WIP - Monarch Accelerator Program to Engineering: A Reflection on the First Semester

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Abstract

This work in progress paper examines the Monarch Accelerator Program to Engineering (MAP2E) program. The MAP2E Program was developed to assist students who desire to become engineers but may need additional assistance in math and science. and it allows students to develop their math and science skills while creating a pathway to personal or professional enriching skills. Furthermore, the MAP2E program allows students to develop their math and science skills and create parallel pathways to personal or professionally enriching skills. For instance, a student may hope to one day start their own engineering firm. A business administration pathway would allow students to become engineers while learning accounting, economics, and financial planning skills, enhancing their career prospects.

As part of the MAP2E program, students participated in a one-week summer transition program to help students build their engineering identity and develop core competencies [1-3]. During the academic year, students became part of an Impact Learning Community (ILC), where they took engineering, math, and science courses together. The ILC also includes weekly meetings, group meetings, intrusive advising practices, field trips, guest speakers, and a study center with tutoring and supplemental instruction. This work in progress paper will present reflections from our first semester.

Introduction

Old Dominion University (ODU) has a non-selective admissions policy for STEM majors, meaning that any student wishing to major in engineering can be admitted. Students placed into college-level algebra and higher are included in the College's advising and support initiatives. Over the years, the College of Engineering and Technology (CET) has found that without additional financial resources, students continue to struggle with the prerequisites of their curriculum.

The MAP2E Program was modeled after the STARS Program [4] and the Building Excellent Engineers (BEE) program [5]. MAP2E offers scholarships to academically and/or economically disadvantaged students by providing academic support. The MAP2E program supports students with academic support during their first year and offers scholarships for three semesters if students show progress in math and science courses.

In a retention effort, the Building Excellent Engineers (BEE) program was developed “to meet the needs of at-risk populations" [5]. The BEE program assists at-risk engineering students by offering services that connect students socially and academically to achieve success in the College of Engineering. Moreover, BEE participants can learn study/test-taking strategies, note-taking strategies, time management skills, and goal setting [5]. Similarly, MAP2E participants receive access to study/test-taking strategies, note-taking, and time management skills during weekly meetings with the MAP2E program director and meetings with peer mentors.

The MAP2E administration team implemented a summer transition program, Holistic Intrusive Academic Advising (HIAA) [6], peer mentoring and tutoring, and specific course selection designed through an impact learning community. MAP2E participants met formally and informally with the program director and piloted the supplemental instruction for precalculus one. See Figure 1 for more information.

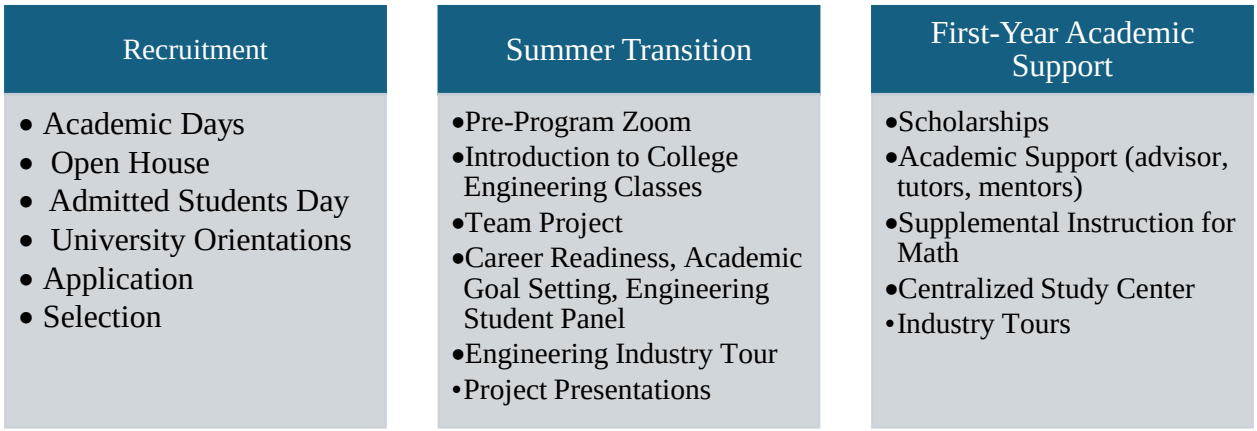

Figure 1. MAP2E Program Design outlining all support initiatives for student success.

The MAP2E program is supported by a financial gift from a local engineering company, which supports stipends, tutors, mentors, travel to industry visits, room and board for the summer transition program, classroom needs, and furniture. Stipends are provided each semester for the first three semesters ($500 Fall, $1000 Spring, $500 Fall).

Summer Transition Program (STP)

The MAP2E program administrators (PA) designed the STP to help students acclimate to campus, build academic and social capital, and an engineering identity [1-3]. Utilizing the Typology of College Transition and Support Programs [3], the MAP2E STP was built to exposure participants to campus resources, prepare for class/major rigor, and build social capital and a sense of belonging [1].

