pairs of college courses and their corequisite supports can be *scheduled* consecutively, with the corequisite either immediately before or after the college course, or they may be offered on different days of the week. Scheduling courses and corequisites consecutively can add significantly to the already labor-intensive and challenging task of course scheduling faced by colleges.[29] There is mixed evidence on the role course sequencing plays in students' college experiences. Some evidence suggests that students enrolled in programs that schedule classes consecutively are more likely to earn a degree,[30] but students in a community college developmental math course had similar grades and were similarly likely to complete their course regardless of how frequently and for how long the class met.[31] Thus, it remains uncertain whether consecutively scheduling corequisite supports and their paired college courses improves students' outcomes.

Learning communities

Corequisite supports can be designed to ensure that a group of students attend the same college course and corequisite support together as a *cohort,* and that the *same instructor* teaches both the support and the college course.[32] This approach mimics some of the features of learning communities.[33] Learning communities involve a cohort of students who enroll in multiple, content-aligned courses taught by the same instructor or, alternatively, by collaborating instructors.[34] Constructing learning communities can be administratively taxing since they involve recruiting and training instructors and placing students in multiple courses with an eye toward their scheduling constraints.[35] Yet, research has shown that students enrolled in developmental courses and randomly assigned to learning communities tend to attempt and earn more credits in courses in the same subject as their developmental course in the next two semesters, though the effects of learning communities dissipate over time.[36] This finding points to the possibility that students enrolled in corequisites as part of cohorts or with the same instructor for their support and college course may have stronger outcomes than students who do not experience these features, though any benefit of a learning community approach to corequisite-supported college courses may not extend to coursework in later terms.

Instructor appointments

The appointment of the instructor teaching the corequisite support can vary. Sometimes corequisites are taught by full-time instructors and other times by part-time instructors, driven to some extent by differences in staff compositions across institutions and the complexities of balancing instructors' teaching loads.[37] Relative to adjunct or part-time instructors, full-time instructors may be more connected to institutional resources that can aid their efforts to support students, such as professional development opportunities or offices in which to meet with students.[38] That said, evidence on the relevance of instructor characteristics in early college courses is mixed. Specifically, being taught by a full-time instructor as opposed to an adjunct or part-time instructor is associated with lower grades and course success in students' first college course, but also may be associated with a higher likelihood of enrolling in or passing higher-level courses after their gateway course.[39] Similar patterns might be observed for students enrolled in corequisite supports.

Class size

Finally, the enrollment *size* of the corequisite can vary considerably, from dozens of students to just one or two, depending on the size of the institution, student need, and the availability of instructors.[40] Smaller class sizes could support students' academic outcomes by increasing the amount of instructor-student interaction.[41] Indeed, early corequisite designs, like ALP, attempted to keep classroom sizes small to better support students (ALP, undated). Yet, other studies suggest that larger class sizes in developmental courses in English are associated with higher grades in students' first college English course.[42] Therefore, it remains to be determined whether smaller sections of corequisite supports are associated with stronger student outcomes.

How can investigating different corequisite designs benefit colleges and students?

As mainstreaming reforms continue to proliferate, an investigation of corequisite designs will illuminate the administrative costs and available resources that shape how corequisites are implemented, and specify which features of corequisite reforms have the largest benefit for students' outcomes. With insight into the features that most support students' academic success, and the institutional contexts that influence corequisite implementation, colleges will be better equipped to deploy developmental reforms in alignment with available resources that maximize students' chances of success. The college-driven approach for implementing corequisites undertaken by the CCCS provides an opportunity to document how different institutional contexts lead to different corequisite designs, and to investigate the implications of differences in corequisite design and execution for students' outcomes. In this study, we sought to answer five questions:

1. How did institutional contexts influence the implementation of corequisite supports for college math and English courses?
2. What corequisite features were students most likely to encounter?
3. What were the most common corequisite designs (combinations of features) that students encountered?
4. Which corequisite features matter most for students' course outcomes?
5. In regard to college math specifically, are there differences by course subject in the relationships between corequisite features and student outcomes?

To answer these questions, we developed and analyzed a unique dataset. The dataset combined state administrative records addressing student coursework and academic outcomes; information collected from interviews with instructors and department chairs at each community college; and responses from instructors and department chairs to clarifying questions collected through a follow-up survey. We used these data to investigate specific features of corequisite supports; understand why certain corequisite designs were implemented by colleges; explore instructors' views regarding the benefits and drawbacks of specific features; and identify the corequisite features that are most strongly associated with students' outcomes. The data included 19,544 first-time college students between the ages of 17 and 64 years who attempted a corequisite-supported college math or English course offered between the 2014–15 and 2019–20 academic years. See Appendix A for more detail on the students in the sample.

Key Findings

How did institutional contexts influence the implementation of corequisite supports for college math and English courses?

Interviews with the instructors and chairs of English and math departments across the 13 CCCS institutions illuminated differences in college cultures, available resources, course offerings, instructors and student populations that shaped the execution of corequisite supports. Enrollment considerations, financial constraints, limitations of existing teaching staff and scheduling concerns all were cited as influential factors. For example, lower enrollments affected the decision to design corequisites around student cohorts, when to schedule corequisites and, in some cases, whether to even offer certain corequisite-supported courses. The chair of one English department explained:

> "We were having the same problem with [the corequisite support course for college composition] where we'd have maybe six students every semester, or something like that, sometimes only three. And then they would all disappear invariably by the end of the semester … so we stopped offering that as well, because it just didn't always make [have a sufficient number of students enrolled to justify the course] and, even if it made, we would lose all of the students by the end."

While some colleges stopped offering specific corequisite supports due to low demand, other colleges adjusted the design of the corequisites. For instance, the chair of one math department explained:

> "We would have 1–2 students in the coreq class. We had very low numbers — instructors felt it was difficult to build community in such small courses. When the pandemic happened and budgets got tighter, we thought it would be a little more economical and efficient to have larger coreq numbers. We explored unlinking to give students more flexibility and choice."

Financial constraints combined with low enrollment led some colleges to experiment with larger class sizes and to abandon efforts to create student cohorts in corequisite-supported courses.

Similarly, the size of the college influenced the number of courses and sections that the college could offer, complicating scheduling. A math instructor described how this impacted the scheduling of corequisite supports and gateway courses, and whether or not colleges attempted to group students into cohorts:

> "A big problem we have is that we're so small, that running a class that is 90 minutes long takes up a big chunk of students' schedules, and a lot of other classes are ruled out for them, especially if they are also in an English coreq, an athlete, or taking a science with a lab component."

In other words, scheduling a corequisite support directly before or after the college-level course sometimes made it difficult for students to enroll in other courses, especially when course options were limited. A similar difficulty arose when administrators tried to establish a cohort by

scheduling or expecting students to enroll in the same section of the college course as their classmates in their corequisite support. As a result, some colleges prioritized flexibility in their corequisite offerings by scheduling corequisite supports and gateway courses on separate days, and by not expecting all of the students enrolled in corequisite supports to attend the same section of the college course.

