Empowering Students to be Adaptive Decision-Makers: Progress and Directions

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Project Overview

The objective of this NSF CAREER project is to help students learn to make academic decisions that lead to success. The research goals are to: (i) identify curriculum-specific patterns of achievement that eventually lead to dropout and corresponding alternative paths that could lead to success, and (ii) advance knowledge of self-regulation patterns and outcomes in engineering students. The education goals are to develop curricula and advising materials that help students learn how to effectively self-regulate their decision processes through contextual activities and story-prompting.

The first research goal, Model Pathways, seeks to identify indicators of poor academic fit in each of the degree-granting engineering disciplines at the PI's institution as well as the corresponding success paths. Commonalities in mechanical engineering across institutions will then be investigated using the Multi-Institution Database For Investigating Engineering Longitudinal Development (MIDFIELD).

The second research goal, Map Theory to Pathways, is to map the relationship between measures of theoretical constructs (decision making competency, self-regulated learning, major fit, major satisfaction, and intent to persist) and real-world behaviors (major changes and academic achievement). This goal has been expanded to include instrument development in an effort to refine our understanding of self-regulated decision-making.

The education goal, Develop Academic Dashboard, aims to create an online system for the sharing of research results with students and advisors. The academic dashboard will provide access to strategies, information, and stories needed to make and implement adaptive decisions.

This poster will present current progress and future directions of the project. We will summarize accomplishments towards each of the project goals and describe our path forward.

Model Pathways

Indicators of Overpersistence

We define "overpersisters" as first-time college students who enroll in a major, remain in school for at least one year, and then either leave the institution without a degree or are still enrolled in the same major after 6 years without graduating. Overpersisters were identified in Mechanical Engineering and studied in an attempt to identify better strategies through which students can persist and succeed in their undergraduate studies. Multiple single-variable logistic regression was used to find the best indicators of overpersistence. We looked at high school GPA, high

school rank, term GPA, SAT scores, and cumulative GPA. The results of our analysis revealed that high school GPA was a better predictor than high school rank, the SAT verbal score was the only SAT score with significant predictive power, and after two terms, the first term GPA is a more powerful predictor than the cumulative GPA. Of the 204 overpersisters in the study [1], only 17 students left school after the first year and before the eighth semester. The remaining 187 students who overpersisted did not graduate within six years, though some did graduate later.

Confidence in Major

We studied the major paths of the students into and out of engineering by measuring students' self-reported intended major in a first-year engineering program and how confident they were in their choice of major. Though students are not permitted to officially declare a major until the end of their first year of study, we found that most students had decided on a specific engineering major in the beginning of their first semester in general engineering. Students were relatively confident in their major choice at the beginning of the semester, and their confidence increased by the end of the semester [2]. Additionally, if we only look at the major in cross-sections, we may not see the changes that occur. For example, 20 students reported electrical engineering as their intended major at the beginning and the end of the semester; however, four of those original twenty had changed their intended major out of electrical engineering and four other students had changed their intended major to electrical engineering. Although the total number of students intending to major in electrical engineering remained the same, some students were not the same at each time point. We are expanding this work to include declared major, from institutional data, one year after the first survey administration and to relate it to the decision-making instrument described below.

Map Theory to Pathways

Development of Instrument

The Self-Regulated Model of Decision-Making [3] was used as the theoretical framework for the revised Decision-Making Competency Inventory (DMCI) [4]. We refined the original DMCI to achieve useful subscales that relate to the Self-Regulation Model of Decision-Making. To accomplish this, 16 items were added to the original inventory to balance the amount of positively and negatively worded items. Over 700 first year engineering students took the revised DMCI (DMCI 2.0). An exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed to determine that five of the original items should be removed from analysis and six of the new items should be kept. The EFA and CFA lead to the three subscales of (i) Generation & Evaluation, (ii) Reflection, and (iii) Impulsiveness/Lack of Process [5].

A subsequent, third refinement of the DMCI (DMCI 3.0), is underway. Four items were added to the Reflection subscale to show more of the learning phase of the Self-Regulated Model of Decision-Making. Responses from 983 first-year engineering students are being analyzed with an EFA and CFA. Preliminary results suggest removing from analysis one additional item from the original instrument, seven items that were added to DMCI 2.0, and one item added to this iteration in the attempt to expand the learning phase. Analysis of DMCI 3.0 suggests a four-factor solution which was found to agree with the Self-Regulated Model of Decision Making. The four factors are currently called (i) Information Gathering, (ii) Avoidance, (iii) Learning, and (iv) Impulsivity. Results from the analysis of DMCI 3.0 will be published soon.

Fit, Satisfaction, Persistence

In addition to decision-making competency, the survey instrument measures fit in engineering, satisfaction in engineering, and intent to persist in engineering. In the survey, fit is a measure of how well the students' skills, interests, and personality align with the first-year engineering (FYE) curriculum and their experiences in the FYE program. Satisfaction in engineering is a measure of how satisfied the students are with their decision to choose engineering based on factors such as instructors, class content, and employment prospects. The intent to persist factor consists of questions that gauge the students desire to obtain a degree in engineering in spite of any obstacles they may face. Descriptive statistics showed that the average scores for fit in engineering, satisfaction in engineering, and intent to persist in engineering all decrease from the beginning of the semester to the end of the first the semester.

Develop Academic Dashboard

The Academic Dashboard will be a tool available to students to provide resources about decision-making strategies and study habits as well as information about major exploration. The purpose is to package research findings about strategic pathways in a form that can provide support for student decision-making. The dashboard is intended to supplement and enhance advising, not replace it.

While the current focus is on the content for the dashboard, some platforms have been explored. Canvas, the learning management system at the PI's institution, has been considered as a platform for the academic dashboard. Our hope is that this platform will make it easy for students to complete coursework and see how the items in the dashboard are relevant to their other classes. We are considering activities that can help with self-knowledge, strategic knowledge, and cognitive tasks. These activities include visual graphics such as charts and concept mapping, as well as self-monitoring documents and self-assessment survey questions. Other options including commercially available advising software and free-to-create websites are being considered as alternative platforms.

Path Forward

The next steps for this project include finalization of the revised DMCI instrument and its factors. With a finalized instrument, data about students' self-regulation of their decision making can be collected. This data can then be combined with data about real-world behaviors including the selection and changing of academic majors. These research results can be then be added to a prototype academic dashboard for dissemination to students and advisors.

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Marisa K. Orr is an Assistant Professor in Engineering and Science Education with a joint appointment in the Department of Mechanical Engineering at Clemson University. Her research interests include student persistence and pathways in engineering, gender equity, diversity, and academic policy. Dr. Orr is a recipient of the NSF CAREER Award for her research entitled, "Empowering Students to be Adaptive Decision-Makers."

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