Board 315: Improving Students' Decision-Making Behavior in Choosing an Engineering Pathway

Mr. Debapratim Ghosh, University of Illinois, Urbana - Champaign

Graduate Student in Statistics

Samuel Harford
Prof. Houshang Darabi, The University of Illinois, Chicago

Dr. Houshang Darabi is a Professor of Industrial and Systems Engineering in the Department of Mechanical and Industrial Engineering at the University of Illinois Chicago. Dr. Darabi's research focuses on the use of Big Data, process mining, data mining, Operations Research, high performance computing, and visualization in improving educational systems and students' learning. Dr. Darabi's research has been funded by federal and corporate sponsors including the National Science Foundation, and the National Institute of Occupational Health and Safety.

Prof. Jennifer R. Amos, University of Illinois, Urbana - Champaign

Dr Amos joined the Bioengineering Department at the University of Illinois in 2009 and is currently a Teaching Professor in Bioengineering. She is a AIMBE Fellow, BMES Board of Director Member, ABET Commissioner, two-time Fulbright Specialist in engineering education and has won multiple awards and recognitions for her teaching and scholarship of teaching. Outside of BME, she has also worked to revolutionize the future of graduate medical education serving as a founding member of the new Carle-Illinois College of Medicine, a first-of-its-kind engineering driven college of medicine. Amos is part of the Illinois NSF RED (Revolutionizing Engineering & Computer Science Departments) research team leading efforts to innovate assessment practices for engineering toward producing more holistic engineers. Amos has a decade's worth of experience leading curriculum reform implementing robust assessment strategies at multiple institutions.

Factors Influencing Engineering Students' decision to select an academic major

Introduction

The choice of academic major is a critical juncture in a student's academic and professional journey. Unfortunately, this decision is often plagued by uncertainty and indecision, leading to a higher attrition rate among students who think they have made a definite choice. [1]

Selecting an academic major is a complex process that is influenced by various factors such as personal interests, family and peer pressure, and access to reliable information. The information available to students can be outdated, unreliable, or inaccessible to underrepresented groups, leading to ill-informed decisions. To address these challenges, we must understand engineering students' information-seeking behaviors when making their major selection.

This research paper aims to delve into the academic major selection process among engineering students at two Midwest universities, the University of Illinois at Urbana Champaign and the University of Illinois at Chicago. The goal is to gain a comprehensive understanding of the information sources and decision-making strategies used by these students, with the hope of improving the major selection process for all students.

Theoretical Framework

The study is rooted in the Social Cognitive Career Theory (SCCT), which posits that students' evolving career interests are shaped by their self-efficacy expectations. This theory has been supported by multiple research studies, which have established a positive correlation between self-efficacy and career interests. [2][3][4]. SCCT asserts that self-efficacy acts as a driving force for career choice.

To complement the SCCT framework, the study also utilizes the Cognitive Information Processing (CIP) theory to examine the process of using external information for major selection. CIP combines career problem-solving and decision-making skills and assumes that career decision-making is a problem-solving activity influenced by thoughts and feelings. Unlike a linear, solution-focused approach, CIP views the decision-making process as complex and interdependent on self-awareness and self-regulatory cognitive operations, in addition to major options and information.

Figure 1 shows the proposed dynamic relationship between SCCT and CIP in a student's major decision-making process.