Finally, due to staffing limitations, some colleges did not design corequisites with the same instructor teaching both the college-level and corequisite. As an adjunct math instructor explained, "We have very few math teachers. So, to get the same teacher to also teach the coreq is really a challenge because everyone is spread so thin." Other colleges were limited by their instructors' qualifications. Colorado legislated that instructors of college-level courses must have a master's degree in the discipline that they teach. Some existing instructional staff that had been teaching developmental education courses did not have the educational credentials required to teach both the corequisite and the college-level course. A math department co-chair explained:

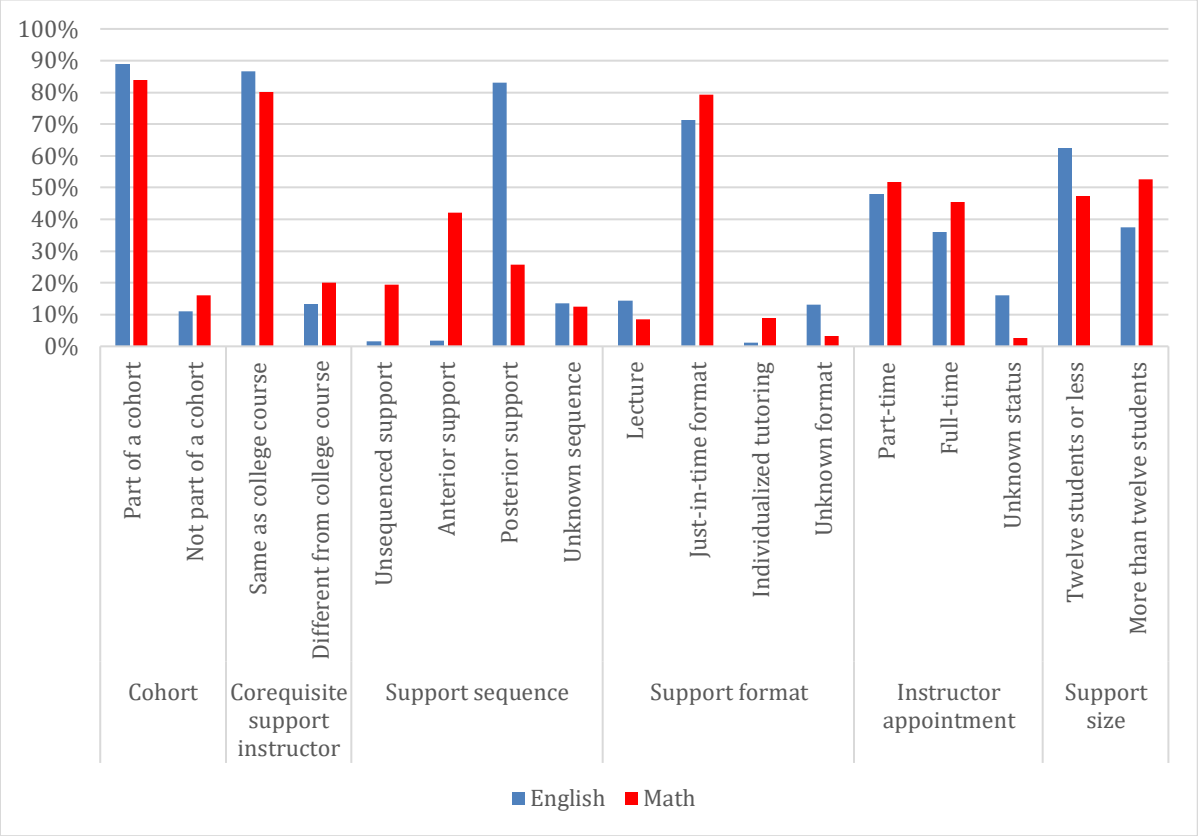
> "At our school, we have some developmental faculty who really are not qualified to teach college-level classes. So, for that reason, we're going to have to have two instructors teaching some of the coreqs, and one instructor teaching some of them, depending on the qualification. There has been a commitment to keep those people employed as faculty. For that reason, there's practical considerations for why there might be two instructors."

What corequisite features were students most likely to encounter?

We investigated the prevalence of the various corequisite features encountered by students in corequisite-supported English and math courses (please see Figure 1). Below, we summarize key findings regarding Composition I (college-level English).

- Nearly nine out of 10 students (89%) who were enrolled in corequisite-supported Composition I were part of a cohort that shared the same college-level course and corequisite.
- Nearly as many students (87%) had the same instructor teach both their Composition I course and the associated corequisite support.
- Students also were very likely to enroll in a corequisite that was ordered sequentially with their Composition I course, with the vast majority (83%) enrolled in a posterior support course scheduled on the same day and immediately following Composition I. Very few students (2%) had an anterior support course on the same day but preceding Composition I. Corequisite sequencing was unknown for 13% of students.
- About seven out of 10 students (71%) were in a support course taught in a just-in-time format, while individualized tutoring was very uncommon (1%). About 13% of students were enrolled in a corequisite course with an unknown instructional format.
- Just shy of half of students (48%) were taught by part-time instructors, while slightly more than one-third (36%) were taught by a full-time instructor. The appointment of the instructor (part-time versus full-time) was unknown for 16% of students.
- On average, support labs had approximately 14 students (median of 12 students).

