Abstract

There is a pressing need to build a skilled and diverse STEM workforce in the United States. This project builds on prior knowledge regarding common “leaks” in the STEM pipeline and offers a new framework for assessing the overall health of academic majors relative to each other. College course sequences from eight consecutive semesters of transcript data for two cohorts of undergraduates at a public university are used to document in- and out-migration patterns through STEM and non-STEM majors. The study helps uncover barriers to STEM degree completion and reveals if particular course-taking pathways are dominated by particular types of students.

Drawing on social sequence analysis and network science, this project conducts an analysis of paths—and not achievement or persistence per se—and thus builds the SciSIP knowledge base regarding the training experiences of the college-educated workforce. Figuring out how to strategically deploy one’s talent during college is a major hurdle for many students. Examining the transcript "stories" of undergraduate cohorts can help postsecondary institutions and future students (1) contextualize the range of course-taking possibilities and performance levels associated with destination majors, and (2) identify key crossroads that students on certain paths will likely encounter.

For policymakers who seek to increase or broaden participation in certain fields, such as STEM, a map of how students flow through academic systems offers insight into the on-the-ground experiences of students who traveled those pathways in the past. For example, if out-migration from STEM majors is dominated by students who languish both in STEM and whichever field(s) they pursue after STEM, this suggests that general deficiencies in academic skill and motivation among incoming students must be addressed in order to grow STEM participation. In contrast, if out-migration from STEM majors is dominated by high-performing students who leave STEM to become champions of other fields, programs to address skill deficiencies may have no effect on retaining STEM majors. Instead, policymakers should investigate why non-STEM majors have become more attractive training arenas relative to STEM majors.

The project’s key objective is to provide a dynamic description of course-taking "traffic" using population-level transcript data associated with two cohorts of matriculating undergraduates (n>10,000 students). As with all campus-specific transcript studies, these data reflect the sorting of a student population that (1) is subject to the same institutional policies, (2) experiences the same exact classroom environment when co-enrolled in a given class, and (3) constitutes true peers in terms of classroom performance hierarchies. Each cohort is first described using an origin-destination typology, which classifies students who start and finish in STEM, students who migrate out of STEM, students who migrate into STEM, and students who start and finish in non-STEM majors. Second, network methodology is employed to quantify the typicality of a student’s course-taking sequence relative to other students, an approach that offers insight into the distribution of pathways through academic majors. Finally, course-taking pathways are linked with student characteristics, including gender, race/ethnicity, first-generation student status and ACT scores.