Impacts Resulting from a Large-Scale First-Year Engineering and Computer Science Program on Students' Successful Persistence Toward Degree Completion

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Abstract

There is a critical need for more students with engineering and computer science majors to enter into, persist in, and graduate from four-year postsecondary institutions. Increasing the diversity of the workforce by inclusive practices in engineering and science is also a profound identified need. According to national statistics, the largest groups of underrepresented minority students in engineering and science attend U.S. public higher education institutions. Most often, a large proportion of these students come to colleges and universities with unique challenges and needs, and are more likely to be first in their family to attend college. In response to these needs, engineering education researchers and practitioners have developed, implemented and assessed interventions to provide support and help students succeed in college, particularly in their first year. These interventions typically target relatively small cohorts of students and can be managed by a small number of faculty and staff. In this paper, we report on "work in progress" research in a large-scale, first-year engineering and computer science intervention program at a public, comprehensive university using multivariate comparative statistical approaches.

Large-scale intervention programs are especially relevant to minority serving institutions that prepare growing numbers of students who are first in their family to attend college and who are also under-resourced, financially. These students most often encounter academic difficulties and come to higher education with challenging experiences and backgrounds. Our studied first-year intervention program, first piloted in 2015, is now in its 5th year of implementation. Its intervention components include: (a) first-year block schedules, (b) project-based introductory engineering and computer science courses, (c) an introduction to mechanics course, which provides students with the foundation needed to succeed in a traditional physics sequence, and (d) peer-led supplemental instruction workshops for calculus, physics and chemistry courses.

This intervention study responds to three research questions: (1) What role does the first-year intervention's components play in students' persistence in engineering and computer science majors across undergraduate program years? (2) What role do particular pedagogical and co-curricular support structures play in students' successes? And (3) What role do various student socio-demographic and experiential factors play in the effectiveness of first-year interventions? To address these research questions and therefore determine the formative impact of the first-year engineering and computer science program on which we are conducting research, we have collected diverse student data including grade point averages, concept inventory scores, and data from a multi-dimensional questionnaire that measures students' use of support practices across their four to five years in their degree program, and diverse background information necessary to determine the impact of such factors on students' persistence to degree. Background data includes students' experiences prior to enrolling in college, their socio-demographic characteristics, and their college social capital throughout their higher education experience. For this research, we compared students who were enrolled in the first-year intervention program to those who were not enrolled in the first-year intervention. We have engaged in cross-sectional

data collection from students' freshman through senior years and employed multivariate statistical analytical techniques on the collected student data.

Results of these analyses were interesting and diverse. Generally, in terms of backgrounds, our research indicates that students' parental education is positively related to their success in engineering and computer science across program years. Likewise, longitudinally (across program years), students' college social capital predicted their academic success and persistence to degree. With regard to the study's comparative research of the first-year intervention, our results indicate that students who were enrolled in the first-year intervention program as freshmen continued to use more support practices to assist them in academic success across their degree matriculation compared to students who were not in the first-year program. This suggests that the students continued to recognize the value of such supports as a consequence of having supports required as first-year students. In terms of students' understanding of scientific or engineering-focused concepts, we found significant impact resulting from student support practices that were academically focused. We also found that enrolling in the first-year intervention was a significant predictor of the time that students spent preparing for classes and ultimately their grade point average, especially in STEM subjects across students' years in college. In summary, we found that the studied first-year intervention program has longitudinal, positive impacts on students' success as they navigate through their undergraduate experiences toward engineering and computer science degrees.

Motivation and overview

There is a critical need for more students with engineering and computer science majors to enter into, persist, and graduate from postsecondary institutions. Increasing the diversity in engineering and science is also a profound identified workforce desire.[1,2] According to national statistics, the largest group of underrepresented minority students in engineering and science attend the Nation's public higher education institutions, thereby often designating such higher educational venues as minority serving institutions (MSIs).[3, 4,5]

Our research would not be so vital were it not for the phenomenon that the nation's economic and social well-being increasingly depends on the skills and knowledge that each individual acquires. In other words, what one earns depends increasingly on what one learns. Rises in the wages of college graduates relative to high school graduates demonstrate this growing relationship between learning and earning. This is especially the case in engineering and computer science. Increasingly, individuals with increased formal education earn more and the differential continues to widen.[6] The earnings of prime working-age men (30–59) with at least a bachelor's degree, like their female counterparts, have increased, but at a slower rate than women. In contrast, the earnings of men with some college or less have seen declines in their inflation-adjusted earnings. The earnings advantage of bachelor's degree holders over high school graduates increased by approximately 36% between 1979 and 2012, reaching 83%.[7]

