

WHY DO FRESHMAN STUDENTS AT THE WENTWORTH INSTITUTE OF TECHNOLOGY CHOOSE THE BACHELOR OF ELECTROMECHANICAL ENGINEERING MAJOR?

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Abstract

On the 2004, 2006, and 2009 final exams for Introduction to Engineering, the students were surveyed about the three reasons why they chose the BELM major along with stating the main reason. 121 students responded.

The largest segment of respondents cited genuine interest in electromechanical engineering as their reason for choosing it as their major (48.8% vs. 59% in the literature). Interestingly, a large segment listed financial aspects as their main reason for choosing the major (17.4% vs. 7% in the literature). More study is required to determine why financial aspects are more important to electromechanical engineering students than non-electromechanical engineering students in the literature. Several of the respondents had been positively influenced because they had relatives who were engineers.

Introduction

While most colleges and universities require students to either major in electrical engineering or mechanical engineering, the Wentworth Institute of Technology provides the option of enrolling in a combined Bachelor of Electromechanical Engineering major (BELM). We hypothesize that most students choose BELM because they have a real interest in both electrical and mechanical systems.

The literature lists many possible reasons why students choose a major[1]. For example, in Israel, students with large financial resources and high cultural capital (high SES – socioeconomic status) prefer theoretical fields with a more extended course of study such as medicine, law, or natural or social sciences. In contrast, students with lower SES take on more “practical” studies, which will provide faster entry into paying positions in the job market (for example, computer science, economics and management, and engineering)[2]. However, in the U.S., business majors were affected by their SES while non-business majors were less affected[3]. In their survey, Adams, Pryor, and Adams reported that 4% of the respondents indicated parental pressure and 10% indicated their major being similar to their parents’

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occupations as strong influences on their decision, while the majority, 59%, indicated that genuine interest in the subject strongly influenced their choice[4].

Although the importance of financial aspects of a job has been reported, other issues such as subjective task value (including attainment value and interest value), quality of life, occupational prestige and type of work are also important[4,5]. The financial aspects of a job include starting salary, high earnings potential, and benefits and opportunities for advancement[1]. Matusovich, et al. found that high attainment value (consistent with sense of self) correlated with high or yearly increasing interest value (enjoyment of engineering tasks), low time and effort sacrifices, and generally yearly decreases in utility value (future usefulness)[6]. Adams, et al. found that genuine interest in the subject received the highest number of respondents (59%), indicating they were strongly influenced by it[4]. Matusovich, et al. suggest that students with low attainment values experience the persistence process differently and with greater difficulty than those with high attainment values[6]. Collins and Giordani reported that 68.4% of respondents chose their major because they would enjoy that kind of work as compared to 7% who chose their major for its earning potential[7].

Subjective task value (STV) is defined as the individual's incentives for engaging in different tasks or activities based both on the nature of the task and how well it aligns with personal values, goals, and needs[8,9]. The four categories of STV are: 1) attainment value, the individual's perception of how performance on the task reflects on the individual and how this reflection matches with self-concept; 2) intrinsic or interest value, the enjoyment of doing the task; 3) utility value, the perceived future value of doing the task; 4) relative cost, the price of success or failure in terms of effort, time, and/or psychological impact[8,10].

Jones, et al. reported that students' expectancy and value-related beliefs decreased over the first year[11]. Expectancy-related constructs (that is, the student's judgment of his or her ability to perform a task in engineering or his or her belief in the possibility of success in engineering) predicted achievement better than value-related constructs (that is, the enjoyment of engineering tasks (interest) or the identification of the student's core personal values with what he or she believes it is to be an engineer (attainment) or the usefulness of engineering in terms of attaining one's long- and short-term goals (utility)). In contrast, value-related constructs predicted career plans more accurately. Interestingly, Jones, et al. reported that the means for the above expectancy-related beliefs, value-related beliefs, and career plans rated in the upper-third during the entire first year, but the means were lower at the end of the first year than at the beginning[11]. This agrees with our findings in that only one student in our survey expressed lack of confidence in the student's ability to succeed in engineering. Based on Jones, et al., we can speculate but not substantiate that the average confidence of our BELM students might lessen later in the first year[11].

