

## Finding direction: Pattern analysis of early academic momentum in STEM at community colleges

Students choose community colleges for a wide array of reasons. Further, the diversity of the student population – both socioeconomically and demographically – adds to the complexity and variety of intent and aspirations. However, students’ goals are seldom actualized. Dropping out, stopping out, or jobbing out are common, especially in STEM fields. Therefore, this study seeks to better understand how students’ intent informs their academic behaviors and present a pattern-based model to illustrate what happens to students along the way.

Using the academic momentum framework, which entails both specific types of academic effort and the maintenance of these efforts over time, researchers engaged in an analysis of course-completion patterns to describe the types of courses STEM-aspiring community college students complete, and how they gain, lose, or change the type of momentum across their first two college semesters. This pattern-based approach provides a sophisticated understanding of what community college students’ early academic achievement looks like based on their coursework and allows for a conceptualization of the fluid nature of how academic momentum is built, improving upon the more traditional static input-output view of academic progress.

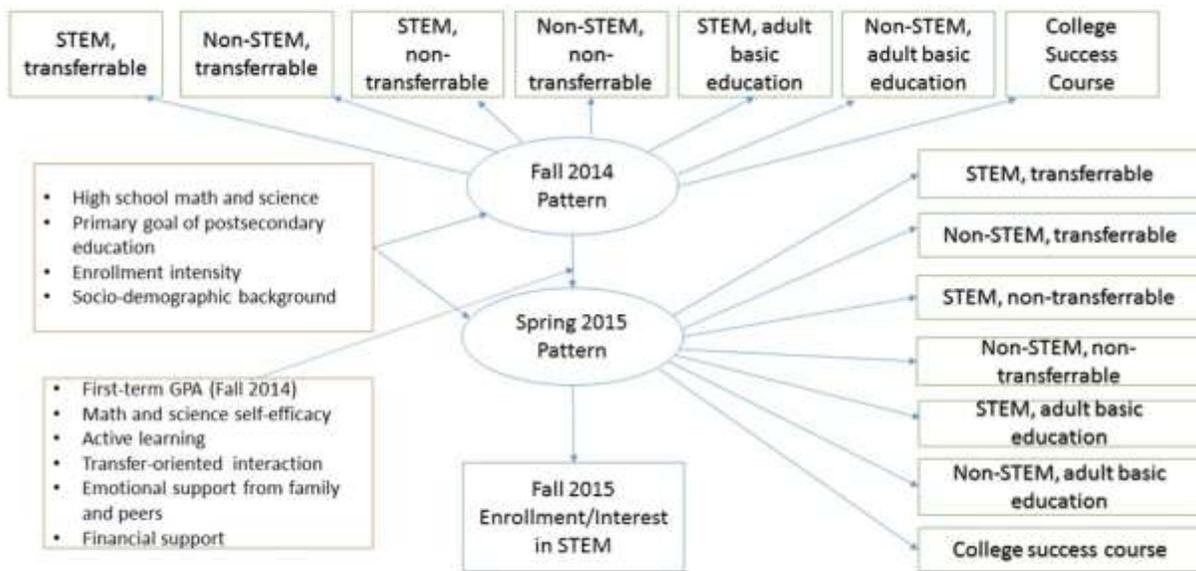


Figure 1. Diagram of pattern-based analysis.

Following a cohort of first-time students who majored or took courses in STEM fields (notably NOT including health-related courses) at two-year institutions, this longitudinal study is based on data collected from a baseline and follow-up survey, along with students’ transcript data. Most (62.3%) students reported that their primary goal in enrolling at their two-year college was to transfer to a four-year institution, and another 30% indicated their intent to get a job after completing their two-year degree.

It has been difficult for researchers to pinpoint what specifically contributes to momentum. However, there are a number likely factors that have theoretical backing. Namely, learning experiences, motivational factors (self-efficacy in particular) and environmental supports. These elements are included in this study. Motivational and environmental factors were measured using a number of variables that represent these constructs, such as whether a student reported enrollment or interest in STEM programs (persistence in intent and enrollment in STEM), course completion patterns in STEM, high school preparation in math and science, self-efficacy in math and science, active learning measures that indicate engagement, transfer-oriented interaction – such as talking to an advisor or learning about transfer requirements, financial and emotional support from family members and peers, first-term cumulative GPA, and socio-demographic background variables.