As the U.S. has evolved from an industrial economy to a global economy, a significantly higher level of education for much larger proportions of society has become a necessity—for each individual and for the collective benefit of all. This trend has multiple direct implications for higher education.[8] This is particularly important for STEM workforces. Demand for

"employment-relevant, technologically focused" postsecondary education programs is increasing, raising the question of whether the U.S. postsecondary education system can effectively respond. This phenomenon calls into question the public's confidence that U.S. higher education can respond sufficiently to growth demands, especially in engineering and in the sciences.[9]

While the U.S. has historically led the world in the quality, scale, and accessibility of postsecondary education, that lead is diminishing, particularly in light of these added demands.[4] As framed by the Commission on The Skills of the American Workforce, America's pipeline has become a bit "leaky."[8] For every one-hundred ninth graders, forty enroll directly in college. Of those who enroll, only twenty-seven continue enrollment beyond their first academic year. This speaks to the importance of students' first-year experiences in college, hence the critical need for our research. Of those who continue beyond year one, only eighteen earn a bachelor's degree within six years.[8] These proportions represent improvements in the U.S. educational system over the last half-century, but comparable improvements in the educational systems of other nations have been greater.[9]

Need for increased enrollments of non-traditional students in 4-year universities

Individuals with education, social capital, and means to pursue postsecondary education continue enrolling in colleges; however, the challenge to postsecondary education is to attract those with fewer inherent advantages, especially where efforts to diversify the workforce are of importance. Hence, growth in enrollments is increasingly composed of "non-traditional students" or students with backgrounds not historically well-represented in higher education especially in engineering and computer science. "Non-traditional" college students for the purposes of our research refers to students with a collection of factors that depart from the stereotypical characteristics of college undergraduates which are: 18–22 years of age, White, from at least a middle-income family, single, successfully completing high school with above average grades, and with relatively little need for separate financial assistance.[10] Departures from this traditional student profile have often been referred to as "risk factors" which historically have been associated with reducing the likelihood of successful admission in, retention in, and completion of baccalaureate academic programs in higher education, and especially in STEM majors.

Research has revealed that non-traditional students, regardless of age, are generally less academically prepared for higher education than their academically focused high school counterparts. Because the overall proportion of individuals above eighteen years of age who seek enrollment in postsecondary programs continues to grow, the risk factors in academic preparation of new cohorts of students have increased.[11] This presents a significant burden to postsecondary institutions that admit "under-prepared" students. Recent higher education statistics have revealed that across all U.S. colleges and universities, approximately half of all incoming freshmen require remedial services, which by statute are no longer allowable in higher education in our state.[12] It is axiomatic that increasing participation rates in higher education imply increasing proportions of students with associated challenges and risks, and an associated demand and moral imperative for such institutions to offer programs to mitigate those challenges and risks. It is ironic that a disproportionate share of such students enter minority-serving institutions, which generally have fewer resources to offer the needed programs.[13]

Higher proportions of non-traditional aspiring engineering and computer science students evidence circumstances that have historically reduced their opportunities for successful college persistence and completion; hence, the origin of the terms "risk factors." The largest portion of non-traditional students continue to be first in their family to attend college, often referred to as "first-generation."[14] These students tend to be "independent" insofar as they often have limited parental, financial, or emotional support, and they are proportionally more likely to have dependents for whom they must provide support.[15]