Characteristics of major include exposure to an introductory course in a major, course variety, ease of earning a degree, faculty reputation, and ability to maintain a high grade point average (GPA). 7% of the respondents reported that faculty reputation strongly influenced them[3]. 4% were strongly influenced by ease of earning a degree or the ability to maintain a high GPA. On the other hand, course variety in a major[12,13] and an introductory course in the major have been identified as important reasons why students choose a major[14,15]. Also, the timing of an introductory course can influence the choice of major. Other influences are wide variety of class sections, class size, faculty with access to practitioners, accessible faculty, and faculty who do on-campus recruiting[15].

48.8% of our respondents expressed a genuine interest in the subject of electromechanical engineering. Surprisingly, 17.4% were strongly influenced by the job market for electromechanical engineers. Even less frequently than stated in the literature, 0.83% of the respondents reported parental pressure as a strong influence. Similar to the literature, 9.1% of the respondents reported a relative or relatives in a similar occupation as a strong influence in making their choice.

Methods

On the 2004, 2006 and 2009 final exams for Introduction to Engineering, the students were surveyed about the three reasons why they chose the BELM major along with stating the main reason. There were two sections of Introduction to Engineering. One section was surveyed. 121 students responded. (See Table 1 for a summary of their responses.) The survey consisted of three questions:

1. State three reasons why you chose the electromechanical major:
2. State your main reason:
3. State your reason why you chose the Wentworth Institute of Technology:

The questions were open-ended so as not to influence the students' answers. Mainly the second answer was analyzed. The survey did not record the gender or socio-economic status of the students.

Survey Analysis

The five-year electromechanical program, introduced in 1993, is the first non-technology engineering degree and the first interdisciplinary degree at the Wentworth Institute of Technology. Unlike the engineering technology programs, the electromechanical program requires freshmen to enroll in calculus in their freshmen-year second semester, and in all years, enroll in courses in the electrical and mechanical disciplines. The chief program objective is to "Have the technical proficiency in both electrical and mechanical engineering to solve multidisciplinary problems that involve system-level analysis, modeling, and design". This

relatively new program also maintains the Wentworth Institute of Technology's focus on hands-on laboratories with faculty instructors, small class sizes, and work-coop experiences. The program is highly successful placing graduates in industry and graduate programs. More than 35% of all Wentworth Institute of Technology students typically accept permanent employment with their co-op employer[16].

The literature on studies of how or why students chose particular majors suggested, as well as the 121 survey responses suggested, that the responses could be categorized into these three broad characteristics[1]:

I. Characteristic of Fit and Interest. (*Personal fit with, and interest in, the discipline or discipline components of electromechanical engineering.*)

II. Characteristics of the Job. (*The career issues related to electromechanical engineering.*)

III. Characteristics of the Major. (*The nature of the electromechanical program in general or at The Wentworth Institute of Technology.*)

The surveys show 59 students (48.8% of respondents) chose the electromechanical major because of their personnel fit and interest (see Table 1, I Characteristic of Fit and Interest). We interpreted their responses as falling into common reasons such as: a) interest in specific fields: robotics, aeronautics, etc, b) interest generally in electronics and mechanical, c) interest in problem solving, d) interest in how things work, e) interest in inventing and creativity, f) interest in challenges and learning, g) aptitude and fit for electronics & mechanical engineering. An example response to question 2 "State your main reason":

"The fact that I always enjoy learning these concepts is the most important because I always felt that if you enjoy what you do, you will be happy in life. After seeing what engineering is about this semester, I am happy to see I chose this program."

The survey results show 39 students (32.2% of respondents) chose the electromechanical major because of its career related aspects (see Table 1, II Characteristics of the Job). We interpreted their responses as falling into common reasons such as: a) ability to get a job, b) desire to improve the world, c) financial stability and rewards, d) available job opportunities, and e) prestige. An example response to question 2 "State your main reason":

"The education of both an electrical and mechanical engineer is important because you can get into a job with both fields and have an advantage."

The above quote is typical of the 4 respondents who have a perception that they will have both job opportunities in electronics and mechanical engineering giving them a wider choice of jobs. 13 respondents expressed a desire to improve the world. The purely financial aspects of the job

were cited by 14 respondents (ability to get a job) and 7 respondents (financial stability and rewards) for a total of 21 students (17.4% of respondents).