Transcript analysis was conducted on students' completion of different types of courses in terms of their transferability, STEM focus and type of course. This analysis was completed by the seven different categories of course-taking displayed in the pattern analysis graphic: 1) STEM, transferrable; 2) non-STEM, transferrable; 3) STEM, non-transferrable; 4) non-STEM, non-transferrable; 5) STEM, adult basic education/remedial courses; 6) non-STEM, adult basic education/remedial courses; and 7) college success courses. Finally, the characteristics of each student profile was represented by response frequency, dimension, or both, maximizing the differences between distinct course-completion patterns in terms of their probabilities revealing: 1) distinctive patterns in course completion for the target group of students to be identified; 2) how these patterns change across the two semesters studied; 3) what other factors, both motivational and environmental, are associated with early academic momentum; and 4) how well these patterns predict persistence both in intent and enrollment in STEM in their second year of college.

Results of these analyses showed three “directions” of academic momentum for students in their first semester at two-year colleges for first-time, STEM-aspiring students, differing in the number of courses completed in the seven categories mentioned earlier. Most students (58.7%) were *transfer-focused*, mainly completing transferable credits in both STEM and non-STEM fields, with a low probability of enrolling in any other courses. Approximately 24.1% were *vocational training-focused*, completing mostly non-transferrable STEM courses (mainly in manufacturing or engineering fields that prepare students for entry into the job market). Lastly, 17.1% of students were *exploring*, not really focusing on one area, but slightly more likely to take non-transferrable courses in non-STEM fields – with roughly equal probability of completing transferrable courses in both STEM and non-STEM.

In the second semester, four patterns were revealed, showing a change in direction of academic momentum for some students. About half (50.7%) of students were *transfer-focused* (as described above), 25.5% of students had few completed courses under their belt – mostly adult basic education or remedial, implying that they had left the institution. This pattern was termed *leaving*, as the NSC data showed this to likely be the case. About 20.3% of students were *vocational training-focused*. Lastly, 3.5% of students were *associate degree-focused*, mainly completing non-transferable courses in both STEM and non-STEM areas.

Differences in educational goals, college readiness, and socio-demographic backgrounds can alter mass, velocity, and direction of academic momentum for students. Some of the findings from this study suggest that in the first semester, *transfer-focused* students tend to have had more preparation in high school in both math and science. Fewer older and married students were *exploring* in college. If a student's intent was to obtain an associate's degree or a credential for better job prospects, he or she was most likely on the *vocational* track.

In the second semester, students who started in the *transfer-focused* pattern were more likely to move into the *vocational training-focused* pattern rather than stay in the *transfer-focused* pattern when students perceived a higher level of financial support for attending college. Lower first-semester GPA led to a greater chance of *leaving*. Higher levels of active learning led *explorers* to transition into *vocational* versus other patterns. However, a few other motivational and learning experience variables were related to transitions for *exploring* group members, whereas active learning could influence students who started out on the *vocational* track to move into the *transfer* track. Similarly, peer support for education led *vocational* track members to transition into the *transfer* track. Greater financial support from family members and higher first-term GPA reduced the number of students leaving college. Lastly, students who persisted in either *transfer* or *vocational* tracks through their first two semesters were more likely to say that they were interested in or already enrolled in STEM programs.

Diverse and shifting patterns are highlighted in this exploratory study. Students use two-year colleges for a multitude of reasons and their course taking is fluid, especially in the first year. However, some of the most salient points brought to light in this study for instructors, advisors and policymakers associated with two-year colleges are that:

1. Financial support may prevent a loss of academic momentum, but as students look to transition from two-year to four-year institutions, financial aid counselors should be available to work together to help paint a more comprehensive picture of what aid is available between institutions. Financial aid eligibility should be expanded at both types of institutions to take into account the responsibilities many two-year college students who wish to transfer may face, including but not limited to supporting their families.
2. Active learning plays a positive role in academic performance and in two-year college students' transfer intent. As such, expanding opportunities for active learning in a broader range of courses, including academic courses would allow more students to thrive in college.
3. Peer support is essential to STEM transfer-aspiring students – impacting the direction of early academic momentum. When colleges provide space and occasion for students to interact with one another informally, peer support can be developed more readily. Providing comfortable common areas, on-site coffee and food options and meeting spaces can all lead to the formation of peer groups.
4. Services should be tailored to the needs of the non-traditional student as well as the traditional student. For example, non-traditional students can benefit from services such as child care options and more flexible hours of services.

References and Works Cited:

Chan, H. Y., and Wang, X. (2017). Momentum through course-completion patterns among two-year college students beginning in STEM: Variations and contributing factors. *Research in Higher Education*. Advance online publication. doi:10.1007/s11162-017-9485-8.