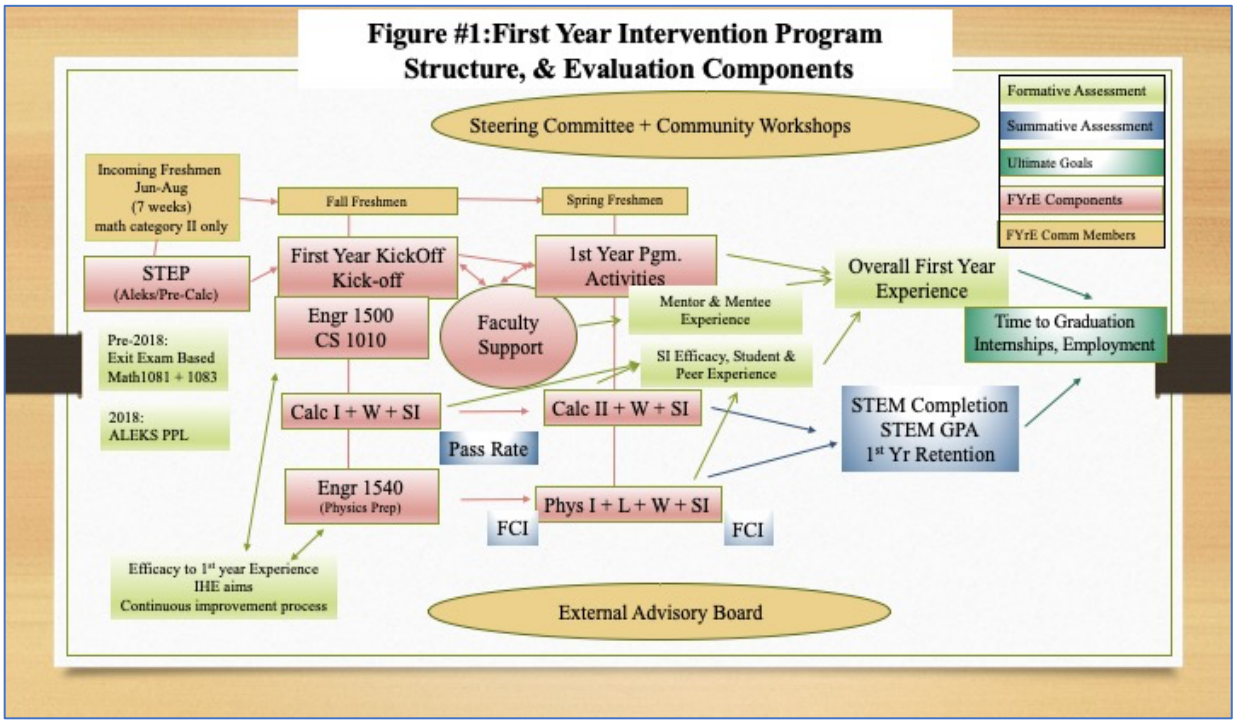
The need to focus attention on non-traditional college students reinforces the argument to examine the performance of those in public colleges and universities and especially in MSIs, like the university in which this research is being conducted. These institutions enroll larger proportions of non-traditional students than other universities.[4,5] There are more than 700 federally designated MSIs that represent approximately 14% of all degree-granting, Title IV-eligible institutions of higher education. MSIs enroll roughly 5 million students, or nearly 30% of all undergraduates in U.S. higher education. These institutions carry a significant postsecondary load for the United States, with greater than 40% from non-traditional backgrounds.[6] Over the past three decades, students enrolling in public MSIs characteristically had socio-demographic, familial, and academic characteristics that complicate attending college and mitigated their chances for degree completion.[7]

As elaborated upon, there has been sparse research conducted on non-traditional college students in large public universities, and in particular those who have career paths in engineering and computer science. It is however useful to note the important work of Rosenbaum and colleagues who have studied such students.[14] Our research builds upon the work of this higher education research group in that it has informed our research design, instrumentation, and data analyses.

The first-year intervention program

For the past five years, we have developed and implemented a first-year intervention program to support a large number of students attending our public MSI, with a large (over 60%) Hispanic and first-generation college student population. From our program's inception, its goal was to apply widely investigated and accepted student-centric interventions or "best practices" to address what were perceived as our students' academic "risks." Unfortunately, in its early stages, the prescribed first-year intervention's results were not as impactful as that which has been reported in the engineering education and higher education literature, which often reports on small minority or under-prepared populations within a larger white and/or academically well-prepared student population. As we continued to improve our first-year intervention program, we realized that the scale at which we have been operating required multi-faceted solutions, especially because of the diverse, multi-dimensional needs of our students. This phenomenon is typically not the case in institutions where the majority of engineering education studies have been conducted. In high-performing universities, researchers have often been able to identify a few key variables that strongly correlate with student success in engineering programs, and that has allowed them and/or their institutions to develop intervention frameworks and activities that target these "success" variables. We argue that the identification of one or very few key impact variables may only be possible because circumstances that are specific to the institutions

inevitably homogenize the incoming students therefore adding controls for variables. However, our large, public MSI differs in that a large percentage (over 60%) of its student population is comprised of "at-risk" college students as defined in the engineering education literature.[11] Thus, the intervention models developed in traditional colleges and universities do not succinctly fit the diverse and multi-dimensional needs of our engineering and computer science students. Accordingly, our research explores factors that contribute to determining the intervention needs for improving student outcomes in MSIs that require large-scale interventions and assessment instruments that target the multi-faceted aspects of a diverse population of at-risk students.[4] The model in which we are testing and operating for this "work in progress" research marries well-known interventions with educational equity practices, and requires faculty development to fully embrace students as holders of college social capital, and other such positive mindsets necessary for increasing students' success. Figure 1 (below), provides a map of the interconnected elements that are contained in our first-year intervention program.



