Analysis of Pathways in Developmental Education at Bakersfield College
— Preliminary Findings —

Research Objective

The objective of this study, as delineated by Bakersfield College (BC), is to analyze students’ pathways through developmental education at BC. The aspect of this study that is presented here concerns students’ pathways in developmental mathematics specifically.

Data

The data for this study were drawn primarily from the database maintained by the Chancellor’s Office of the California Community Colleges (CCC). The data address all first-time college students who entered BC as their first postsecondary institution between Fall 2000 and Summer 2011 (a period of 11 years) and who reported a valid social security number at college entry. For the purposes of this study, a first-time student is one who, at the point that he/she first enrolled in coursework at BC, had not enrolled previously in any college of the CCC system, was not dual-enrolled in high school and college, did not transfer college credits into BC, did not report having achieved a college degree prior to beginning at BC, and did not appear on the enrollment records of any postsecondary institutions (whether four-year institutions or less-than-four-year institutions) in the six years prior to entering BC. In addition, first-time students who, in their semester of entry to BC, enrolled simultaneously in both BC and another college of the CCC system were excluded from this study. Using this definition, a total of 52,701 first-time students who reported valid social security numbers began their studies at BC between Fall 2000 and Summer 2011.

The course-taking of these first-time students was observed from each student’s term of entry through the Summer 2013. With respect to math course-taking, just over half (51.6%; \( n = 27,174 \)) of first-time students enrolled in at least one math course during their time at BC, and many enrolled in more than one math course. Unfortunately, final grade information for a reasonably large fraction (9.5%) of these math course enrollments was missing from the data, requiring that these course enrollment records be dropped from the analysis. Missing grade information occurs when the final grade for the course is not reported to the Chancellor’s Office or is reported as Incomplete, Report Delayed, or a small number of other categories. Eliminating from the analysis all math course enrollments for which final grade information was missing resulted in the loss of 1,308 students from the data, due to the fact that these students had no math course enrollment records for which the final grade was known. Once these records were eliminated, the cohort included 25,866 first-time students who enrolled in at least one math
course with a valid (i.e., not missing) final grade between their respective terms of entry and Summer 2013.

Given that this analysis focuses on developmental math, the final step in the process of defining the analytical cohort was the elimination of all students whose first math course was college-level. The resulting final analytical cohort included 20,804 first-time students who reported a valid social security number, who entered BC between Fall 2000 and Summer 2011, who enrolled in at least one math course prior to the Summer of 2013, and whose first math course was developmental in nature.

Method

The goal of this analysis is to provide a detailed picture of students’ progress through the developmental math sequence. In that regard, this analysis focuses on students’ forward (upward) progress only. The analysis incorporates and considers all instances of advancement in the developmental math sequence from one math course to the next higher-level math course in the sequence, including the first college-level math course. It also incorporates the first repetition (second attempt) of a math course of a given level that a student did not complete successfully on the first attempt. The overall rates of success in the first attempt of each math level and, when relevant, the second attempt of each math level also are reported. A successful course outcome is one resulting in a grade of A, B, C, or Pass. Grades of D, F, No Pass, and Withdrawal are treated as unsuccessful course outcomes.

Given the focus on forward progress, this analysis does not consider “backtracking” in the developmental math sequence, defined as enrolling in a math course of a lower level of skill than the most recent math course attempted. It also does not consider the repetition of any level of math that was completed successfully on the first attempt, nor does it consider the third, fourth, or subsequent attempts of a math course of a given level that was not completed successfully on the first attempt.

Finally, this analysis does not consider patterns of progress characterized by the “skipping” of levels of the development math sequence, such as progressing from beginning algebra immediately to college-level math, bypassing intermediate algebra. Though the “skipping” of levels of math certainly would fall within the bounds of forward progress, which is the focus of this analysis, math level “skipping” proved to be a relatively rare phenomenon at BC. Moreover, incorporating the infrequent occurrence of math level “skipping” into a graphical representation of students’ progress in developmental math greatly complicates the display and interpretation of information. Consequently, it was determined that the costs to comprehensibility resulting from incorporating math level “skipping” into the analysis outweighed the small benefit derived from including this rare phenomenon.