Figure 1. Proportion of student enrollment by corequisite feature and subject



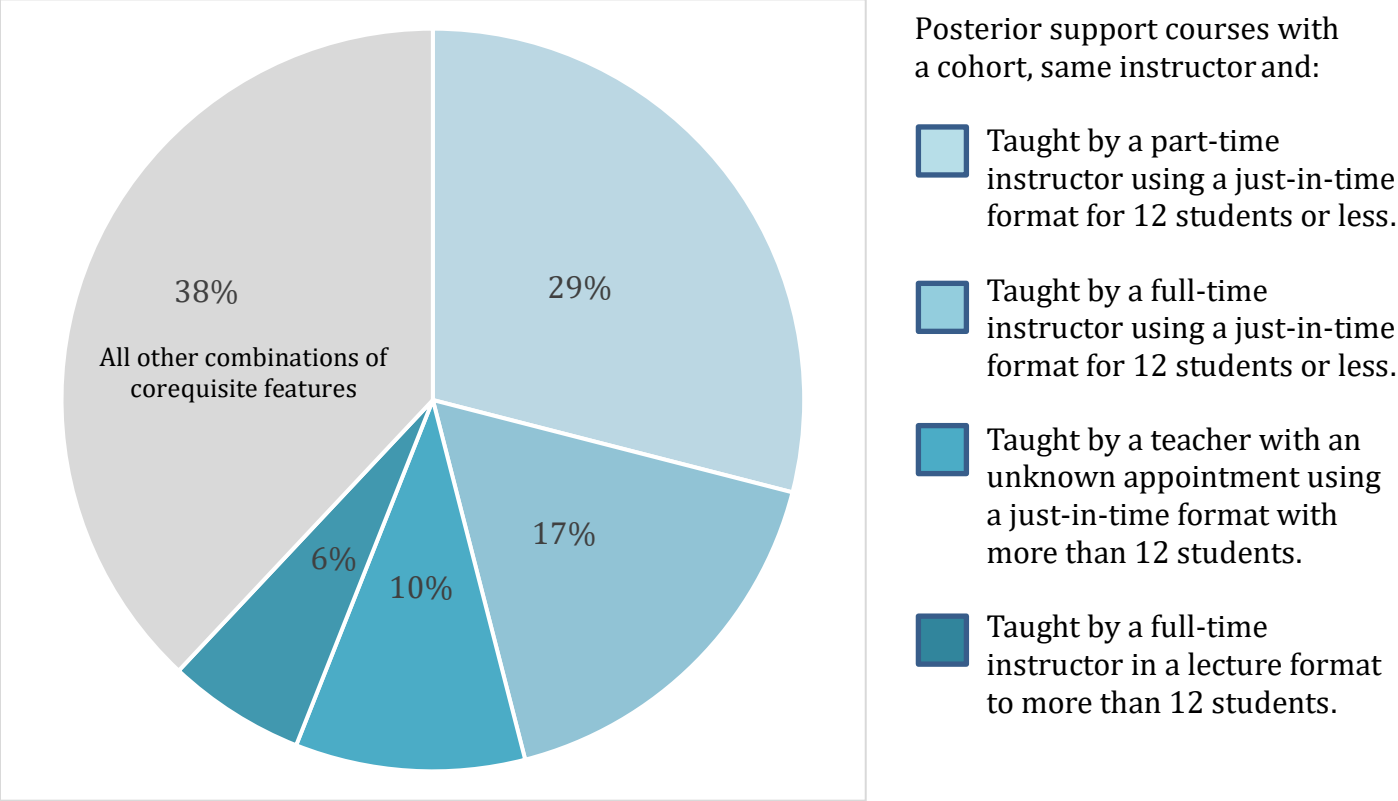
The parallel findings for transfer-level math are summarized below.

- Among students who took corequisite-supported transfer-level math courses, 84% were in cohorts.
- Four out of five students (80%) had the same instructor for their support course and college math course.
- As compared with English, students were less likely to have sequentially ordered math supports (68% vs. 85%). About two in five students (42%) enrolled in a college math course with an anterior support course, and about one quarter (26%) enrolled in a math course with posterior support.
- Nearly four out of five (79%) students received just-in-time instruction in their math support course, and 9% received individualized tutoring.
- Over half (53%) of students in corequisite-supported math courses had a part-time instructor teach their math support class, while 45% had a full-time instructor. The instructor appointment was unknown for the remaining 3% of math corequisite students.
- On average, math corequisite supports had 13 students enrolled (median of 12 students).

What were the most common corequisite designs that students encountered?

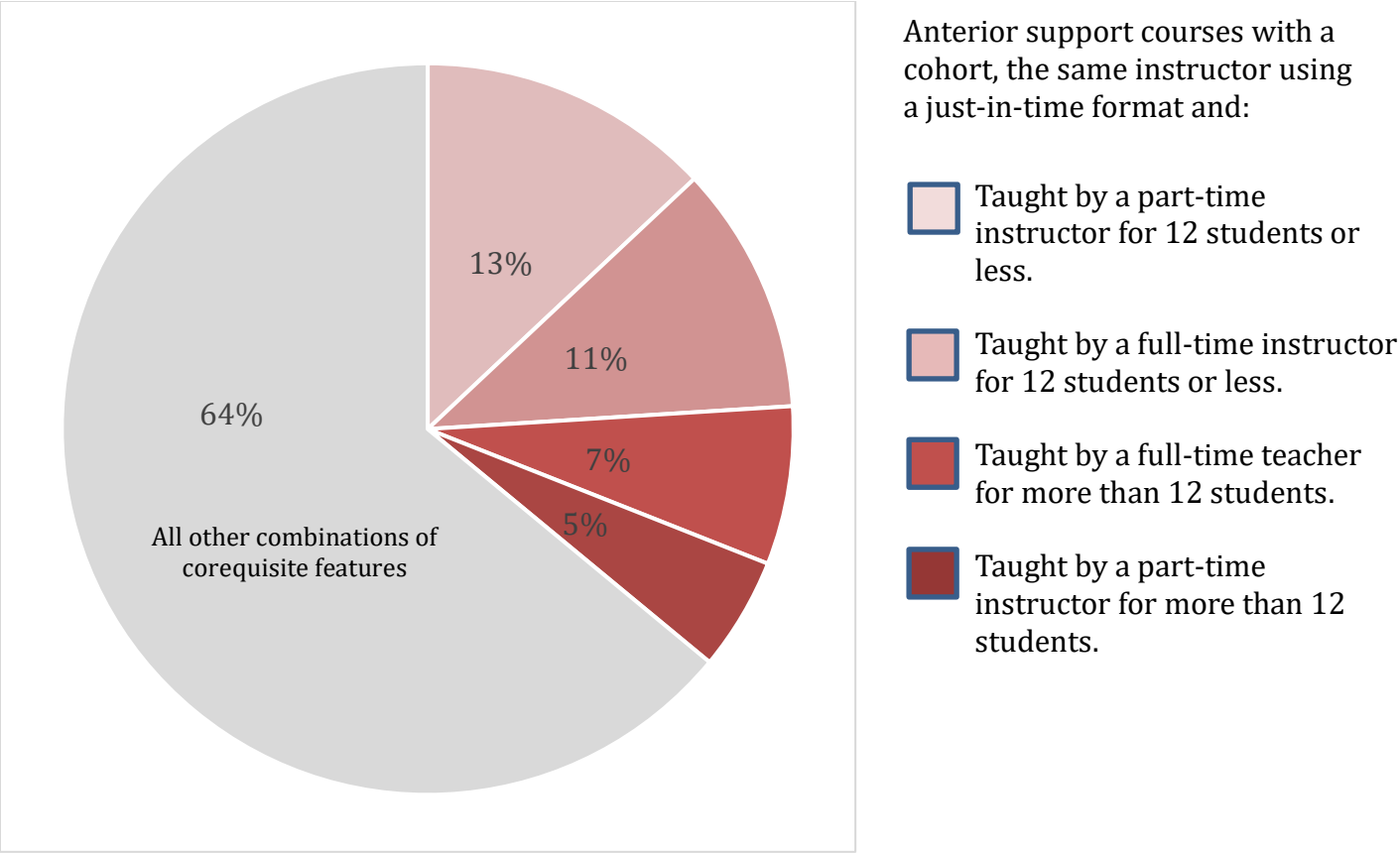
To better understand the most common corequisite designs implemented across the CCCS, we examined the combinations of features students most often encountered (see Figures 2 and 3). For the purposes of this part of our analysis, we dichotomized corequisite size as 12 or fewer students versus 13 or more students. This threshold was selected based on an early corequisite model used in Baltimore's community colleges, which capped enrollment in corequisite supports at 12 students.[43]

Figure 2. The four most common combinations of English corequisite designs



For corequisite-supported Composition I (see Figure 2), almost two-thirds of students (62%) enrolled in a corequisite that created a student cohort were taught by the same instructor who taught the students' Composition I course; and the corequisite was scheduled on the same day as and immediately after the meeting time of the Composition I course (a posterior support course). These corequisites differed in size, instructional format and the appointment of the instructor, with about three-quarters of these students (74%) enrolled in a small corequisite that served 12 or fewer students and was taught in a just-in-time format. Of these, about two-thirds (63%) had a part-time instructor.