Study population

The study population for this research includes undergraduate students attending our large, public MSI with majors in engineering and computer science . The targeted students are predominately first-generation, non-traditional college students (as defined above). The dominant ethnicity of the population is Hispanic, at approximately 65%, and most of the students are financially needy and therefore Pell-grant eligible (> 70%), as well as first-generation college-goers.

The first-year intervention group for this research was selected at the end of an immersive summer math program from those who placed into Calculus I. Calculus placement is determined by a specific score on the ALEKS PPL evaluation platform during the summer program for the

Fall 2018 and Fall 2019 cohorts, while previous cohorts were placed into calculus following a Math-department administered placement test. Students indicated their interest in the first-year intervention program during the summer, and were selected randomly out of the interest group but with adjustments made to have proportionate representation of different majors as well as female students. The non-intervention comparison groups were those who either were not selected or were not interested in the first-year intervention program but started in Calculus I in the Fall term. It should also be noted that the Fall 2015 intervention group started their academic careers on the quarter system, while subsequent groups started in the semester system. Computer Science students were added to the program in Fall 2017.

Research design

This study responds to three research questions:

- What role does the first-year intervention's components play in students' persistence in engineering and computer science majors across undergraduate program years?
- What role do particular pedagogical and co-curricular support structures play in students' successes?
- What role do various student socio-demographic and experiential factors play in the effectiveness of first-year intervention?

To address these research questions and therefore determine the formative impact of the first-year engineering and computer science intervention program on which we are conducting research, we have collected diverse student data using a College Pedagogical Practice Index (CPPI). The CPPI was designed with the intent of enabling STEM education researchers to study the impact of a constellation of student support related interventions to determine relationships among such interventions and relative impacts of these intervention components on students' success and matriculation toward college and university degrees. The CPPI has now been used in eleven federally funded college and university research studies and is particularly effective in determining the impacts of interventions for students who have been traditionally underrepresented in STEM fields. The CPPI has both experiential and sociodemographic items loaded onto its scales to parse out the role that such factors play in student successes and challenges. Content-wise, the CPPI contains the several subsections: (1) socio-demographic items that determine students' background, personal structures, non-college and precollege experiences and academic histories, (2) items related to types and degree of pedagogical support practices offered to the students by their college and the frequency and usage of such practices, (3) GPA which serves a proxy for overall academic performance in college at the time of the index administration, and (4) items that measure critical aspects of student affect aligned to theoretical approaches and research in higher education (e.g. college social capital, research process understandings, and college-going mindset). The CPPI includes a battery of items designed, tested, and used for Ragusa's STEM education research[11] and also includes adaptations of a college social capital scale from research conducted by Solberg and colleagues.[12] The Index has been extensively tested for reliability and validity using item response theory (IRT).[13]

Structurally, the CPPI is a questionnaire in which students respond to close set questions associated with socio-demographics, type, duration, frequency, and usage of pedagogical support practices that are categorized as three sub-scales: (1) *college academic support, (2) college social*

support, and *(3) college advisory support.* These categories are converted during analyses to percent use from Likert-type scores.

For this research, we have compared students who were enrolled in the first-year intervention program to those who were not enrolled in the first-year intervention. Those who were enrolled in the intervention as freshmen were distinguished from those who were not via an item on the CPPI. We have engaged in cross-sectional data collection from students' freshman through senior years (years 1-5 in college) and employed comparative, multivariate statistical analytical techniques on the collected student data using an exploratory research perspective.

As previously described, this paper is a "work in progress" research project funded by the National Science Foundation (NSF). Accordingly, the results that follow are formative. To place our research in context, our results are mixed and diverse. Some of these results provide baseline contexts and formative information that will guide our research leadership team as we engage in successive improvements of the first-year intervention program utilizing NSF funding so that the program is scalable to all "college-ready" engineering and computer science students upon culmination of NSF funding, and fully sustainable post funding. For these results, we looked both at the academic successes and challenges of the students, and also at the factors that may contribute to such successes and challenges in the program.

Formative Results

Exploring the students' entering background and experiential characteristics and their relationship to academic success has revealed information that may help us to further improve the first-year program longitudinally. For example, we examined whether students' college social capital, [16, 17] which is a factor that has been found to impact students' undergraduate academic success in STEM fields, affected the choices students have made while navigating their undergraduate degree.

