

Are You Sure You Are in The Right Major?

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Abstract - “Am I sure that I am in the right major?” is a question that many first time college students have. The common First-Year Engineering Program at Michigan Technological University provides time and opportunities for students to either confirm their choice of major or discover a new major. There are several components incorporated into the first-year engineering courses to support students with this decision making process including Engineering Explorations and their choice of a variety of semester design projects in their second semester. This work-in-progress highlights activities incorporated in Michigan Technological University’s common first year engineering experience to aid in the answering of this question.

Index Terms – design projects, first-year engineering, selecting a major.

INTRODUCTION AND BACKGROUND

At Michigan Tech, students may enter directly into an engineering degree program, or they may enter as an Engineering Undecided student. Approximately 15-20% of incoming engineering students choose Engineering Undecided as their major, making it the second largest major chosen by incoming first-year students within the College of Engineering (COE), as well as the university. All Engineering Undecided students will need to select a degree granting major by the time they complete the common first-year engineering courses: Engineering Analysis & Problem Solving (ENG1101), Engineering Modeling and Design (ENG1102), Physics 1, Calculus 1, Calculus 2, Chemistry, Composition, and Global Issues (a social sciences course).

Many students that chose to come directly into a degree granting engineering program change their minds. Some studies indicate as many as 70-80% of students change their major [1,2]. One study at Michigan Tech found that only 40% of first-year engineering students graduate in their originally declared major, while 21% changed into another major within the COE, 6% left COE, but stayed at Michigan Tech, and 30% left Michigan Tech altogether [3].

A variety of methods are used to help students select or confirm their major. For example, at the University of Pittsburg, reflective writing assignments are incorporated into a first year Introduction to Engineering course to encourage students to research an engineering field of interest. Additionally, they have incorporated a “Freshman

Career Conference” where corporate speakers talk about professional development [4]. Arizona State University also has a Freshman Engineering Career Exploration event where students interact with industry partners and alumni [5]. At Carnegie Mellon University all engineering students must take two out of seven introductory engineering courses taught within each of the departments before declaring a major [6]. Several schools use a seminar or orientation course to help engineering students explore and select a major [7,8].

ACTIVITIES TO HELP CHOOSE A MAJOR

At Michigan Tech, several activities provide students with the opportunity to explore different areas within the COE. In their first semester course, ENG1101, students attend at least five Engineering Explorations. Students may also select the design project that they will work on in their second semester engineering course, ENG1102.

1. ENG1101 Engineering Explorations

As part of the first-year engineering program, all engineering students are required to complete a series of five Engineering Explorations. There are three different types of explorations and students must complete a mix of these:

- **First-Year Engineering Lecture Series:** A talk given by an influential engineer working at a high level in their industry. Talks focus on exciting the students and showing them successful engineering career paths. This lecture is typically given during the first week of classes. All students are required to attend this lecture.
- **Departmental Open Houses:** Sessions held outside of class by each department at Michigan Tech allowing students to meet faculty, upperclassmen, and advisors; tour and use engineering facilities; and learn about job and research opportunities. Students must attend at least two Departmental Open Houses.
- **Other Explorations:** Additional sessions engaging students in engineering activities outside of class. These include seminars, professional society meetings, conferences, defenses, and career center events.

For Undecided Engineering students, explorations offer the opportunity to explore the various disciplines of engineering offered at Michigan Tech to help them select a major. Students already admitted into an engineering degree also benefit, as explorations offer them the opportunity to solidify or modify their choice and understand better how their discipline integrates with the other engineering disciplines.

II. ENG1102 Design Project Options

In an effort to bring some options into the first year and help students gain more exposure to engineering disciplines, students may select from a variety of design projects offered during the second semester engineering course, ENG1102. All projects include a pre-project preliminary investigation and project proposal. The design work includes a virtual physical model created using NX, hazard analysis, energy budget or mass balance, program logic flowchart, and a MATLAB simulation. The final deliverables include a project book which is a compilation of all improved deliverables and a presentation given in a "conference" setting to other ENG1102 students and instructors from outside of their section. This is done to show how engineering tools are utilized in different design projects.

The design projects students were able to choose for spring 2015 include the following:

- **Alternative Fuels:** students develop a concept design for a biomass-to-ethanol process using various regional biomass sources. Design teams research and develop a sustainable process for the production of biofuels.
- **Alternative Power Generation and Design:** students develop new designs of power generation. Topics introduce and focus on designs associated with solar-thermal wind turbine systems. Students utilize actual data on energy consumption in their simulations.
- **Autonomous Robotic Design:** students develop a design concept for a fully autonomous robot. Student teams identify a real need and develop a virtual prototype and control program. Student teams in previous classes have developed robots for high risk rescue, deep ocean exploration, and extra-planetary exploration.
- **Human Power in Design:** students develop a design concept for a vehicle that uses human power. Design teams consider the "state of the art" for this type of vehicle, then develop ideas to take the design to the "next level". Students collect data using a GPS and use this data in their simulations.
- **Microbrewery Design:** students develop a design concept for a semi-automated microbrewery to allow part-time brewers to produce batches of basic ale recipes. Design teams research the brewing process and equipment and develop an innovative concept design.

RESULTS AND ANALYSIS

To determine if these activities in the first year engineering program are helping students to select or confirm their major, students completed two sets of surveys. The first set was completed as they attended Engineering Explorations in ENG1101. Students completed an Exploration survey after each Exploration they attended (max of four). Students identified which Exploration they attended and answered a series of Likert questions on the Exploration organization and the students' interest in the major. For example, students were asked to rank: a) I was interested in this major BEFORE attending this Exploration and b) I am interested in this major AFTER attending this Exploration. These last two questions were primarily used to determine if students are finding Engineering Explorations useful in choosing a major. As the structure for Explorations has not changed over the past several years, data collected in the Fall 2012 was analyzed. In that semester, students completed 1400 departmentally sponsored Explorations surveys. Of those, 64% of the students (n=893) expressed a change in their interest in the engineering major (46% increase, 17% decrease). This suggests that Explorations are helping students to choose a major.