Figure 3. The four most common combinations of math corequisite designs



Holistically speaking, there was greater variation in the combinations of corequisite features for college math (Figure 3) as compared with college English (Figure 2). Just over one-third of students (36%) enrolled in a math corequisite that created a student cohort; employed a just-in-time instructional format; was taught by the same instructor who taught the students' college math course; and was scheduled on the same day as and immediately before the meeting time of the college math course (an anterior support course). These corequisites differed in size and the appointment of the instructor, with two-thirds of these students (67%) enrolled in a small corequisite that served 12 or fewer students, split nearly evenly in terms of instructional appointment between part-time and full-time.

Which corequisite features matter most for students' course outcomes?

The efficacy of corequisite-supported college courses for improving students' short-term academic outcomes already is increasingly well documented.[44] The primary goal of this study was to identify the corequisite features that have the strongest associations with key student outcomes, and to differentiate them from features that are not strongly associated with student outcomes. By examining the joint relationships between features and outcomes, our analyses recognize that corequisite-supported courses can be delivered in myriad ways with multiple potentially important features. Our analyses illuminate relationships between each particular corequisite feature and student outcomes, while accounting for other aspects of corequisite design.

In Table 1, we present selected results of our analysis of two short-term student outcomes and one long-term outcome for students who enrolled in corequisite-supported Composition I (transfer-level English). The short-term outcomes were passing the college English course on the first attempt and grade points achieved on the first attempt of college English (on a four-point grading scale). The long-term outcome was successfully completing a second college English course, specifically College Composition II, conditional on passing the first English course on the first attempt and then attempting Composition II within one year. We used multilevel linear models to analyze the outcomes, regressing each outcome on corequisite features, student characteristics, enrollment patterns and other variables, as detailed in Appendix A.

Table 2 presents parallel results for math. The two short-term math outcomes were passing the college math course on the first attempt and grade points achieved on the first attempt of college math (on a four-point grading scale). The long-term outcome was successfully completing any second college math course, conditional on passing the first college math course on the first attempt and then attempting the second college math course within one year. As with our analyses of English courses, each outcome was regressed on corequisite features, student characteristics, enrollment patterns and other variables, but we also accounted for the subject of the math course (e.g., College Algebra, Statistics). See Appendix A for details.

Corequisite-Supported College English Courses

Once other factors were taken into account, comparatively few corequisite features emerged as having statistically significant associations with students' chances of passing college Composition I on the first attempt and their average grade in their first attempt of Composition I. Most notably, students taught by the same instructor in their Composition I course and corequisite had markedly higher chances of success (estimated at 38 percentage points higher) and achieved markedly higher grades (estimated to be 1.1 grade points higher on average, or slightly more than one full letter grade) when compared to their peers in corequisites taught by a different instructor. A faculty member in an English department expounded on the advantage of having the same instructor teach both the college course and the corequisite, explaining that the additional time with the same instructor allows more opportunities for students to become comfortable with the instructor and eventually ask questions to better understand the course material. The faculty member explained:

> "There's also a more emotional part of [the corequisite support course for college composition] … People who are really shy, like introverts, will almost never attend office hours, so having another time, like once a week or biweekly, with me asking questions or repeating the same lectures again really helps them."

Students enrolled in corequisites that delivered individualized support achieved a higher average grade in Composition I (nearly three-quarters of one letter grade) than did students enrolled in corequisites delivered in a lecture format. Course outcomes of students in corequisites using a just-in-time instructional format did not differ significantly from outcomes of students in lecture-format corequisites.

Table 1. Estimated relationships between three course outcomes and selected corequisite features for students enrolled in a corequisite-supported transfer-level English course.

	Likelihood of Passing Composition I	Grade in Composition I	Likelihood of Passing Composition II
	Estimated Percentage Point Difference	Estimated Grade Point Difference	Estimated Percentage Point Difference
Cohort of students in corequisite support and college course			
Part of a cohort vs. Not part of a cohort	–21.5	–0.5	n/s
Corequisite support instructor			
Same instructor vs. Different instructor	+38.0	+1.1	n/s
Support Sequencing			
Anterior support vs. Unsequenced support	n/s	n/s	n/s
Posterior support vs. Unsequenced support	n/s	n/s	n/s
Unknown sequencing vs. Unsequenced support	n/s	n/s	n/s
Support format			
Just-in-time vs. Lecture	n/s	n/s	n/s
Individualized vs. Lecture	n/s	+0.7	n/s
Unknown format vs. Lecture	n/s	n/s	n/s
Instructor appointment			
Full-time instructor vs. Part-time instructor	n/s	n/s	n/s
Unknown appointment vs. Part-time instructor	n/s	n/s	n/s
Size of corequisite support			
For each additional 10 students enrolled	n/s	–0.1	n/s
Number of Students	14,282	12,978	3,784

Note: See Appendix A for descriptions of the outcomes, the corequisite features and the statistical controls included in the models. A cell containing "n/s" indicates an estimated coefficient that was not statistically significantly different from zero after applying the Bonferroni adjustment, setting the maximum acceptable probability of falsely concluding that there is a relationship between a given corequisite feature and a given outcome to 0.005 (i.e., one half of one percent).

Students in corequisites scheduled immediately after or before their Composition I course had outcomes that did not differ significantly from students in corequisites scheduled on a different day. We note, though, that there were very few students enrolled in either an anterior support course or an unsequenced support course, making it difficult to estimate differences with sufficient precision to speak confidently about the relationships.

The size (enrollment) of the support course had a small but statistically significant relationship with average grade in Composition I. Average grade declined by an estimated one-tenth of one grade point for each additional 10 students enrolled.

Composition I outcomes of students taught by full-time instructors did not differ significantly from outcomes of students taught by part-time instructors. In part, this may be because both full-time and part-time instructors have to acclimate to new ways of teaching in corequisites. The assistant chair of one participating English department explained some of the necessary changes in teaching:

> "My feelings have been that we have to change our thinking about what students really need. So, training teachers on how to identify reading disabilities, understand making [attending] office hours every day, checking email, etc."

Similarly, the chair of the English department at one college explained how teaching a corequisite requires a different orientation to teaching than other courses:

> "When I started teaching [the corequisite support courses for college composition], a big part of me felt like I wasn't teaching because I wasn't up in front of the room being a teacher for an hour and fifteen minutes. I was letting them do work on their own time, intervening when they wanted me to, having one-on-one conversations. It took me a couple of semesters to shake that feeling and really feel like this is what teaching looks like."