Using the data collected from the first-year intervention program, we first examined whether students' personal and familial backgrounds impacted their college social capital.[18,19] Using regression analyses, we found a significant relationship between students' parental level of education and their college social capital. For these exploratory analyses, the students' data in the first-year program were not separated analytically from that of their non-intervention peers. A statistically significant regression equation was found ($F(1,107) = 6.98$, $P<.005$) with an R^2 of .00591. Parental education level was a significant predictor of students' college social capital during their first year of college. This result is not surprising to us as researchers,[15, 22] however it provides baseline information for our cross-sectional research with the students in the first-year intervention program (additional results follow,) and confirmation that our study population is similar to that of other underrepresented groups in STEM majors nationally.

One dilemma for undergraduate students from populations with backgrounds such as those in our College relates to the students' incoming readiness for college. Specific to our MSI, the faculty have noted that incoming freshmen are often not quite "ready" for college upon initial enrollment in math, science, engineering and computer science courses. The research on college readiness underscores the finding that students need college social capital to be ready for college

experiences and for effectively navigating college environments.[15, 18] With this research supported premise in mind, we conducted exploratory analyses of our students' data examining incoming freshmen's readiness for college using a measure of college social capital as a proxy variable for college readiness.[19] We wished to test the premise established in higher education literature by comparing students' high school experience, high school course taking practices, and high school ranking (self-reported) on their college social capital. Multiple regression was used to determine such relationships. We found a significant relationship between students' reported ranking in high school and their readiness for college; ($F(1,96) = 4.37$, $P<.05$), R^2 of .042. These results indicate significant relationship between high school rank and students' college social capital ($P<.05$).

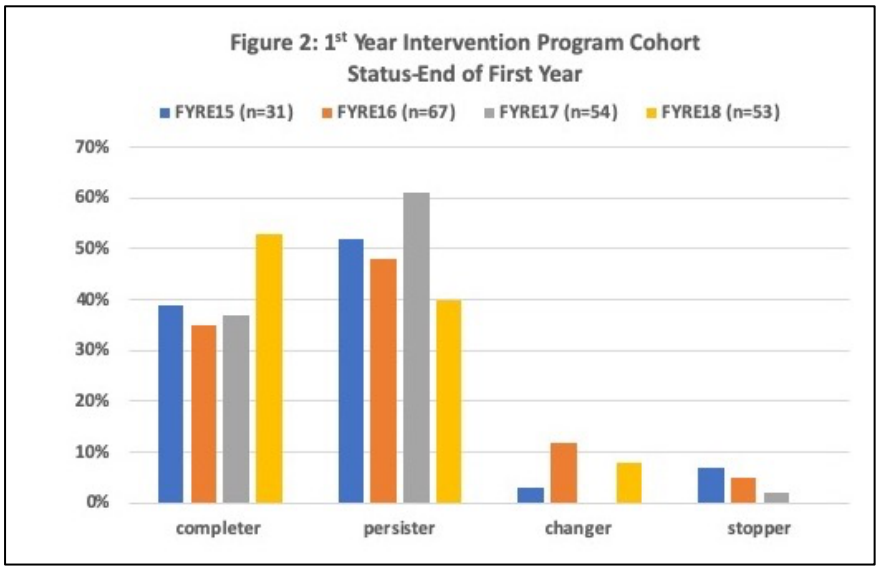
In addition to examining precursing factors and students' readiness for college, we wished to understand the impact of our first-year intervention program on students, formatively (during their first year in college). Importantly, the analyses that follow are first-year data so should be interpreted with some caution as the first-year results interesting, yet limited by the fact that the students were in their first year in college. For these analyses we compared students in the first-year intervention to those who were not in the intervention during their first semester in college. As a launching point, to determine if the first-year intervention students were more "college ready," than those engineering and computer science students who were not in the intervention, we compared college social capital results between intervention and non-intervention students and no statistically significant differences between the samples were noted during the students' first semester of college.[22] Next, we compared the GPA between non-intervention and intervention students and found the freshmen students' overall GPA was higher for the intervention students. Accordingly, a significant regression equation was indicated ($F(1,38) = 5.29$, $P<.01$) with an R^2 of .1319.

