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Integrating First-Year Experience Programming into a First Year Engineering Mathematics Course

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Work-in-Progress: Curricular Integration of First-Year Experience Programming

The gold standard of First-Year Experience (FYE) programming is the First Year Seminar course taken for credit in the first year of college. Such courses have been extensively researched and identified as a high-impact practice [1]. At many institutions, including most Canadian institutions, such seminars are not prevalent, so alternative models of delivery are needed.

The purpose of this study is to investigate the cost and benefit of maintaining the high-impact nature of such programming while embedding into a curriculum. From the student perspective, the benefit (skills improvement, academic success, and direct academic reward) must be balanced with the cost (time, effort, and motivation) to ensure sufficient engagement as to have an impact on student outcomes. We will present results from the first two years of a pilot study investigating the integration of FYE programming into a core engineering mathematics course, including a discussion of potential usefulness as an Early Alert metric.

Background and Development

We integrated into an introductory engineering mathematics course a series of FYE modules on the following topics: values affirmation, memorizing vs. understanding, test wrappers, notetaking, time management, procrastination, accessing campus resources, advice to/from faculty, test anxiety and professional communication. Each module was developed from evidence-based resources and designed to take no more than 30 minutes for students to complete. The time management module, for example, was inspired by a study that explored the correlation between grades and specific time management behaviors and concluded that while students are inclined to set time management goals and establish priorities, they may not yet have the tactical skills to effectively implement these goals [2]. The pedagogical design of this module was also inspired by Lizzio's Sense of Capability [3] and NSSE's Student-Faculty Interaction [4].

Results and Discussion

Data were collected from each student who consented to participate in this study: 190 in Phase 1 (Fall 2019, in person) and 125 in Phase 2 (Fall 2020, remote), all enrolled in the same first-year calculus course taken primarily by Engineering and Physical Science majors. These pre- and post-COVID offerings of the course covered the same topics at the same pace for the same student audience, but differed in the nature of the timed assessments (3 higher-value tests in person, 10 lower-value quizzes remotely). Students were encouraged to complete up to 5 modules and completed, on average 4.1 modules in Phase 1 and 4.5 modules in Phase 2.

Students were asked about their perceived costs and benefits to participating in these FYE modules. A comparison of results between Phase 1 and Phase 2 is presented in Figure 1. After a module redesign based on Phase 1 student feedback, student perceived value significantly increased (Mann–Whitney $U = 5672.5$, $p < 0.01$) and the perceived time cost relative to value significantly decreased (Mann–Whitney $U = 9207.5$, $p < 0.01$), indicating that the redesign process was effective in better optimizing student motivation and effort.

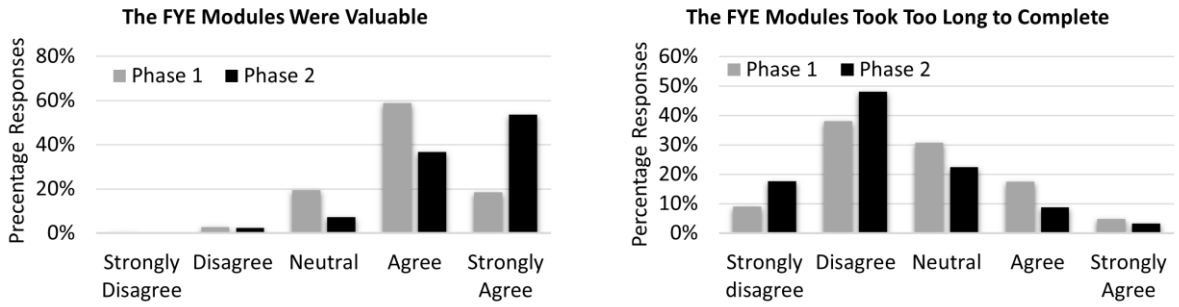

Figure 1. Student survey responses to the prompts "The First-Year Experience Modules Were Valuable to Me" and "Given the Value of the FYE Modules, They Took Too Much Time to Complete".

Students were also asked whether they believed the formal academic reward was appropriate relative to their perceived cost and benefit. In Phase 1, students were formally rewarded with a final course grade re-weighting up to 15% and proportional to the number of completed activities, producing a +3.6% average effect on final grades. In Phase 2, students were formally rewarded with up to 5% of their final grade. Students indicated that the latter was a significantly more appropriate (Mann–Whitney $U = 9457.5$, $p < 0.01$) formal reward.

Each module was available to the students for an average of 47 days with staggered start and end dates. There was an abrupt uptake in module completion rates as each deadline approached. Among the students who accessed the test wrapper module, for example, 60% completed it in the first 43 days of availability and 40% completed it in the final two days. In Phase 1, this abrupt uptake began, on average, one week before the deadline and in Phase 2, on average, 2 days before the deadline. That this pattern appeared independently for each module in both phases inspired us to consider whether it could be used as an Early Alert metric.

A successful Early Alert program pairs an *alert*, where a systematic approach is taken to identify students falling short of successful behaviors, with an *intervention,* where these behaviors are changed before the student faces academic consequences. Examples of effective alerts include attendance rates, midterm grades and behavioral changes [5]. There is evidence in our data to suggest that procrastination behaviors may also make an effective alert. We collected final course grades and flagged whether each student was at risk for future attrition, defined as earning a low grade (D in Phase 1 and C/D in Phase 2 to account for moderate grade inflation during the remote COVID-19 affected semester), failing the course, or withdrawing from the course.

Students who completed at least one module proactively were associated with a significantly higher (Phase 1: $t = 3.75$, $p < 0.01$; Phase 2: $t = 1.96$, $p = 0.03$) average final grade and, among these students, significantly fewer (Phase 1: $z = 2.14$, $p = 0.02$; Phase 2: $z = 3.88$, $p < 0.01$) were flagged as at-risk for future attrition (Table 1). In both phases, the number of students who demonstrated procrastination tendencies for every module is relatively low, thus identifying a small group of students for whom a resource-intensive intervention is feasible.

Table 1. A comparison of student success indicators for students who completed at least one FYE module early and proactively before the deadline versus students who did not.

Project Phase	Module Completion	# of Students	Average Grade	% At Risk
Phase 1 (F19)	None early	64	64%	47%
	At least one early	126	74%	20%
Phase 2 (F20)	None early	26	77%	31%
	At least one early	99	82%	13%

Although there was no significant correlation between number of modules completed and final grade, there was a significant correlation (Kendall's Tau = 0.16, $z = 2.69$, $p < 0.01$) between the number of modules completed proactively and the final grade in the course. It is not immediately clear if this result would make an effective or actionable alert since these data are not available until the completion of the course, but there may be value in reporting this result to students for motivational and coaching purposes.

Future Work

The next phase of this project is to consider the cost (time, workload, motivation, perceived sacrifice of course content and TA support, lack of confidence and knowledge of such materials) and benefit (improved student outcomes, retention, and preparation for advanced courses) from the faculty perspective and develop open-source, content-agnostic, accessible, and portable modules designed to increase the likelihood of faculty adoption. The authors will also be partnering with campus academic advisors to investigate and validate the Early Alert potential.

References

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