

Creating Accelerated Pathways for Student Success in Mathematics

A Snapshot of Courses Offered at the Launch of the Mathematics Pathways to Completion Project

By Adnan Moussa and Susan Bickerstaff

Mathematics requirements are a significant barrier to completing a credential for many college students. This is particularly true for the 59 percent of public two-year and 33 percent of public four-year college students who enroll in prerequisite, noncredit developmental mathematics courses—many of whom are students of color, adults, first-generation students, and low-income students (Chen, 2016; Gordon, 2008). Indeed, many of these students never complete their developmental coursework and move on to college-level mathematics courses (Bailey, Jeong, & Cho, 2010).

To improve student success, many institutions of higher education are working to implement *mathematics pathways*, which encourages all students, regardless of college readiness, to enroll in one of several college-level mathematics courses (e.g., introductory statistics, quantitative reasoning, or the traditional entry-level course, college algebra) that best aligns with their chosen field of study soon after entering college. One primary aim of the model is to have students complete one transferable mathematics course within their first year that will apply for credit in their major or program of study. Institutions implementing mathematics pathways support students to address any developmental mathematics needs they may have quickly and efficiently—either in a single, sometimes compressed, prerequisite developmental course taken just prior to enrollment in college-level mathematics, or in a corequisite course taken concurrently with college-level mathematics. In either case, these developmental supports are aligned with the content and objectives of the target college-level course.



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cross-institutional coordination, students who intend to transfer (as an estimated 80 percent of incoming community college students want to do) are likely to enroll in college algebra, which has been the default college-level mathematics course in many programs and institutions. Similarly, without this coordination, institutions may have different prerequisite requirements for college-level mathematics courses, negatively impacting their transferability.

To address these challenges, the Charles A. Dana Center at the University of Texas at Austin, a leader in the national mathematics pathways movement, launched its three-year Mathematics Pathways to Completion (MPC) project in 2015. The goal of the project was to support the implementation and scaling of the Dana Center Mathematics Pathways (DCMP) mathematics pathways model in six states: Arkansas, Massachusetts, Michigan, Missouri, Oklahoma, and Washington.¹ The Dana Center helped these states envision and plan the implementation of mathematics pathways with the goal that all students at public two- and four-year institutions in each state would have the opportunity to complete a transferable, college-level mathematics course aligned to their program of study within one year of enrollment, regardless of their initial level of preparation.

To aid state-level planning and establish a baseline for the states' internal evaluation efforts, the Dana Center partnered with the Community College Research Center (CCRC) to develop and administer a survey to collect information about institutions' fall 2017 mathematics course offerings.² Institutional implementation of the mathematics pathways plans developed by each state was to begin in fall 2018.

In this research brief, we describe findings from the aggregated baseline survey results. These results indicate that while college algebra was the most frequently offered college-level mathematics course in fall 2017, many institutions offered a variety of other mathematics courses that could be aligned to non-STEM programs of study. However, we found that in many contexts, large proportions of students would not have been able to complete these courses within one year of enrollment, either as a result of multi-semester developmental course sequences or college-level prerequisite requirements. This suggests that there are opportunities for states to support institutions as they continue to refine prerequisite requirements and aligned and accelerated developmental mathematics offerings as a part of their broader mathematics pathways implementation efforts.