Using particular categories of student support offered to students (see CPPI description above), we wished to determine the relationship of accessing such types of support on the students' score on the Force Concept Inventory[21] (FCI) which was taken by all engineering and computer science students during their first semester in college as a pre-assessment measure and compared at the end of their second semester in college as a post- first-year intervention measure. We selected this particular measure as it one that the research team's leadership has implemented as a means of tracking students' understanding of primary physics concepts taught in courses over time and is also an introductory physics measure commonly used nationally in engineering and science departments. We wish to understand if and to what degree a particular type of student support affects the FCI results using regression. The results of these analyses indicate statistically significant relationships only for student support practices that are categorized as academically focused (college academic supports). A significant regression equation was found ($F(1, 25) = 4.82$, $P<.05$) with an R^2 of .00592. Interpretively, this indicates that the amount of time a student spends using academically oriented supports (interventions) impacts the students' FCI score even in the students' first year in college. More specifically, via further data aggregation, our results indicate that students who completed a particular first-year academic intervention component, an introduction to mechanics course (pre-physics), performed better on the FCI than those who were not in the first-year intervention.

Longitudinal cross-sectional comparisons across program years (pilot to present day)

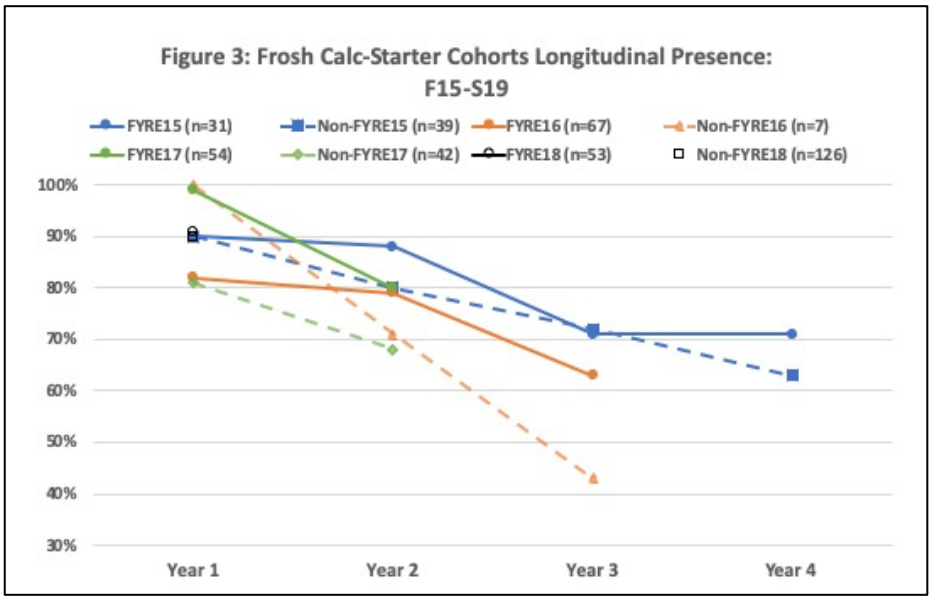
In addition to exploring the impact of the first-year intervention on students while they were freshmen, we wished to compare students who had enrolled in our first-year intervention program to those who had not, across academic years as they progressed toward their bachelor's degree. Accordingly, we engaged in cross-year comparative analyses of students' data (first-year intervention and non-intervention) to determine the first-year program's impacts longitudinally with students dating back as far as Fall 2015. Figure 2 (below) illustrates the first-year outcomes of four cohorts of first-year intervention students in terms of persistence in engineering or computer science majors.

In this figure, "completers" refer to students who completed or successfully finished the required courses in the intervention program, which initially included Calculus I, Calculus II, and Physics I (Mechanics); Chemistry was added beginning in F17, for all but CS students); "persisters" are defined as students of a particular cohort who did not successfully complete the required courses in the first year, (e.g. they may had needed to repeat a course to receive a passing grade), but continued in the major through the end of the spring semester of the referenced year. Figure 2 does not differentiate between those who have performed well academically from those who have been struggling academically – rather it represents a count of students whose records indicate that they continued to be enrolled in the major. Notably, some students changed major during the summer or before the following fall, so they may have been recorded as "persisters" in the figure though they may not have persisted into the following fall semester. In Figure 2, student who changed major within the university ("changers"), or those who left the university ("stoppers") voluntarily or not, are considered "non-persisters." Importantly, the first-year intervention program has an additional intent of improving students' major decision-making during their first year, thereby making fewer students "stoppers" and more "changers" by supporting some students to find new and more appropriate majors early in their academic careers so that they can attain a bachelor's degree within six years, regardless of major. Figure 3 compares the intervention cohort with the non-intervention cohort over time since matriculation. Non-intervention student cohorts included all freshmen engineering students (Fall 2015 and Fall 2016 cohorts) or all engineering and computer science students (Fall 2017 and Fall 2018 cohorts) who started in Calculus 1 during their first semester in our university, after bridging summer intensive program. It should be noted that the sum of "completers" and "persisters" in Figure 2 are the persistence cohort of Figure 3. For example, the Fall 2017 cohort had a two-year persistence



of approximately 80%, while the non-intervention cohort had a two-year persistence of about 68%. For all four cohorts, persistence beyond the first-year is greater for the intervention group.