Participants met via Zoom prior to spending the week on campus. The MAP2E director discussed the program expectations, events for the week, and items students should bring for dorm rooms. Additionally, participants were introduced to the Monarch Engineering and Innovation Lab (M-Lab) and required to complete safety models before arriving on campus.

Participants arrived on campus on a Sunday evening and stayed through Friday afternoon (Table 1). Students were divided into four teams of four. They implemented the engineering design process throughout the week to build a catapult, which was judged on four areas: maximum distance, maximum height, rapid/reliable accuracy, lightest weight, and communication. Students utilized the M-Lab's laser cutter to fabricate their catapults. At the end of the week, teams presented their projects to faculty, staff, industry, and family.

Other activities planned during the week included icebreakers, a campus tour, finding class locations, goal setting, career readiness, current engineering student panel, tour of Water Treatment Plant, Student Orientation, reverse engineering project, presentation preparation with engineering fundamentals faculty, and an etiquette lunch.

Participants noted that they enjoyed getting to know other students before arriving on campus for the fall semester, participating in an engineering project, and the engineering student panel. Participants indicated that lectures should be spread out during the week rather than having them on the first day, and due to travel costs, they would prefer the program be offered closer to the first day of classes. Overall, students indicated they had a wonderful experience and felt prepared for the fall semester.

Academic-Year Support

When designing the academic year support, the MAP2E administration team built a comprehensive program for the participants based on prior work indicating that student success should be synergistic and presented to the students from different perspectives [3], which can lead to opportunities for students to find strategies that work for them. The MAP2E administration team identified a study space for participants to utilize. Additionally, participants were supported by academic mentors and tutors, weekly meetings, support from a professional academic advisor, supplemental math instruction, and impact learning community courses for math, chemistry, and introduction to engineering, and participants toured NASA.

Study Space. Commuter students' participants emphasized having the study space as a location to "call home" in between classes. Other participants noted that having classes with their cohort was important for collaboration. Additionally, tutors and mentors were helpful because they were in the study center and did not have to attend various on-campus tutoring centers. Participants also noted that they enjoyed the trip to NASA and would like more opportunities to shadow engineers, more industry visits, and guest speakers from local engineering companies.

Advising Support. Participants who struggled in classes will have one-on-one meetings with the director for the spring semester. Weekly meetings will continue, but we will be more intentional by breaking the cohort into two different meeting times per week based on students' schedules. We are planning another industry tour and plan to have more industry guest speakers.

Supplemental Math Instruction. ODU provides Supplemental Instruction (SI) to support student success in college algebra courses. Currently, students enrolled in the MAP2E cohort are the only group receiving SI for both Pre-Calculus I and Pre-Calculus II. To facilitate this support, a professional advisor with a background in mathematics was appointed to lead the SI sessions. These sessions were offered as a zero-credit course during both the fall and spring semesters, consisting of 50-minute remediation sessions designed to reinforce course content and improve student performance.

Pathway to Personal or Professional Enriching Skills

Students attending ODU are required to complete an enriching curriculum, including lower-level general education courses and complete a minor or upper-division courses outside of the College of Engineering. Typically, students can tie a lower-level general education course to a minor.

Using the example of a business or economics minor, participants would take Principles of Microeconomics as their human behavior course, which meets both a minor prerequisite and a general education requirement. Trying to minimize additional classes students must take to be full time students while completing pre-requisites for engineering classes, while achieving a value-added area in their degree program is an additional goal of this program. Students could pursue minors of interest as well as certificates tied to their major or other personal interests. Recommended minors or certificates for MAP2E students include, but are not limited to, business, psychology, energy engineering, engineering management, financial management, history, the impact of technology, applied ethics, communication, cybersecurity, environment and resources, and public law.

Fall 2024 Results

The MAP2E program had sixteen students participate in the STP. Four students were in college algebra, and twelve participants were placed into precalculus one. Due to the small class sizes, we opened the ILCs to other students. Eight participants were added to the college algebra cohort, and three were added to the precalculus one cohort. Students who participated in STP received all the integrated interventions (tutoring, mentoring, weekly meetings, etc.). While students who did not participate in the STP were in the same cohort with the ILC and receive the same academic support as the students who participated in the STP.

Eleven of the 12 (91%) students passed college algebra, while 12 of 15 (80%) students passed precalculus. Regarding the three students who failed precalculus, two changed their major, and one did not return for the spring semester. Furthermore, MAP2E participants in precalculus performed at five percentage points higher than students who did not participate in the supplemental instructional. It should be noted that supplemental instruction was only offered to students in the MAP2E cohort, and this is not a customary practice for all precalculus students (Table 1).