The second survey students were asked to complete occurred at the end of ENG1102. Instructors requested that students complete the questionnaire through Survey Monkey. The survey asked students to select their response (Strongly Disagree to Strongly Agree) to the following Likert type questions:

1. The following was an important factor in choosing a section for ENG1102 this semester: a) Time the section was offered, b) Instructor, c) Friends in that section, d) Design project sounded interesting, and e) Design project seemed relevant to my major.
2. The following was helpful for confirming/selecting my choice of major: a) Explorations, b) ENG1102 Design Project, c) Meetings with Academic Advisor, d) Career Center, and e) other.

Also on this survey, students were asked to identify their major at three different points during the academic year: at enrollment, beginning of the second semester, and at the end of their first year, to track changes in majors throughout their first year. Additionally, they were asked how confident they are that they will be graduating in their current major.

There was a 27% response rate on the second survey with 173 students completing the survey. For the Likert questions, students could choose more than one important factor, so these results represent the level of agreement or importance of each item. From these results, it appears that the ENG1102 design project was the most helpful for confirming/selecting a major (46% agreed or strongly agreed), followed by meetings with academic advisor (44%), engineering explorations (30%), and career center (15%). There were 23 responses (13%) in the "other" category as well. Several students (n=8) commented that

they had decided on a major prior to coming to Michigan Tech, while others suggested that major specific courses, problems, or conversations were helpful as well (n=4).

In addition, the design project itself was chosen to be the most important factor in choosing a section of ENG1102 for spring 2015. Of the respondents, 77% agreed that “the design project sounded interesting” was an important factor when selecting a section and 52% agreed that “the design project seemed relevant to their major.” Time of day was a major contributor as 69% of students selected this as a factor. All design projects spring 2015 were offered at least at two different times, although only two projects, Autonomous Robot and Microbrewery Design, were offered in the morning and the afternoon. The other projects were offered only in the morning or only in the afternoon.

We used the students’ self-reported major at the three different times during the academic year to determine if and when the students are switching their majors. Figure 1 below shows the general trend of major declaration from the beginning to the end of the academic year. As expected, the students enrolled as Engineering Undecided (n=17), switch out of this major and into different majors. The majority of those in the “Other” category are students who have selected a second major (n=14). Overall, in this group of 173, 40 students (23%) switched majors at least once during the academic year. The majority of these (95%) switched to another engineering major, while the remaining 5% switched out of engineering. Ten percent of those students who changed, switched more than once. A slight majority (56%) of these changes occurred in the first semester. At the end of the academic year, 93% of the students were fairly confident that they would graduate within their current major.

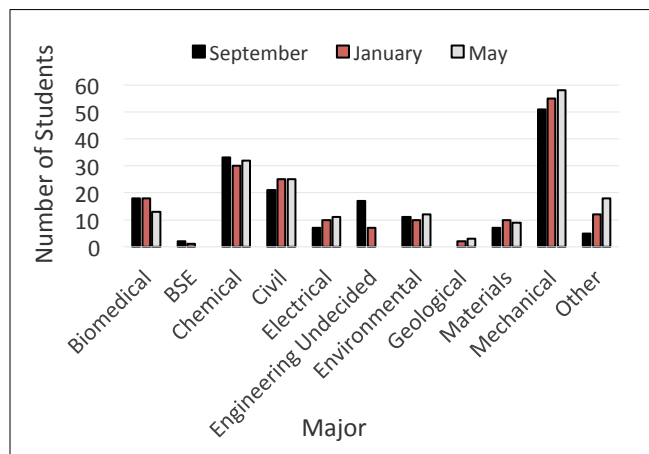


FIGURE 1

MICHIGAN TECH FIRST-YEAR STUDENT DISTRIBUTION OF MAJORS THROUGHOUT THE ACADEMIC YEAR 2014-15

To determine which factors most influenced those students that changed their major within the first-year, a subset of the survey results were examined. This subset is comprised of all students that reported changing their major, including only those Engineering Undecided students that

selecting a new major, as well as those that switched from one engineering major to any other major. The importance of the factors used to help these students select a major were slightly different than those reported by all respondents. A larger percentage of the students that changed their major felt that meetings with academic advisor (60% agreed or strongly agreed) and Explorations (45%) were important in selecting a major. While fewer (38%) agreed or strongly agreed that the ENG1102 Design Project was important in selecting a major. The reasons the students that changed their major reported for selecting an ENG1102 section were similar to all respondents. Of the subset respondents, 70% and 65% agreed or strongly agreed that “the design project sounded interesting” and time of day, respectively, were important factors when selecting a section.

CONCLUSIONS

The first year engineering program at Michigan Tech gives students time to select or confirm a major. The activities incorporated into this program, Engineering Explorations and a choice of ENG1102 design projects, seem to help students with their choice of major. The Engineering Explorations survey results indicate that 64% of the respondents showed a change in their interest in the engineering major. The ENG1102 design project was most helpful to students in confirming or selecting a major, followed by meetings with academic advisor and engineering explorations. By the end of the students’ first year, 93% expressed they were fairly confident that they would graduate within their current major.

Future work may include surveying first year students at the beginning of their first year on their confidence in their choice of major. The university student database could be analyzed to track migration from one major to another. To increase the response rate, the student survey could be incorporated into the course.

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