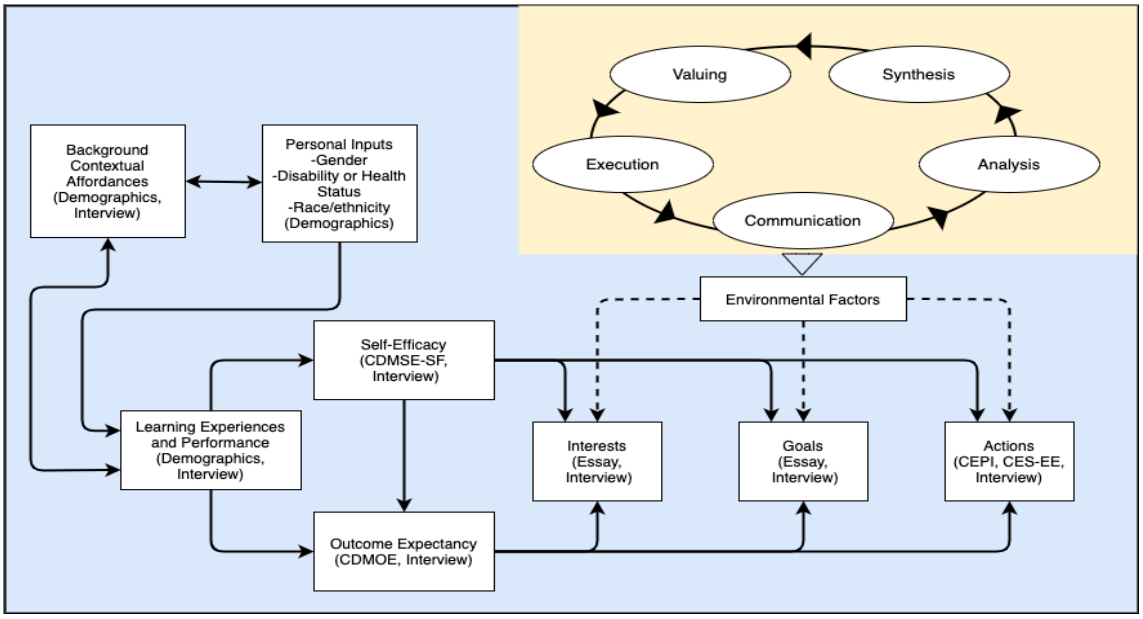

Figure 1: Theoretical framework combining SCCT and CIP. Blue shaded area: Social Cognitive Career Theory choice model (modified from Lent and Brown 2003) showing proposed effect of environmental factors on the relationships in the choice process. Yellow shaded area: CIP decision making processes.

Methods

The study was conducted among students at the University of Illinois at Urbana Champaign (UIUC) and the University of Illinois at Chicago (UIC) who were enrolled in a specific engineering course. The research design was mixed methods[5][6], involving both quantitative and qualitative data collection. The focus was on the impact of cognitive factors (such as self-efficacy) and contextual influences (such as career barriers) on the major decision-making processes of STEM students.

Over 500 participants across both universities participated in the study through an online survey. The survey was based on modified instruments from previous studies, specifically tailored to examine academic major selection, rather than career decision-making.

Survey Instruments

The online survey was developed leveraging 6 different survey instruments: 1) Career Decision Self-Efficacy Scale-Short Form (CDSE-SF) [7][8], 2) Career Decision Making Outcomes Expectation (CDMOE) [9], 3) Career Exploratory Plans or Intentions (CEPI) [10], 4) Career Exploratory Survey: Environmental Exploration (CES-EE) [11], 5) Career Thoughts Inventory (CTI) [12][13].

The Career Decision Self-Efficacy Scale-Short Form (CDSE-SF) [7][8] is a comprehensive survey instrument, consisting of 5 questions that use a 5-point rating scale to gauge an individual's confidence in making informed career decisions. The questions aim to assess the participant's level of introspection regarding their career, their understanding of the impact of their past experiences on their future career prospects, and related topics. By providing insight into an individual's self-belief in making career choices, the CDSE-SF can help them make informed decisions and plan their career path effectively. Example questions include "*How often have you been retrospective in thinking about your career?*", "*How often have you understood the relevance of past behavior for your future career?*" etc.

The Career Decision Making Outcomes Expectation (CDMOE) [9] is a powerful survey instrument that consists of 9 questions. It is designed to measure an individual's beliefs about the long-term outcomes of their educational and career decision-making. The questions are framed in a way that assesses the participant's confidence level in their decision-making process's impact on their future success. A few examples of questions include " *If I spend enough time gathering information about careers, I can learn what I need to know to make a good decision."*, "*If I know my interests and abilities then I will be able to choose a good career.*" etc.

Career Exploratory Plans or Intentions (CEPI) [10] is a survey instrument, consisting of 5 questions that measure an individual's plans and intentions for behaviors critical to their academic major and career decisions. A few examples include "*I intend to spend more time learning about careers than I have been*", "*I plan to talk to advisors and counselors in my college about career opportunities for different majors.*" etc.

Career Exploratory Survey: Environmental Exploration (CES-EE) [11] is a survey instrument that consists of 6 questions. It is designed to measure an individual's level of exploration and engagement concerning different occupations, jobs, and organizations. The questions aim to assess the participant's exposure and experience in the career-related environment. A few examples of questions include "*Went to various career orientation programs.*", "*Initiated conversations with knowledgeable individuals in my career area.*" etc.

And finally, Career Thoughts Inventory (CTI) [12][13] is a survey instrument that consists of 33 questions. It measures an individual's career thoughts and provides insights into any negative thoughts that may be hindering their career decision-making. The questions aim to assess the participant's level of confidence and positivity toward their future career prospects. A few examples of questions include "*There are few jobs that have real meaning*", "*I know so little about the world of work*" etc.

Results

The online survey was distributed to nearly 2,000 students who were part of an introductory engineering orientation program across two universities, UIC and UIUC. A substantial number of over 500 students participated in the survey, and after accounting for missing values, 437 responses were meticulously selected for analysis.

