

The ECSEL Program: An Effort to Increase Diversity in STEM Fields in Higher Education

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1. Abstract

The underrepresentation of women and people of color in engineering colleges has long been identified in vocational psychology (e.g., Lent et al., 2005). The poster presents initial analyses of one multidisciplinary effort funded by the National Science Foundation (NSF Grant #1565130) to recruit, retain, and develop leadership skills in underrepresented students in the electrical, computer, and software engineering (ECSE) departments at one large Midwestern university by offering scholarships and programming. These data are from 37 currently students. Self-determination theory (SDT; Deci & Ryan, 1985) posits that basic psychological needs (autonomy, competence, and relatedness) mediate the relationship of barriers and career well-being operationalized as major satisfaction and subjective career distress. Preliminary review of quantitative analyses show volitional autonomy predicted both indices of career well-being while barriers predicted only subjective career distress. Qualitative data expressed by some of these students highlight themes identifying barriers and the value of relatedness.

2. Introduction

- Women and people of color have been historically underrepresented in the university departments of electrical, computer, and software engineering (ECSE) as women hold only 19% of the degrees awarded in these fields (National Science Board, 2018).
- To increase diversity in these fields, Iowa State University's Electrical, Computer, and Software Engineers as Leaders (ECSEL) program provides funding and access to learning communities, professional development, and leadership opportunities.
- The authors were interested in the relationship between environmental barriers for these scholars and their career well-being.
- Self-determination theory (SDT; Deci & Ryan, 1985) posits basic psychological needs that can be used to understand students' major satisfaction, including:
 - Volitional autonomy: the perceived ability to act according to one's own agenda
 - Relatedness: the need to feel a sense of connection and belongingness with others

3. Hypothesis

- Consistent with SDT, the authors expected fulfillment of these basic psychological needs to contribute to higher levels of career well-being and lower levels of subjective career distress among the ECSEL scholars despite the presence of environmental barriers.
- The authors expected this pattern to be supported by quantitative data collected from scholars as well as qualitative interviews and journal entries.

4. Method

Quantitative Analysis

- **Participants (N=37)**
 - Undergraduates at Iowa State University enrolled in the ECSEL program
 - Age: $\bar{M} = 20.68$, $SD = 2.94$
 - Gender: 34 females, 3 males
- **Measures**
 - Balanced Measure of Psychological Needs (BMPN; Sheldon & Hilpert, 2012)
 - 3 six-item subscales pertaining to the SDT needs (i.e., autonomy, competence, and relatedness)
 - Five-point Likert items
 - Higher scores indicate greater fulfillment of the SDT needs
 - Environmental barriers
 - 23 5-point Likert items taken from Engineering Fields Questionnaire (Lent, Brown, Nota, & Soresi, 2003)
 - Higher scores reflect greater perceived levels of environmental barriers
 - Academic Major Satisfaction Scale (AMSS; Nauta, 2007)
 - 6 5-point Likert items
 - Higher scores indicated greater satisfaction with major
 - Coping with Career Indecision (Larson, Toulouse, Ngumba, Fitzpatrick, & Heppner, 1994)
 - 21 six-point Likert items
 - Higher scores reflected more subjective career distress
- **Statistical Analysis**
 - Descriptive statistics, correlation coefficients, and multiple regression analyses were calculated using SPSS 24
 - Academic major satisfaction and subjective career distress were used as dependent variables

Qualitative Analysis

- **Participants (N=28)**
 - Undergraduate students enrolled in the ECSEL program
 - All women
- **Measures**
 - Participants completed 90-minute individual interviews with study personnel and were asked to keep reflective journals
 - Interviews were transcribed verbatim for analysis
 - On a bi-monthly basis, participants given 4-5 questions around which to structure their journals
- **Analysis**
 - Used a phenomenological analysis approach (Moustakas, 1994)
 - Used transcripts and journals to identify meaning units created by students and integrated them with essence of the phenomenon

5. Results

Table 1. Regression Results for Variables Predicting Academic Major Satisfaction (N=38)

Variable	Academic Major Satisfaction					
	<i>B</i>	<i>SE B</i>	β	<i>R</i> ²	<i>Adj. R</i> ²	<i>F</i>
<i>Model Characteristics</i>						
Volitional Autonomy	.20	.07	.44*	.27	.22	5.39**
Environmental Barriers	-.09	.08	-.20			

Note. * $p < .05$. ** $p < .01$.

Table 2. Regression Results for Variables Predicting Subjective Career Distress (N=38)

Variable	Subjective Career Distress					
	<i>B</i>	<i>SE B</i>	β	<i>R</i> ²	<i>Adj. R</i> ²	<i>F</i>
<i>Model Characteristics</i>						
Volitional Autonomy	-.63	.16	-.54**	.47	.43	12.21**
Environmental Barriers	.32	.15	-.31*			

Note. * $p < .05$. ** $p < .01$.

Relevant Qualitative Themes

1. Scholars report feeling more connected to faculty and peers as a result of the program's engagement activities, systematic meetings, and dedicated physical space.
 - "It's also been nice to have a connection with some of the faculty...I think it's getting better now that they've added the faculty mentor meetings...having relationships to professors and faculty has been so beneficial to my opportunities thus far."
2. Scholars' relationships with male classmates are strained/inhospitable.
 - "At this point I didn't feel like an engineer. I was worried that I was going to have to deal with these guys who thought that I was just another girl who has everything handed to her."
3. Scholars report feeling isolated or receiving condescending responses due to their identities.
 - "This guy who thought he was hilarious was like 'I don't even know what XX is working on. But she's been working on it for a long time' which also annoyed me."

6. Conclusions

- Fulfillment of one's need for autonomy positively related to academic major satisfaction while dissatisfaction with autonomy was related to more career distress.
- Per scholar report, the ECSEL program contributes to heightened feelings of relatedness with peers and faculty in the ECSE departments.
- Scholars report a lack of relatedness leads to dissatisfaction with major.
- SDT needs appear to be useful in conceptualizing the relationship between the learning environment and academic major satisfaction as well as subjective career distress among underrepresented students in ECSE.