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Survey Data and Analysis

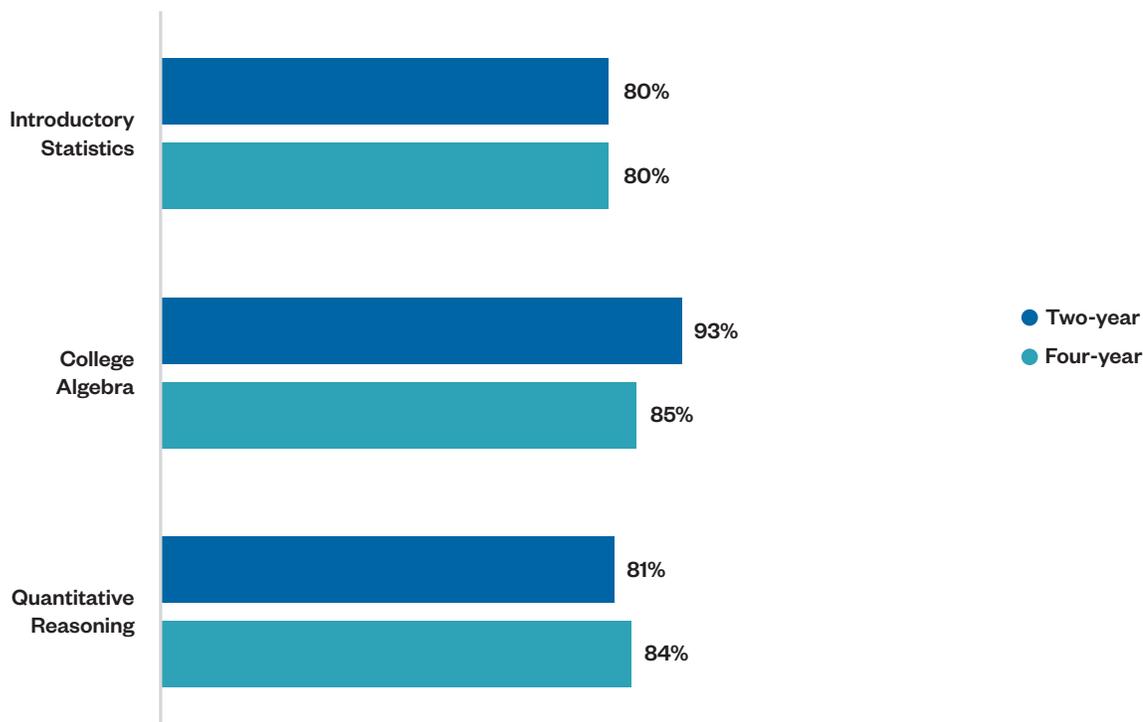
The survey asked institutions about developmental and college-level mathematics courses they offered in fall 2017, including information about prerequisite requirements and the availability of corequisite support options. It also included a number of questions about developmental mathematics course offerings more broadly. In total, 93 public two-year and 60 public four-year institutions completed the survey, with response rates of 92 and 90 percent, respectively. The results of the survey provide a window into the circumstances of the different states and institutions as they began working with the Dana Center on MPC, but before they began to implement changes in accordance with the project. Survey results were provided back to the six states, and the Dana Center encouraged them to use the baseline data to track their implementation and scaling progress.

Key College-Level Course Offerings

The survey asked about six mathematics courses that could potentially align to the pathways model: introductory statistics, college algebra, quantitative reasoning, mathematics for education majors, mathematics for business majors, and pre-calculus. These were courses known to be part of the state-level mathematics pathways plans in one or more of the six states. According to the survey results, the three most commonly offered courses from among these are introductory statistics, college algebra, and quantitative reasoning. For the remainder of the brief, we focus on these three key courses which are offered at most institutions in all six states.

Figure 1.

Proportion of Institutions Offering Key College-Level Mathematics Courses



Developmental Course Offerings

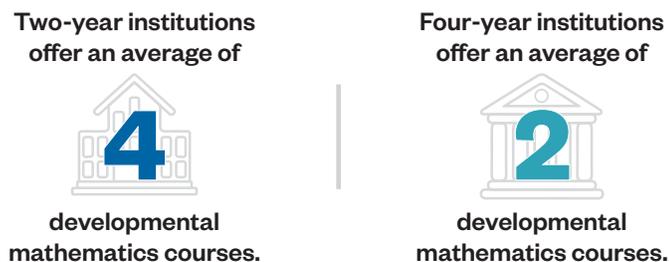
Nearly all two-year institutions reported offering developmental mathematics courses. Likewise, the vast majority of four-year institutions also reported offering developmental mathematics courses, as shown below.

Figure 2.
Proportion of Institutions Offering Developmental Mathematics Courses



Survey findings also show that two-year institutions offered, on average, twice as many unique, non-accelerated developmental mathematics courses as their four-year counterparts.