Tabel 1. Pre-Calculus 1 Grades for Fall 2024 semester – MAP2E Students vs. General Population.

	n	%
Average Final Grade: All Students	37	75
Average Final Grade: S.I. (MAP2E Student)	14	78.8
Average Final Grade: Not S.I. students (All Other Students)	23	73
Average Final Grade: All students who took all tests/final	33	80
Average Final Grade: S.I. students who took all tests/final (MAP2E)	12	86
Average Final Grade: Not S.I who took all tests/final (All Other Students)	20	76
Percentage C or Better: All Students	25	75.67
Percentage C or Better: S.I. Students (MAP2E)	11	85.70
Percentage C or Better: Not S.I. Students (All Other Students)	14	69.56

Chemistry proved to be a much more difficult subject. No other interventions, such as supplemental instruction, were offered. Participants registered for college algebra were paired with a skill-building chemistry course, Introductory Chemistry. Participants in precalculus took the required chemistry course for all engineering majors, Foundations of Chemistry 1 Lecture and Laboratory. Seven of twelve students passed Introductory Chemistry (58%) with a grade of C or higher. Six of fifteen students passed the Foundations of Chemistry Lecture (40%) with a grade of C or higher, and thirteen out of fifteen students passed the laboratory (86%) with a D- or higher grade.

Introduction to Engineering was the last course in the ILC for precalculus participants. Similarly to precalculus, twelve out of 15 (80%) students passed this course. This class does not have implications for other engineering courses, so a D—or higher is considered. Students in the college algebra cohort took a 0-credit orientation course, in which eleven out of 12 (91%) participants passed.
During the first semester, we did not retain four students. Three students participated in the STP, and one participant was added to the college algebra cohort. Three students changed their major but were retained by ODU, and one did not return for the spring semester (Figure 2).

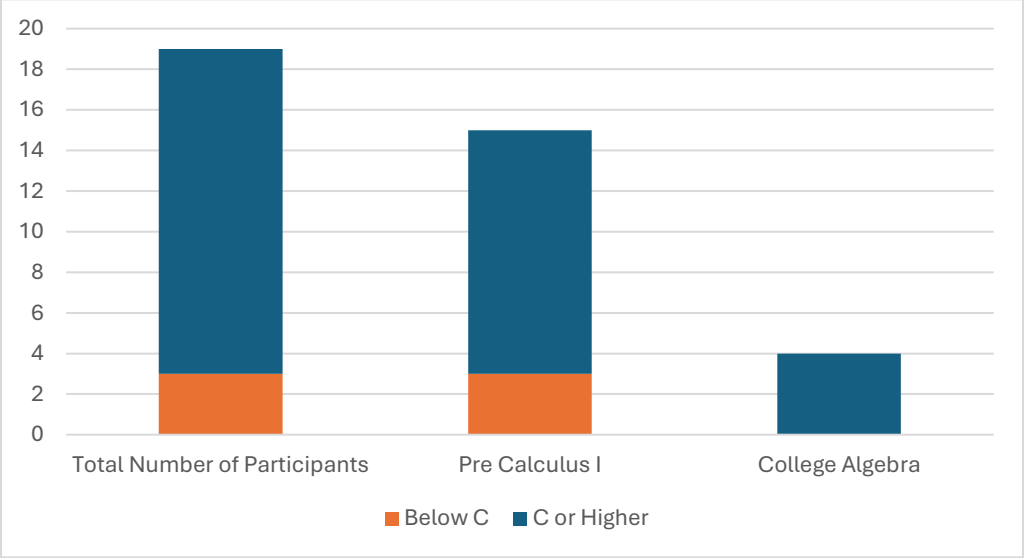

Figure 2. Math success for MAP2E students during the Fall 2024 semester.

Discussion, Implications, and Future Research

Overall, the PA are happy with the program's first-semester results, specifically the success in the mathematics course. These students will be followed throughout their academic career and additional cohorts will allow PA to quantify the overall success over traditional student pathways. Participants will stay in ILC cohorts for the spring semester, including supplemental instructions for precalculus one and two. More intentional advising meetings and tutoring appointments will occur for students who did not earn a 3.0 or higher during their first semester.

While planning for the summer transition program for year two, PA have moved the STP to the university Week of Welcome, incorporating university events with programming for participants. Participants will still have the Zoom premeeting and M-Lab introduction. Moving the date closer to the university's start date should increase the program's scalability by decreasing room and board costs. Moving the STP will give students additional time to complete the required math and chemistry placement tests. Also, PA will have additional time to recruit and implement a formal application and interview process.

Regarding scalability, the College has asked the program PA to prepare a budget for tutoring all first-year students and look for additional space for a more extensive study room. With support from the Associate Dean for Undergraduate and Graduate Education, a new course has been created for college algebra students, “Exploring Engineering," to assist students with engineering identity as they build their math skills. Due to scholarship requirements, the College has also created two one-credit courses for students who are not enrolled in 15-credits each semester. One is Engineering Orientation for the fall semester and Engineering Career Readiness for the spring semester.

The PA are seeking approval from the university's Institutional Research Board (IRB) to implement a pre-and post-test for all first-year students enrolled in Introduction to Engineering in Fall 2025. By utilizing the Longitudinal Assessment of Engineering Self-Efficacy v3.0 developed by [7], the PA aim to gain insights into the persistence and success of participants in the engineering program. Additionally, this approach will enable the tracking of each cohort over time to evaluate the program's overall success.

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