There is also evidence that intervention students who persist even without successfully completing their first or second semester in college (i.e. they failed and repeated calculus or physics courses), persisted longer in engineering or computer science majors. This is confirmed in our regression analyses results (described below). As a research team, we believe this may be due to stronger support in the students' first year, resulting in more completers; more network-building amongst students' within their cohort so as to have classmates to study with; and a greater sense of "belongingness" to the university as a consequence of participating in the first-year intervention. Furthermore, an independent t-test was used to calculate mean differences amongst intervention and non-intervention participants, and statistical significance was found between students who were enrolled in the first-year intervention and non-intervention students' grade point average (GPA) across program years ($P<.05$) Multiple linear regression was calculated to predict students' GPA based on students' enrollment in the first-year program. A significant regression equation was found ($F(1,472) = 5.32$, $P<.05$) with an R^2 of .0111 indicating that first-year intervention program enrollment was a significant predictor of higher student GPAs. In other words, the first-year intervention students maintained a higher GPA than non-intervention students with statistical significance across all cohort years and students moved toward degree completion. Intervention persisters who were not completers the first year "stayed on track", repeating difficult courses if necessary, making use of their networks and academic supports, and persisting on into a sturdier GPA.

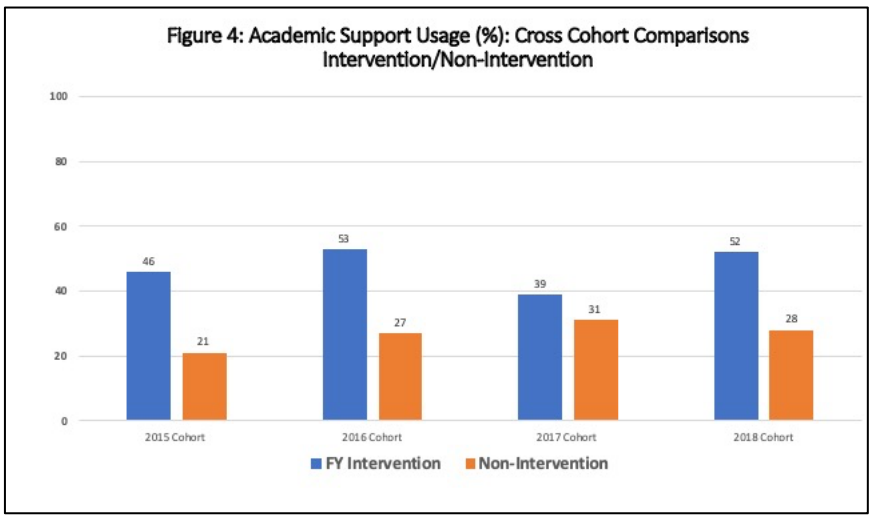


In addition to documenting students' persistence across program years in our study (2015-2019; Figures 2 and 3), we wished to determine the role that their sociodemographic and experiential factors had on their persistence toward their undergraduate degrees. Salient findings from these multivariate analyses follow.

Specifically, we sought to uncover whether the students who were enrolled in the first-year program intervention continued to use more support practices after their freshman year to assist them in academic success as they continued in their degree programs, given that they had

experienced the intervention supports in their first year. We compared these data to students who were not in the first-year intervention. Figure 4 illustrates this comparison.