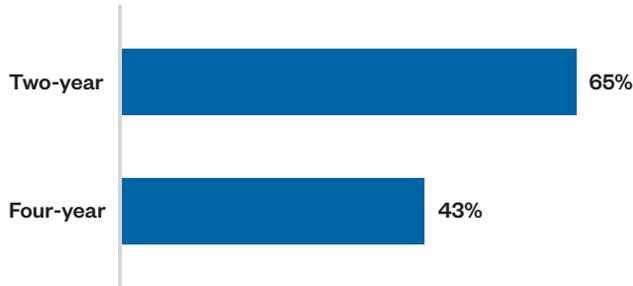
Figure 3.
Number of Unique, Non-Accelerated Developmental Mathematics Courses Offered at Institutions



The survey asked if institutions offered any accelerated developmental mathematics options, including but not limited to corequisite models, compressed prerequisite developmental mathematics courses, and modular options.³ Figure 4 shows the proportion of two- and four-year institutions that reported any accelerated developmental mathematics offerings. Institutions were asked to describe these accelerated options. The majority of two-year institutions with accelerated options reported offering modular and compressed prerequisite courses. Among four-year institutions offering accelerated options, the majority reported offering a corequisite model.

Figure 4.

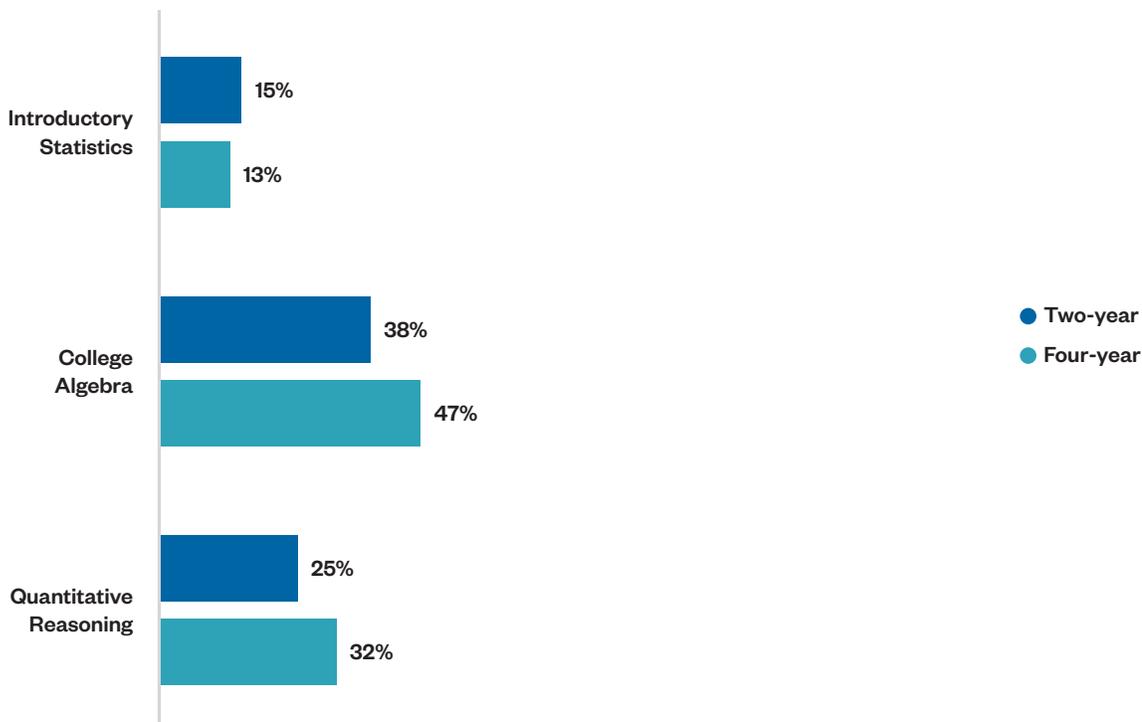
Proportion of Institutions Offering Accelerated Developmental Mathematics Options (Among Those That Provided Developmental Mathematics)



Institutions were also asked more specifically whether they provided a corequisite option for key college-level mathematics courses. On average, four-year institutions offered corequisite options for college algebra and quantitative reasoning courses at higher rates than two-year institutions, whereas two-year institutions offered slightly more corequisite options for introductory statistics courses.

Figure 5.