As the survey results did not meet the criteria for normality, non-parametric tests were employed to differentiate between the responses of various groups (Majors, Race, etc.). The non-parametric tests utilized included the Kruskal-Wallis test, which is the non-parametric equivalent of

ANOVA, and the Wilcoxon-Rank-Sum test, which serves as the non-parametric equivalent of a t-test. These tests allowed the researchers to make meaningful conclusions about the survey responses despite the lack of normal distribution.

Below are the results which came out to be statistically significant (p-value <0.05) across underrepresented minorities, across majors, and different student statuses.

Table 1: Results of Significant Survey items for Under-represented minorities

Survey Item: Whenever I become interested in something, important people in my life disagree

URM	count	mean	sd	median	IQR
No	385	2.08	1.06	2	2
Yes	52	1.80	1.02	1	2

Survey Item: Deciding on an occupation is hard, but taking action after making a choice will be harder

URM	count	mean	sd	median	IQR
No	385	3.06	1.13	3	2
Yes	52	2.76	1.19	3	1.25

In the study, students from the ethnicities of "Black or African American," "American Indian or Alaska Native," and "Native Hawaiian or Other Pacific Islander" were consolidated into a single under-represented minority group. The analysis revealed that their responses were statistically significant in three questions across two survey instruments. The first two questions where their responses differed from those of other students were from the Career Thoughts Inventory survey instrument. The third question where the response was found to be statistically different was from the Self Exploration survey. This highlights the importance of considering the unique experiences and perspectives of under-represented minority groups in career development and decision-making.

The next section provides a comparative analysis of the responses of electrical engineering students and those of students from other majors with regards to the Career Environmental Exploration survey instrument. The results of the analysis were obtained by comparing the responses of electrical engineering students with those of students from other majors, on a question-by-question basis. The results revealed that electrical engineering students had a significantly different response to the questions in the Career Environmental Exploration survey. As a result, electrical engineering students were grouped together and compared with the remaining students to identify any differences in their responses.

Table 2: Results of Significant Survey items for Majors

Survey Item: Went to various career orientation programs.

Major Group	**count**	**mean**	**sd**	**median**	**IQR**
Electrical Engineering	29	1.86	1.05	2	1
Other Majors	408	2.50	1.28	2	2

Survey Item: Initiated conversations with knowledgeable individuals in my career area.

Major Group	**count**	**mean**	**sd**	**median**	**IQR**
Electrical Engineering	29	2.17	0.96	2	1

Other Majors	408	3.00	1.25	3	2

Survey Item: Obtained information on the labor market and general job opportunities in my career area.

Major Group	count	mean	sd	median	IQR
Electrical Engineering	29	2.24	1.05	2	2
Other Majors	408	3.01	1.27	3	2

Survey Item: My achievements must surpass my mother's or father's or my brother's or sister's.

Major Group	count	mean	sd	median	IQR
Electrical Engineering	29	3.55	1.40	4	2
Other Majors	408	2.84	1.33	3	2

Table 3: Results of Significant Survey items for Student Status

Survey Item: Obtained information on specific jobs or companies.

Student Status	count	mean	sd	median	IQR
Domestic In State	342	2.78	1.29	3	2
Domestic Out of State	50	3.08	0.85	3	0
International	45	3.46	1.25	4	1

Survey Item: Initiated conversations with knowledgeable individuals in my career area.

Student Status	count	mean	sd	median	IQR
Domestic In State	342	2.84	1.29	3	2
Domestic Out of State	50	3.2	0.94	3	0
International	45	3.4	1.13	4	1

Survey Item: Obtained information on the labor market and general job opportunities in my career area.

Student Status	count	mean	sd	median	IQR
Domestic In State	342	2.87	1.30	3	2
Domestic Out of State	50	3.22	0.88	3	1
International	45	3.35	1.28	4	2

Survey Item: Sought information on specific areas of career interest.

Student Status	count	mean	sd	median	IQR
Domestic In State	342	1.84	1.03	1	2
Domestic Out of State	50	2.12	0.89	2	0
International	45	2.17	1.02	2	2

Discussion and Future Work

Based on the findings from the analysis, it can be concluded that under-represented minority groups hold a more positive and confident outlook towards their career prospects, as evidenced by their significantly lower negative career thoughts and higher level of self-exploration.

Additionally, the results indicate that electrical engineering students tend to be less proactive in exploring their career environment, potentially due to the lack of readily available resources for informed decision-making.

Furthermore, we can also observe that Domestic in-State students have less inclination to explore different resources for making a career choice.

To gain a deeper understanding of the challenges students face in selecting a major, it would be beneficial to conduct in-depth interviews with a diverse range of students who participated in the survey. The findings from these interviews could be used to identify common themes and experiences in the major selection process.

To support informed decision-making and improve student success and satisfaction, these insights can be used to develop a comprehensive platform that allows students to evaluate and compare different majors based on their personal preferences. The effectiveness of this platform can then be evaluated through a randomized field experiment, to determine its impact on student outcomes.

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