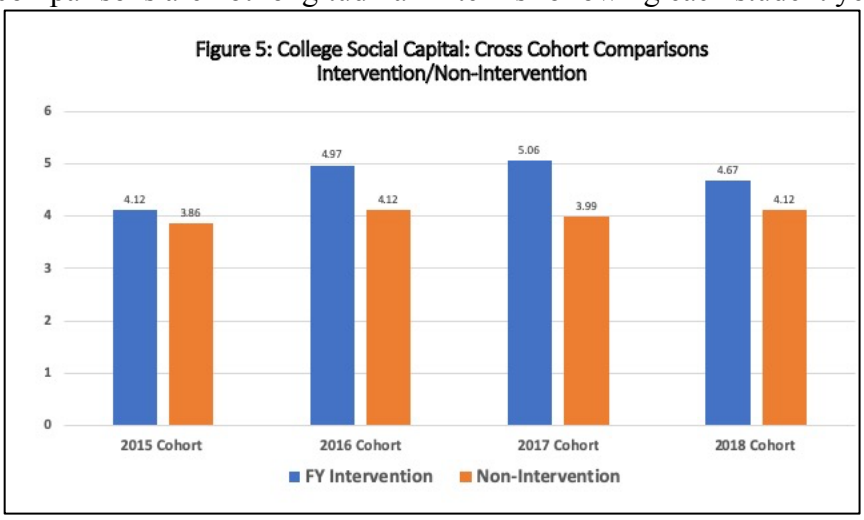
The percentages in the figure refers to the degree to which each type of categorical supports individuals used across program years. Students were asked via a Likert-type scale to determine frequency of use of a particular type of support from a listing of supports specific to the MSI that were scaled (categorized) into academic supports, social supports and advisory supports within the past six months (see CPPI description under *research design* above for details). Accordingly, the second year students provided information about what they had used in their second year in college, the third year students reported on what they used in their third year in college and so on through graduation, enabling a cross-sectional analyses of student support usage across students' degree matriculation. The questionnaire was administered electronically in engineering and computer science courses in second, third and fourth-year required courses within the majors. As noted in Figure 4 across cohort years, the students who completed the first-year intervention program continued to use more college academic supports as they continued to progress toward their academic degree (noted as the percentage use of academic supports, in the figure.)



Multiple regression was also calculated to determine the use of college academic support practices by intervention and non-intervention students across program years (Fall 2015-18) as they progressed toward degree completion. A statistically significant relationship was found ($F(1,469) = 16.87$, $P<.01$) with an R^2 of .0347. Interpretively, this indicates that students who began their academic career in the first-year intervention program continued to use academic supports at greater frequency than their non-intervention peers, thereby inferring that the intervention students continued to recognize the value of such academic supports as a consequence of having these supports built-in to their first-year intervention program.

We also measured whether students' college social capital, which is recognized as a strong indicator of academic readiness for college across time, remained high across time for the intervention students. College social capital is the "capital" that students gain either prior to or while in college that provides them with understandings of how to navigate college systems and landscapes to access support when they need it, organize themselves, and prepare academically for their college success.[17,18,20] Figure 5 illustrates the results in terms of cross-cohort comparisons of students who participated in the intervention from those who had not participated in the first-year intervention.

As noted by the figure (5), across cohort years, the students who participated in the first-year intervention measured higher in college social capital. This cross-sectional analysis indicates that even as students progressed closer to degree completion, their college social capital remained higher for those who had participated in the intervention in their freshman year. While these comparisons are not longitudinal in terms following each student year-by-year (rather they are cross-sectional by cohort), the results indicate higher scores for the students who had experienced the first-year intervention across cohorts. This phenomenon was further reinforced with our statistical analyses in which we compared students' college social capital to their GPA.[21] We found via regression analysis that students' college social capital was a significant predictor of students' GPA cross-sectionally ($F(1,469) = 3.86$, $P<.01$), $R^2=.0319$ across cohorts.



As a culminating analysis, we compared whether the students who participated in the first-year intervention spent more time preparing for courses than their non-intervention peers and whether such comparison was statistically significant. Again, multiple regression was applied to predict time spent preparing for class based on intervention status. A significant regression equation was found ($F(1,492) = 12.90$, $P<.01$) with an R^2 of .0256. Formatively, being in the first-year intervention program as freshmen was indeed a significant predictor of time spent preparing for class as students persisted toward their undergraduate degree completion.

Conclusion and future work

While this paper presents results that are formative and therefore a "work in progress" effort, we are pleased to find that the designed first-year intervention program on which we have conducted research has revealed promising positive results. We recognize that our research is formative, and therefore wish to engage in iterative, data informed improvements of the first-year intervention program over time. Added to these ongoing programmatic improvements, our longitudinal cross-sectional comparative analyses for the intervention program will be expanded upon in future years of our research in an attempt to measure the long-term gains and challenges associated with participating in a comprehensive, student-centric first-year experience designed for diverse students, many of whom are first in their families to attend college. This research has great promise to inform other large MSIs as they grapple with intervening to meet the diverse needs, both academically and experientially, of their students.

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