Proportion of Institutions Offering Each Key College-Level Mathematics Course With a Developmental Corequisite Option (Among Those That Provided Developmental Mathematics)

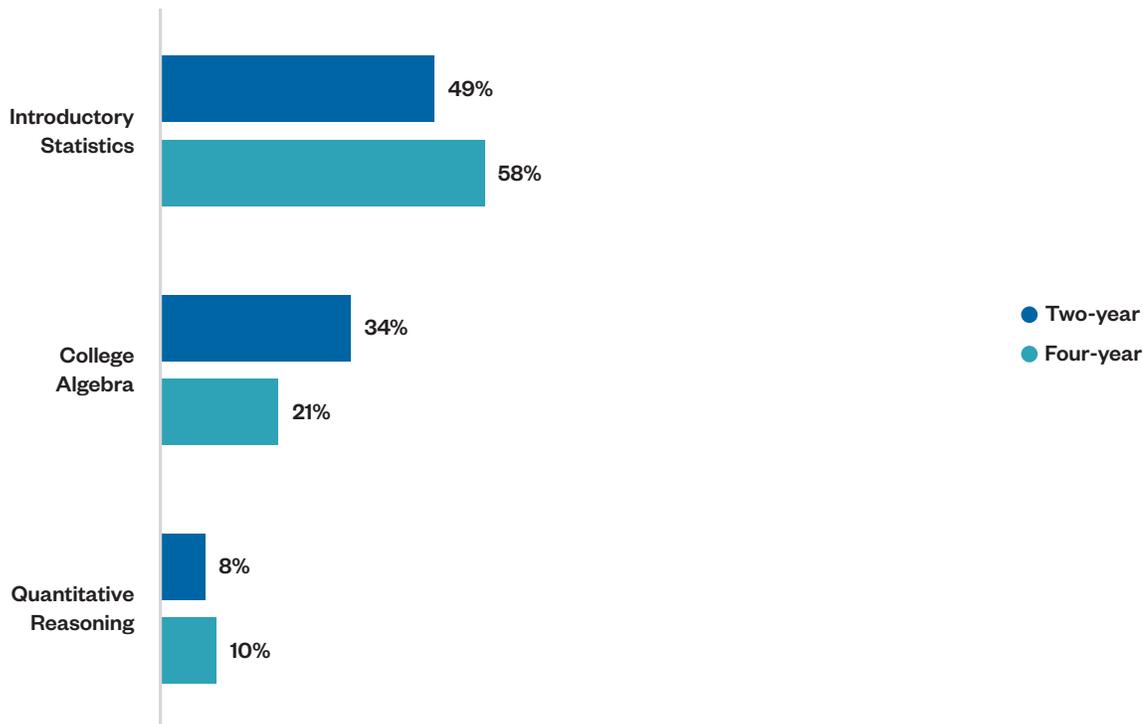


College-Level Prerequisites to Key Mathematics Courses

Institutions were asked if key college-level mathematics courses had a college-level prerequisite (see Figure 6). According to the survey results, introductory statistics was the key mathematics course most likely to have a college-level prerequisite, followed by college algebra. Of those institutions reporting that introductory statistics had a college-level prerequisite, most indicated that college algebra was the prerequisite for the course. Intermediate algebra was the most common college-level prerequisite listed for college algebra.⁴

Figure 6.

Proportion of Institutions Requiring College-Level Prerequisites for Each Key College-level Mathematics Course (Among Those That Offered Such Courses)