Preliminary Findings

The analysis of pathways in developmental math at BC is presented in Figure 1. A number of noteworthy findings may be drawn from this analysis, many of which are consistent with findings that have been discussed in the recent research literature (e.g., Bahr, 2012). First,
success rates in the first attempt of each level of developmental math and the first attempt of college-level math are relatively low, with an overall rate of success (across all first attempts of all developmental and first college-level math courses) of 49%. The rate of success in the first attempt of beginning algebra is markedly lower (43%) than the rate of first attempt success for any other math level, which, again, is consistent with prior research that has demonstrated that the lowest rate of success across the developmental math sequence occurs in beginning algebra (Bahr, 2012).

Although not immediately evident in Figure 1, the rate at which students re-attempt a level of math in which they did not succeed on the first attempt also is fairly low, with an overall rate of 47%. In other words, of those students who did not achieve a passing grade in their first attempt of a given developmental math course or first college-level math course, slightly less than half attempted this level of math at least one more time. The overall rate of success in math courses attempted for a second time is 42%, which is somewhat lower than the rate of success for first attempts.

The rate at which students advance to a math course higher skill after completing successfully on the first attempt a given level of developmental math is moderate at 67%. That is, across all developmental math courses, students who pass a given level of math on the first attempt have a 67% chance of attempting the next highest-level math course. The overall rate of advancement among students who complete a given level of developmental math on the second attempt is somewhat lower at 61%.

Considered globally, one observes here patterns that are largely consistent with those noted in prior research (Bahr, 2012), though no prior studies have provided the level of detail afforded by this analysis. In particular, one observes evidence of the problem of nonspecific attrition described by Bahr (2012, p. 663), insofar as much of the total loss of students from the math sequence between the point of entry to the sequence and the achievement of college-level math competency does not occur at a single point in the sequence but, rather, occurs through the progressive “whittling down” of the developmental math population with each step of the sequence. The result is that none of the students who began in basic math achieved college-level math competency within two attempts, only 8% of students who began in arithmetic / pre-algebra achieved college-level math competency within two attempts, just 17% of students who entered the sequence through beginning algebra achieved college-level math competency within two attempts, and 32% of students who entered via intermediate algebra achieved college-level math competency within two attempts.1 A startling 28% of all developmental math students considered here did not complete any level of math within two attempts.2

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1 Since this analysis considers only the two first two attempts of any level of math, including college-level math, it may be that a small fraction of students who did not complete a college-level math course successfully on the first two attempts eventually did complete it successfully on the third attempt, fourth attempt, or a subsequent attempt.

2 The phrase “within two attempts” refers to the fact that this analysis considers the first two attempts of any given level of math, but does not consider any attempts of that level of math beyond the second attempt.
This undesirable process of “whittling down” the developmental math population is driven largely (but not exclusively) by course non-successes. That is, students who do not pass a given level of math suffer a disturbingly high rate of attrition from the sequence, never attempting that level of math again or, for that matter, any level of math. Students who do attempt that level of math again experience a higher rate of non-success than was experienced at the first attempt of the course, and, even when they succeed in the second attempt, they have a lower rate of advancement to the next higher-level math course. Hence, non-success in any level of math greatly reduces students’ chances of advancing to the next math course.

Even under ideal conditions, however, when students pass each math course in the sequence on the first attempt, they nevertheless experience a troubling rate of attrition. On average, about one-third of students who pass a given level of math on the first attempt drop out of the sequence despite their success. Leaving aside the transition from basic math to arithmetic / pre-algebra, at which one observes a remarkably low rate of advancement, the rate of advancement from one level of math to the next is stronger at lower levels of math skill than it is at higher levels of math skills, possibly due to programmatic differences in math requirements (e.g., graduation from some programs may be possible with lower levels of demonstrated math competency).

As noted earlier, one also observes particular difficulty experienced by students with achieving a passing grade in beginning algebra, which is not unique to BC and which Bahr (2012, p. 664) described as course-specific attrition. The evidence indicates that beginning algebra is an especially challenging course for students, presumably (but not certainly) due to the shift in the course content from pre-algebra to algebra. Given the findings discussed here concerning the impact of non-success on students’ advancement in the sequence, it is not surprising to observe in Figure 1 a rate of advancement from beginning algebra to intermediate algebra than is much lower than the rate of advancement from arithmetic / pre-algebra to beginning algebra. Thus, it is clear that students who enter the math sequence at beginning algebra, or who advance into beginning algebra from a lower level of math skill, need additional supports to improve their chances of success in this course and, thereby, their chances of advancing through the math sequence to college-level math.

References

Figure 1: Progress of first-time students in development mathematics at Bakersfield College