Oddly contradictory to our expectations, students in cohorts had lower chances of successfully completing Composition I (estimated to be about 22 percentage points lower) and lower average grades in Composition I (estimated to be one-half of one letter grade), as compared with students who were not part of a cohort. A closer investigation of these findings revealed that the negative association between cohort and course outcomes emerged only after we accounted (controlled statistically) for whether the corequisite and college course were taught by the same instructor, which had a strongly positive association with first-attempt success and grade achieved in the college English course. Later, we discuss possible explanations for this unexpected finding.

Turning to the longer-term outcome, we found no evidence that particular corequisite features play an important role in students' likelihood of successfully completing Composition II. None of the corequisite features considered here had statistically significant associations with students' chances of passing Composition II, conditional on attempting it within one year of passing Composition I.

Corequisite-Supported College Math Courses

Unlike English, students in college math courses who enrolled in a posterior support course meeting immediately after the college course had a significantly greater chance of passing the college math course (estimated to be about 18 percentage points greater) than did students in unsequenced corequisites (Table 2). They also had significantly higher grades in the math course, estimated at approximately one-half of one letter grade. Students receiving anterior support did not have pass rates or average grades that differed significantly from students in unsequenced corequisites. A math instructor explained why students may benefit from a support course scheduled directly after the college math course:

> "A lot of our faculty believe that one of the benefits of the [corequisite] is time to support students with homework. Scheduling after allows students to get started [immediately] on their homework related to the content they just covered in class with that extra support."

As noted earlier, students in Composition I who were part of cohorts in their corequisites had significantly lower pass rates and significantly lower grades in Composition I than did students who were not in cohorts. The results differed for math; students in cohorts had modestly but significantly higher pass rates (about 5 percentage points) and higher average grades in college math (estimated to be one-quarter of one letter grade) than students who were not part of a cohort.

One of the most noteworthy associations between corequisite features and student outcomes in English was whether the college course and corequisite were taught by the same instructor. Students' chances of passing Composition I and average grade in Composition I were significantly higher when the same instructor taught both. In math, this relationship was not evident; we did not find a significant association between course outcomes and whether the same instructor taught the college course and corequisite support course.

Whereas an instructor's appointment (full-time versus part-time) was not significantly associated with course outcomes in English, students in college math corequisites taught by full-time instructors had slightly but significantly lower average grades in college math (estimated to be about one-fifth of one letter grade), compared with students in corequisites taught by part-time instructors. This finding contradicts our expectations and seems to contradict evidence from the qualitative data that we collected as well. Corequisite courses often are taught with different goals in mind than developmental courses or college-level courses. Both full-time and part-time instructors may need training to acclimate to new ways of teaching, as described by the chair of a math department:

> "It's just a challenge to communicate to new people or adjunct instructors what we're trying to do. … We have full-time faculty that still have a hard time with that. They want to be able to plan for their class in the way they do for their college-level classes."

As the interview demonstrates, both full-time and part-time instructors can struggle to shift their instructional techniques. Regardless of who is more or less likely to struggle to make the shift, a chair of a math department succinctly argued, "We need to have structure and really well-trained faculty to teach the coreqs. I think that's been the biggest issue nationwide," pointing to an important institutional lever to improve student outcomes when introducing corequisite courses in place of developmental courses.

Table 2. Estimated relationships between three course outcomes and selected corequisite features for students enrolled in a corequisite-supported transfer-level math course.

	Likelihood of Passing Transfer-Level Math	Grade in Transfer-Level Math	Likelihood of Passing a Second Transfer-Level Math Course
	Estimated Percentage Point Difference	Estimated Grade Point Difference	Estimated Percentage Point Difference
Cohort of students in corequisite support and college course			
Part of a cohort vs. Not part of a cohort	+4.9	+0.2	n/s
Corequisite support instructor			
Same instructor vs. Different instructor	n/s	n/s	n/s
Support Sequencing			
Anterior support vs. Unsequenced support	n/s	n/s	n/s
Posterior support vs. Unsequenced support	+17.9	+0.5	+17.7
Unknown sequencing vs. Unsequenced support	+12.7	+0.4	n/s
Support format			
Just-in-time vs. Lecture	n/s	n/s	n/s
Individualized vs. Lecture	n/s	n/s	n/s
Unknown format vs. Lecture	n/s	n/s	n/s
Instructor appointment			
Full-time instructor vs. Part-time instructor	n/s	–0.2	n/s
Unknown appointment vs. Part-time instructor	n/s	n/s	+35.7
Size of corequisite support			
For each additional 10 students enrolled	n/s	n/s	n/s
Number of Students	5,262	4,363	716

Note: See Appendix A for descriptions of the outcomes, the corequisite features and the statistical controls included in the models. A cell containing "n/s" indicates an estimated coefficient that was not statistically significantly different from zero after applying the Bonferroni adjustment, setting the maximum acceptable probability of falsely concluding that there is a relationship between a given corequisite feature and a given outcome to 0.005 (i.e., one half of one percent).

Individualized instruction was the only corequisite format that was associated with significantly better Composition I outcomes, as compared with outcomes of students in lecture format corequisites. In math, neither students in individualized format corequisites nor those in just-in-time format corequisites had significantly different outcomes than their peers in lecture format corequisites. Also, in English, corequisites of larger size (higher enrollment) were associated with slightly lower average grades in Composition I, but the size of the corequisite was not associated with students' outcomes in college math.

Finally, none of the corequisite features were associated with the long-term outcome of completing Composition II. The same is generally true of college math except that students in a posterior support course were more likely to pass a second college math course, conditional on passing the first college math course in the first attempt and attempting a second college math course within one year.

Corequisite-Supported College Math Courses by Subject

Experimental evidence has shown that students' academic outcomes in corequisite-supported math depend in part on the subject of the math course,[45] highlighting the importance of investigating whether there are different relationships between corequisite features and course outcomes for different math subjects. Table 3 provides regression estimates of the relationships between corequisite features and the likelihood of passing transfer-level math disaggregated by math subject, specifically College Algebra, Math for Liberal Arts and Introductory Statistics, which were the three math courses with the highest student enrollment. Table 4 provides the parallel estimates for the relationships between corequisite features and grade points achieved in the transfer-level math course.

Once math courses are disaggregated, we find that the positive relationships between participating in a cohort and the likelihood of passing college math is driven by and limited to College Algebra. This relationship does not achieve statistical significance for students enrolled in Introductory Statistics or Math for Liberal Arts.

The aggregated math analyses (Table 2) indicated that students enrolled in a posterior corequisite had better course outcomes than students in unsequenced corequisites. Disaggregating students by subject reveals that this advantage of posterior support is limited to College Algebra and Introductory Statistics.

Finally, the evidence did not support a relationship between instructional format and course outcomes when college math courses were aggregated. When disaggregated, however, we find that students in Math for Liberal Arts courses had higher average grades when they received just-in-time instruction rather than instruction in a lecture format. This relationship is not observed in College Algebra or Introductory Statistics.