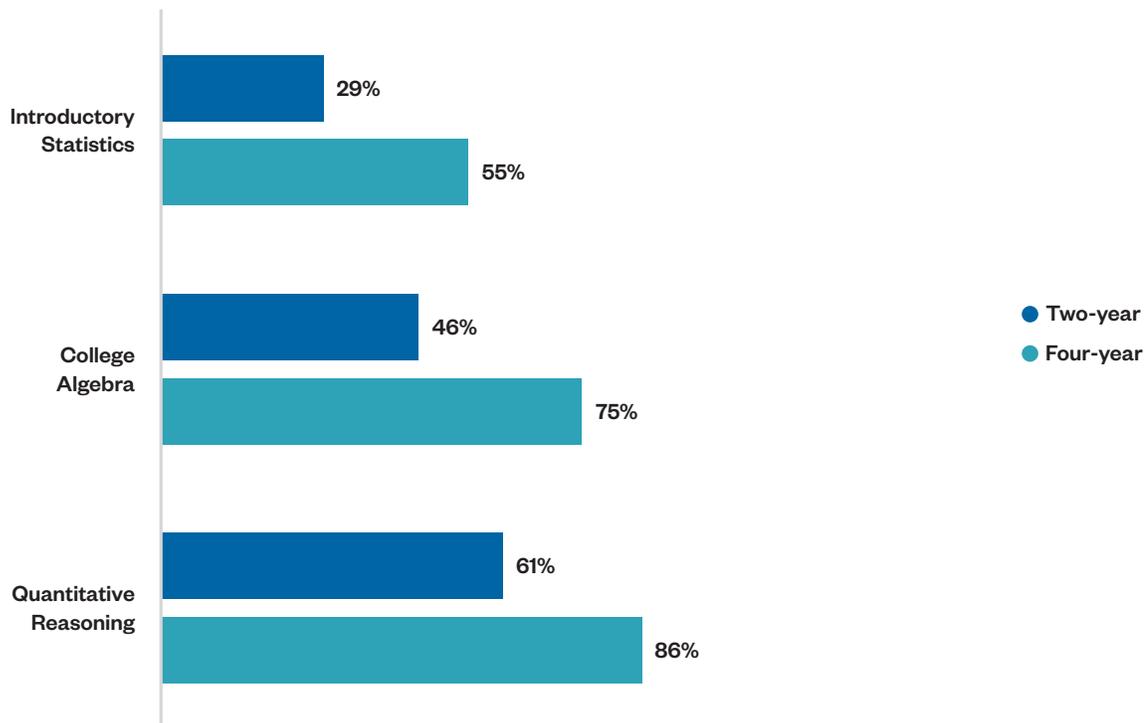


Completing Within One Year

Institutions were asked if all students, regardless of placement, could complete these key college-level mathematics courses and all of their associated prerequisite requirements within one year.⁵ Overall, four-year institutions enabled students to complete these courses within one year at higher rates than did two-year institutions.

Figure 7.

Proportion of Institutions in Which All Students, Regardless of Developmental Placement, Could Complete a Key College-level Mathematics Course Within One Year



Conclusion

Mathematics pathways is a promising model for reshaping college mathematics in ways that help students, and in particular underprepared students, learn skills and concepts relevant to their programs of study and complete their mathematics requirements efficiently. Analysis of survey data shows that by fall 2017 the overwhelming majority of institutions that were just beginning their participation in the Dana Center MPC project were already offering multiple college-level mathematics courses that could align to the pathways model. Yet, it appears that many students would be unable to complete these courses within their first year of enrollment as a result of college-level or developmental prerequisites. This suggests that reformers working to implement mathematics pathways must attend not only to the range of college-level mathematics courses offered and their alignment to programs of study, but also to systemic barriers to student progression. Findings from this survey also point to differences in course structures and offerings across two-year and four-year institutions, suggesting that cross-sector collaboration and learning in mathematics pathways design would be beneficial. (For information about how the Dana Center has supported states to address these kinds of challenges, see Bickerstaff et al., 2018; Bickerstaff & Moussa, forthcoming.)



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The MPC project concluded in 2018, but the use of institutional survey data to track progress on the goals set by the states will continue. By collecting and analyzing institutional survey data and student unit record data at periodic intervals, states will see how their institutions' mathematics pathways are evolving and how students are faring in completing their mathematics requirements. States will be able to track, for example, the spread of mathematics pathways corequisite options and their effect on student outcomes; and they will be able to see if college-level prerequisites to college mathematics courses function as a barrier to the timely completion of mathematics requirements. The Dana Center also plans to collect additional data in fall 2019 to assist in these efforts. This information can help guide the reform and decisions on the allocation of resources, making data collection of this sort an essential tool for states evaluating and refining large-scale initiatives.

Endnotes

1. For a detailed description of the MPC project, see Ortiz and Cook (2019); Bickerstaff, Chavarín, and Raufman (2018).
2. A copy of the survey is available here: <https://ccrc.tc.columbia.edu/publications/accelerated-pathways-student-success-mathematics.html>
3. Corequisite courses place underprepared students directly into a college-level course and provide additional support, such as a companion course or extended course time. Compressed courses shorten the time to completion by condensing multiple courses into a single semester, often through an eight-week “mini-term.” Modularization divides a traditional semester-long course into discrete learning units, or modules, that are designed to improve particular competencies or skills.
4. Intermediate algebra is considered to be a college-level course at some institutions and a developmental-level course at others.
5. While the Dana Center defines one year to include only the fall and spring semesters, for this question we define one year as a full academic year that includes fall, spring, and summer terms.

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