Lastly, the survey results show 21 students (17.4% of respondents) chose the electromechanical major because of the nature of the electromechanical program in general or at Wentworth Institute of Technology (see Table 1, III Characteristic of the Major). We interpreted their responses as falling into common reasons such as: a) major covers multiple disciplines, b) major avoids choosing electrical or mechanical - ambivalent of either discipline, c) major avoids choosing electrical or mechanical - interested in both disciplines, d) major gives synergistic options in career, e) major provides co-op experience, f) major provides learning by teams. An example response to question 2 “State your main reason”:

The fact that I believed electromechanical engineering provides for an endless amount of opportunities was the most important reason because I’ve liked the idea of having many options. With electromechanical engineering, I feel that I’ll never be bored within my career; I’ll most likely find something that is interesting to me and worthwhile to pursue.”

Two of the student responses (1.7% of respondents) provided no identifiable reasons why they chose Electromechanical as their major.

Table 1: Summary of Results

Survey (Number of students)		121	100.0%
I Characteristics of Fit & Interest		59	48.8%
a	Interest in specific fields: robotics, aeronautics, ...	14	11.6%
b	Interest generally in electronics and mechanical	10	8.3%
c	Interest in problem solving	9	7.4%
d	Interest in how things work	9	7.4%
e	Interest in inventing and creativity	7	5.8%
f	Interest in challenges and learning	6	5.0%
g	Aptitude and Fit for electronics & mechanical	4	3.3%

II Characteristics of Job

	39	32.2%
a Financial stability, rewards, and ability to get a job	21	17.4%
b Desire to improve the world	13	10.7%
c Available job opportunities	4	3.3%
d Prestige	1	0.8%

III Multidisciplinary Characteristics of Major

	19	15.7%
a Major covers multidisciplines	7	5.8%
b Major avoids choosing E or M. Ambivalent	5	4.1%
c Major avoids choosing E or M. Interested in both	4	3.3%
d Major gives synergistic options in career	3	2.5%

IV Other Characteristics of Major

Major provides COOP experience	2	1.7%
	1	0.8%
Major provides learning by teams	1	0.8%

V No identifiable reason provided

2	1.7%
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The interpretation of the results, nonetheless, tells us that their personal fit and interest in both the electrical engineering and the mechanical engineering disciplines attest to their interest in how things work, interest in inventing and creativity, and in problem solving as their chief reasons they chose the electromechanical major (48.8%). Less important, we interpret, is the effect of the electromechanical major in the career (32.2%) or the electromechanical major itself (17.4%), although combined are significant reasons for choosing the major (49.6%).

Conclusions

The percentages in parentheses are from the Adams, Pryor, and Adams survey for comparison to our survey[4]. 48.8% (59%) of the respondents expressed a genuine interest in the subject of electromechanical engineering. Even less frequently than stated in the literature, 0.83%(4%) of the respondents reported parental pressure as a strong influence. Similar to the literature, 9.1%(10%) of the respondents reported a relative or relatives in a similar occupation as a strong influence in making their choice. In their survey, Adams, Pryor, and Adams reported that 4% of the respondents indicated parental pressure and 10% indicated their major being similar to their parents' occupations as strong influences on their decision, while the majority, 59%, indicated that genuine interest in the subject strongly influenced their choice[4]. The percentage in parentheses is from the Collins and Giordani survey for comparison to our survey[7]. 17.4%(7%) were strongly influenced by the financial security and rewards for electromechanical engineers.

The largest segment of respondents cited genuine interest in electromechanical engineering as their reason for choosing it as their major (48.8% vs. 59% in the literature)[4]. In the category of fit and interest, interest in specific fields such as robotics and aeronautics with 11.6% is the largest sub-segment. Interest in nonspecific electrical and mechanical engineering with 37.2% shows a demand for an interdisciplinary engineering major. Interestingly, a large segment listed financial aspects as their main reason for choosing the major (17.4% vs. 7% in the literature)[7]. This shows that our Co-op program is an essential and beneficial part of the BELM major. A desire to improve the world with 10.7% could be related to the ethical goal of engineering to serve society by improving the standard of living or to the BELM option of biomedical concentration. The 32.2% segment of students who cited job characteristics might be attracted to the new bachelors of science in mechanical and electrical engineering which are approximately four years rather than five years for BELM and so less expensive. A distinctive feature of the BELM major is its multidisciplinary nature. 13.2% of the respondents were attracted by this particular characteristic. A major which allows students to study a combination of different disciplines might also attract these students. The students were split almost evenly with 5.8% wanting an interdisciplinary major, 4.1% not sure which to choose between a mechanical and an electrical major and 3.3% were interested in both a mechanical and an electrical major. This reflects a desire of some students to keep their options open at least until graduate school or beginning employment.

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