Table 3. Estimated relationships between corequisite features and the likelihood of passing transfer-level math by math subject.

	College Algebra	Introductory Statistics	Math for Liberal Arts
	Estimated Percentage Point Difference		
Cohort of students in corequisite support and college course			
Part of a cohort vs. Not part of a cohort	+6.9	n/s	n/s
Corequisite support instructor			
Same instructor vs. Different instructor	n/s	n/s	n/s
Support Sequencing			
Anterior support vs. Unsequenced support	n/s	+14.5	n/s
Posterior support vs. Unsequenced support	+19.4	+33.3	n/s
Unknown sequencing vs. Unsequenced support	+13.1	+54.4	n/s
Support format			
Just-in-time vs. Lecture	n/s	n/s	n/s
Individualized vs. Lecture	n/s	n/s	n/s
Unknown format vs. Lecture	+36.3	n/s	n/s
Instructor appointment			
Full-time instructor vs. Part-time instructor	n/s	n/s	n/s
Unknown appointment vs. Part-time instructor	n/s	n/s	n/s
Size of corequisite support			
For each additional 10 students enrolled	n/s	n/s	n/s
Number of Students	3,146	780	944

Note: See Appendix A for descriptions of the outcomes, the corequisite features and the statistical controls included in the models. A cell containing "n/s" indicates an estimated coefficient that was not statistically significantly different from zero after applying the Bonferroni adjustment, setting the maximum acceptable probability of falsely concluding that there is a relationship between a given corequisite feature and a given outcome to 0.005 (i.e., one half of one percent).

Table 4. Estimated relationships between corequisite features and grade points achieved (4-point scale) in transfer-level math by math subject.

	College Algebra	Introductory Statistics	Math for Liberal Arts
	Estimated Grade Point Difference		
Cohort of students in corequisite support and college course			
Part of a cohort vs. Not part of a cohort	n/s	n/s	n/s
Corequisite support instructor			
Same instructor vs. Different instructor	n/s	n/s	n/s
Support Sequencing			
Anterior support vs. Unsequenced support	n/s	n/s	n/s
Posterior support vs. Unsequenced support	+0.5	+1.3	n/s
Unknown sequencing vs. Unsequenced support	+0.5	+1.6	n/s
Support format			
Just-in-time vs. Lecture	n/s	n/s	+0.5
Individualized vs. Lecture	n/s	n/s	n/s
Unknown format vs. Lecture	+0.7	n/s	n/s
Instructor appointment			
Full-time instructor vs. Part-time instructor	–0.2	n/s	n/s
Unknown appointment vs. Part-time instructor	n/s	n/s	–0.9
Size of corequisite support			
For each additional 10 students enrolled	n/s	n/s	n/s
Number of Students	2,587	619	832

Note: See Appendix A for descriptions of the outcomes, the corequisite features and the statistical controls included in the models. A cell containing "n/s" indicates an estimated coefficient that was not statistically significantly different from zero after applying the Bonferroni adjustment, setting the maximum acceptable probability of falsely concluding that there is a relationship between a given corequisite feature and a given outcome to 0.005 (i.e., one half of one percent).

Recommendations

Research has shown that corequisites help students master academic skills while supporting their progress through college coursework.[46] In short, corequisite supports often are a better alternative to placing students in developmental education courses. Here, we sought to provide clarity about the features of corequisite supports that maximize the benefits to students. Our aim is to help colleges and stakeholders determine which corequisite features to implement in the face of frequently limited resources and other institutional constraints.

Colleges navigate different administrative contexts as they determine which features to incorporate into their corequisites. In Colorado, low enrollments, course scheduling conflicts, and financial limitations complicated scheduling at some colleges. Colleges sometimes were precluded from providing anterior or posterior supports, grouping students into cohorts, or from offering multiple small corequisite sections.

Other colleges could not schedule the same instructor to teach both the college course and the corequisite if the instructors' credentials did not meet the minimum educational requirements established in Colorado. This also limited colleges' flexibility in determining the appointment of the instructor (whether full-time or part-time) teaching the corequisite.

In response to these administrative challenges, colleges designed corequisites that fit their individual contexts in ways that maximized flexibility for students and instructors. Despite institutional differences, however, colleges often designed similar corequisites and included many of the features that were resource intensive or difficult to include in corequisite designs. Although it may not be feasible to produce a set of best practices that apply to every college's unique context, creating opportunities for administrators, department chairs and instructors to share ideas and strategies for designing corequisites across institutions likely would facilitate continued innovation, especially among colleges navigating similar administrative challenges.

Given the obstacles to incorporating certain features into corequisite designs, it is important to identify which features are important for students' outcomes. The features that are particularly beneficial in English are not necessarily the ones that support student success in math. In addition, we found that, in math, the subject of the corequisite-supported college course is another factor that influences which corequisite features are important. Colleges should be mindful of these distinctions when designing corequisites.

For instance, posterior support offered immediately after the college math course, particularly for College Algebra or Introductory Statistics, is beneficial to students' chances of success and average grade achieved in the college course and, remarkably, even their success in a second, college math course. This aligned with instructors' expectations that posterior support provides an opportunity for students to receive extra guidance on the course content and apply it to their homework assignments. Interestingly, posterior supports were much more common in English than in math, while math was more likely to utilize anterior support courses — the corequisite supports preceding the college math course rather than following it. Reversing the order of the anterior support course and the college math course may be a low-cost, low-effort approach for colleges to improve the academic outcomes of students in corequisite-supported college math courses. Moreover, in light of the benefits for students' outcomes, colleges that offer

unsequenced corequisite supports might consider scheduling the corequisite support after the college math course when possible, focusing first on College Algebra and Introductory Statistics courses.

For college English only, students' outcomes were better when the college course and the corequisite were taught by the same instructor. In addition, students receiving support instruction in an individualized format had better course grades in college English than students receiving lecture-formatted instruction, and students in English corequisites of smaller size (lower enrollment) likewise had slightly better grades. As noted, these design features are resource-intensive and may be difficult for some colleges to implement. In interviews, department chairs and instructors explained how it can be challenging for colleges with a smaller instructional staff to offer a corequisite support with the same instructor as the college course. Department chairs also reported that transitioning instructors from lecture courses to courses that provide more personalized support to students would require professional development, which could be financially prohibitive for some colleges. Similarly, reducing the enrollment size of corequisite support courses may require offering more sections of the corequisite, which would be difficult for colleges with fewer instructors or more limited financial resources. If colleges seek to increase offerings of corequisites taught by the same instructor as the corresponding college course, they should prioritize doing so in Composition I courses where we documented the benefit to having the same instructor.

Unexpectedly, we found that college English corequisites that do not create a student cohort offer a meaningful advantage in course success rate and average course grade over cohort-based corequisites. In additional analyses, this finding remained robust to different specifications of our cohort variable. Given the documented benefits to students of participating in learning communities with a cohort component,[47] our findings are surprising and deviate from the descriptions offered by department chairs and advisors in the interviews that we conducted.

The unexpected cohort patterns in English were driven in part by much lower academic outcomes among students who were in a cohort but had different faculty teaching their English course and support lab. These students had lower placement test scores than their peers who were not in a cohort or students in a cohort and with the same instructor, suggesting that students assessed as more underprepared may have been systematically assigned to cohorts. If our statistical controls for academic readiness did not capture all relevant differences in academic readiness, this negative selection may explain the surprising relationships between cohort and academic outcomes in English. However, it is puzzling that this pattern is not observed in math. Indeed, in College Algebra specifically, students in cohorts had somewhat better course outcomes than peers in corequisites that did not create a cohort. Furthermore, department chairs and advisors in our interviews did not report systematically assigning students with lower readiness to cohorts, and, if colleges were systematically investing in students with lower placement test scores, it is unclear why they would have a different instructor in the corequisite and college English course.

Given how resource-intensive it is to develop learning communities,[48] future research should investigate these incongruent findings to shed light on the contexts in which cohorts and learning communities may be more or less effective. In the meantime, however, students may be better

served when colleges focus on creating cohorts for corequisite-supported College Algebra, rather than expending the effort and resources on other math or English courses.

Also unique to college math, students in supports taught by full-time instructors had slightly lower average grades in college math than peers in corequisites taught by part-time instructors. Qualitative interview data point to the importance of helping corequisite instructors shift their instructional approaches for the particular goals of corequisites. Both full-time and part-time instructors may benefit from professional development before and during corequisite implementation and regardless of the corequisite design utilized by the college.

That said, more research on both short- and long-term outcomes is needed. Our study examined the independent relationships of features to outcomes and did not consider how these features interact. For instance, one might hypothesize that the academic benefits of individualized instruction in English corequisites may be partially dependent on the size of the corequisite (the number of students enrolled). Future research should investigate whether the importance of each corequisite feature depends on the other aspects of corequisite design. This will provide additional clarity to policymakers, administrators and instructors about how to implement corequisite supports to maximum effect.

Conclusion

Until recently, it has been commonplace for a majority of first-time students in community colleges to be assessed as academically underprepared in math and/or English,[49] which typically has meant requiring them to complete developmental coursework before enrolling in college courses.[50] However, in response to evidence that developmental courses may hamper students' academic progress more than help, many community colleges are engaged in implementing reforms to developmental education.[51] One of these reforms involves *mainstreaming* students — placing those who are assessed as underprepared directly into college-level courses and simultaneously enrolling them in a corequisite to provide additional instructional support.[52] In the twenty years since early corequisite programs like ALP were implemented, mainstreaming efforts have expanded considerably,[53] but there has been minimal investigation of the various features that maximize the benefits of corequisite support models.

This study investigated the different designs of corequisite-supported college math and English courses used in the CCCS colleges and the associations between design features and students' outcomes. The outcomes of interest in this study included passing the college-level course that was supported by the corequisite, grade points achieved in the college-level course, and whether students passed an additional college-level course in the subject. Drawing on a unique dataset that combined qualitative information from interviews and surveys of math and English faculty and department chairs with administrative data from the CCCS, we analyzed associations between these outcomes and six features of corequisite supports. The six features addressed were:

1. Whether the corequisite created a student cohort.
2. Whether the college course and corequisite were taught by the same instructor.
3. How the corequisite was sequenced relative to the college course.
4. The instructional format used in the corequisite support course.
5. The size (enrollment) of the corequisite support.
6. Whether the instructor for the corequisite support course was full-time or part-time.

Understanding the features that maximize students' chances of success in corequisite-supported college courses is key to guiding policymakers, administrators and instructors about how to apply scarce resources to best effect.

Colorado community colleges utilized a variety of strategies in developing their math and English corequisites. Interviews with Colorado department chairs and faculty suggested that structural and institutional factors sometimes shaped the ways corequisites were designed. In particular, they mentioned low enrollment; limited number of instructors; course scheduling conflicts; and instructor qualifications as factors that influenced designs — such as whether they could offer cohorts; have the same instructor teach both the corequisite support course and the college-level course; the appointment of the corequisite support instructor; and the scheduling of the corequisite support course. These insights from department chairs and faculty shed light on how important it is for colleges to have autonomy to design corequisite supports with their specific students and resources in mind. It also highlights the value placed by colleges on flexibility when designing corequisites to navigate their unique structural and institutional contexts.

Our findings regarding the associations between corequisite features and course outcomes provide some evidence that specific features play a role in systematically better or worse student outcomes in college math and English courses. However, none of the features considered here had consistent associations across math and English. In addition, none of the features had consistent associations with students' chances of passing a second college course in the subject, conditional on attempting a second course within one year. These inconsistencies point to the possibility to be investigated in future research that the impact of corequisite supports depend less on specific features, and more on designing corequisites that consider institutional context, such as the financial and human resources available and the students served.[54] Importantly, designing different types of corequisites across subjects may offer colleges greater flexibility and produce corequisites that are even more aligned with the contexts and constraints of specific college departments.

Appendix A. Data, Measures and Methods

Data Sources and Sample

Data for this study were drawn from three sources. The first source was the administrative database of the Colorado Community College System (CCCS), which includes all students enrolled in Colorado's 13 public community colleges. We used these data to create an analytic sample composed of CCCS students who first enrolled in college between fall 2010 and summer 2019, excluding dual-enrolled high school students, students who attended college previously as indicated by matched NSC data and students younger than 17 years or older than 64 years at first enrollment in the CCCS. We limited the sample to students who attempted a transfer-level gateway math or English course at some point during their enrollment in the CCCS, and then retained only those students whose first transfer-level math or English course was corequisite-supported. For math, these courses included College Algebra, Introductory Statistics, Finite Math, Integrated Math and Math for Liberal Arts. English was limited to first-semester College Composition. The final sample of students whose first transfer-level math course was corequisite-supported included 5,262 students, while the final sample for English included 14,282.

The second source was qualitative interviews of math and English faculty and department chairs as well as advising staff at each of Colorado's community colleges conducted over the spring and summer of 2021. In math departments, 19 faculty and department chairs were interviewed, and 15 department chairs and faculty were interviewed in English departments, each for approximately 45 to 60 minutes. A standard interview protocol was used, which included questions about the structure and delivery of corequisite-supported college math and English courses at each community college from academic year 2014–15 through 2020–21. The questions focused on various features of corequisites, including teaching structure, cohort structure, scheduling sequence, primary foci and modes of delivery. Further, during the interviews, we asked about the challenges and the successes of colleges with corequisite implementation, and about faculty and chair perceptions of the effectiveness of different corequisite models. Interview information also included faculty experiences and perspectives about the use of corequisites. All interviews were recorded, transcribed and coded. After transcription, follow-up questions were sent to a select number of informants via email in order to clarify certain responses and ensure the accuracy of coding.

The final source of data for this project was a follow-up survey conducted with math and English faculty and department chairs across the CCCS institutions. The survey focused on clarifying corequisite placement processes, teaching structures and scheduling sequences, as well as more specific nuances, such as the use of a first week diagnostic and actual course content. Responses to the survey were incorporated into the interview data.

Outcomes

Building on prior literature on developmental education reforms,[55] we investigated three outcomes for students enrolled in a first corequisite-supported transfer-level math/English course:

1. *Achieving a passing grade on the first attempt of the corequisite-supported math/English course*, defined as a grade of C or higher, Pass or Satisfactory. Grades of D, F, No-Pass, Unsatisfactory and Withdrawal were coded as non-passing grades.

2. *Grade points achieved in the corequisite-supported math/English course*, measured on a four-point scale, conditional on earning a letter grade in the course.

3. *Achieving a passing grade on a second transfer-level math/English course* within one year following the term in which the first transfer-level math/English course was completed, conditional on passing the first math/English course on the first attempt and then attempting a second transfer-level math/English course within one year.

Corequisite Features

Corequisite supports can be designed and executed with a range of features that prior research suggests may influence students' outcomes. We drew on a data set that combined information collected from qualitative and quantitative sources to operationalize the following features. See the Glossary of Terms in Appendix B for details about terminology.

1. *Use of a cohort model*: Using the administrative data, we created a dichotomous indicator (0/1) of whether all students in a corequisite support course enrolled in the same transfer-level course. Those who did were considered to be part of a cohort.

2. *Corequisite support instructor*: Using the administrative data, we created a dichotomous indicator (0/1) of whether students were taught by the same instructor in both their corequisite support course and the associated transfer-level course, as indicated in administrative data.

3. *Corequisite support sequencing*: Using the qualitative data, we created a variable describing how the corequisite support course was sequenced relative to the transfer-level course: immediately before (anterior), immediately after (posterior), on a different day (unsequenced) or unknown.

4. *Corequisite support format*: Using the qualitative data, we created a variable addressing the instructional format of the corequisite support with four categories: lecture, just-in-time, tutoring or unknown.

5. *Instructor appointment*: Using the administrative data, we created a three-category variable to describe each instructor's appointment: part-time, full-time or unknown.

6. *Size of the corequisite support*: Using the administrative data, we constructed a continuous variable that captures the number of students enrolled in each corequisite support.

Statistical Controls

We incorporated a number of statistical controls.

1. Demographic characteristics, including self-reported race/ethnicity, self-reported gender, age at college entry and citizenship status.

2. Being the first in one's family to attend college.

3. Application for and receipt of financial aid.

4. Placement test percentile score interacted with the placement test on which it was based.

5. Enrollment history, including whether a student attempted a developmental course prior to attempting the corequisite-supported course, the cumulative number of credits completed prior to attempting the corequisite-supported course and enrollment intensity in the term in which the corequisite-supported course was attempted.

6. Whether the corequisite-supported course was taught in an online delivery format.

7. For math only, the subject of the corequisite-supported course.

Methods of Analysis

We used multilevel linear models (MLMs) to estimate the relationships between corequisite features and the three outcomes, separately for math and English. We structured the data as students (level-1) nested in corequisite support courses (level-2) nested in combinations of particular colleges and years of entry (level-3). Students were assigned to the college in which they enrolled in the corequisite-supported course, which, for some students, differed from the college through which they entered the CCCS. Due to small sample sizes for most of the rural colleges in Colorado, we combined Colorado Northwestern Community College, Lamar Community College, Morgan Community College, Otero College and Trinidad State College into a single category of *small, rural colleges*.

Characteristics of the Analytical Samples for Math and English

	English		Math	
	mean	std dev	mean	std dev
Age at college entry	22.86	7.46	21.43	6.28
Female	0.55	0.50	0.55	0.50
Neither parent has college degree	0.71	0.45	0.68	0.47
Race/Ethnicity				
Asian	0.04	0.19	0.05	0.22
Black/African American	0.10	0.31	0.14	0.35
Hispanic	0.31	0.46	0.33	0.47
White	0.43	0.50	0.33	0.47
Other	0.06	0.24	0.06	0.23
Unknown	0.07	0.25	0.09	0.28
U.S. Citizen	0.96	0.19	0.93	0.25
Financial Aid Experience				
Did not apply for financial aid	0.19	0.39	0.21	0.41
Applied for financial aid but did not receive	0.13	0.33	0.13	0.33
Applied for and received financial aid	0.68	0.47	0.67	0.47
Placement Test Percentile	40.21	23.71	41.64	26.85
Test Type (English)				
Accuplacer (Reading Comprehension)	0.48	0.50		
ACT/SAT	0.13	0.34		
CCPT	0.15	0.36		
Accuplacer (Sentence Skills)	0.09	0.29		
Accuplacer (Writing)	0.03	0.16		
No test	0.12	0.33		
Test Type (Math)				
Accuplacer			0.41	0.49
ACT/SAT			0.22	0.41
CCPT			0.12	0.32
No test			0.26	0.44
Developmental Course Prior to Coreq-supported Course	0.03	0.18	0.20	0.40
Credits Completed Prior to Coreq-supported Course	2.50	7.36	10.84	16.21
Enrollment Intensity in Term of Coreq-supported Course	10.48	3.22	11.41	3.18
Corequisite-supported course delivered in online format	0.16	0.37	0.04	0.20
First math subject				
College Algebra			0.60	0.49
Finite Math			0.07	0.25
Math for Liberal Arts			0.18	0.38
Introductory Statistics			0.15	0.36
Integrated Statistics			0.01	0.09
Number of Students	14,284		5,263	

Appendix B. Glossary of Terms

Anterior support: A corequisite support course that is scheduled on the same day as and immediately before the associated transfer-level course.

Cohort model: The condition in which every student who is enrolled in a particular corequisite support course is enrolled together in the same transfer-level math/English course.

Individualized format instruction: A corequisite support course that is structured around addressing individual instructional needs or tutoring.

Just-in-time format instruction: A corequisite support course that is tailored to students' instructional needs and structured around helping students understand the course material through group problem-solving or personalized work.

Lecture format instruction: A corequisite support course that serves as an extension of the main college lecture course, frequently including additional content, such as academic success strategies.

Posterior support: A corequisite support course that is scheduled on the same day as and immediately after the associated transfer-level course.

Unsequenced support: A corequisite support course that is scheduled on a different day than the associated transfer-level course.

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[11] It also included two non-system colleges, Aims Community College and Colorado Mountain College.
[12] ALP mainstreams students assessed as needing developmental education by placing them in a college-level course that enrolls an equal number of students who are assessed as being college-ready, and by providing corequisite support for the students assessed as needing developmental education. The corequisite is taught by the same instructor who teaches the college course and is scheduled immediately following the meeting day and time of the college course. See https://alp-deved.org/about-alp/ for more information.
[13] DCMP is a multifaceted mainstreaming model with the option of corequisite labs. It involves changes at the institutional and classroom levels. At the classroom level, all students enter college math courses in their first term. The course is designed to align with students' fields of study and career goals. See https://dcmathpathways.org/dcmp for more information.
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