

Research Brief

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Competence in Engineering: A Tale of Two Women

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Who persists in science, technology, engineering and math (STEM) fields? Looking for ways to increase persistence rates, we frequently look for the characteristics that differentiate persisters and non-persisters. However, the choice to persist may not be as binary as these two terms would imply. The research reported here begins to unravel the complexities of persistence by looking at the choice to be an engineer as a process which extends over time and involves continual motivated decisions. Additionally, using primarily interview data, this research looks at the choice to be an engineer from the student perspective.

Implications of Findings

A lesson for engineering education practitioners, based on the findings in this paper, is that some female engineering students, and perhaps some students in general, need on-going help to bridge the gap between their classroom learning and their perception of the skills needed to practice engineering. Proper interventions could help them build useful definitions of success against which to more accurately gauge their ability. Since self-assessment of ability beliefs is a continuing process, positive competence beliefs must also be promoted in a longitudinal process.

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Methods and Background

This current study builds on and expands a previous study (Matusovich et al.) by examining an additional six participants and focusing on similar research questions. Since qualitative research can be used to generalize to a theory, increasing participant numbers increases potential generalizability. In the previous work, Matusovich et al. asked, How do students characterize success in their given engineering field? How do these characterizations develop and change with time? Do students believe they have these characteristics that they define as important to success? The current study starts with the broader question, What are student's engineering-related ability beliefs and how do they change over the undergraduate years? How do these beliefs contribute to persistence choices? Although the original focus of the study including ten participants was not to identify differences between genders, gender-related patterns emerged that could have implications for further research, for engineering education practitioners, and for students.

This research is framed in Eccles' expectancy-value theory. Eccles' theory suggests that choices to engage or persist in activities, such as becoming an engineer, are based on an individual's beliefs about 1) his or her ability with regard to that activity, and 2) how important that activity is to him or her. This study focuses on ability beliefs.

This research incorporates data from multiple methods with each participant representing an individual case study. Cases were examined both individually and collectively. The primary data source included interviews collected over a four year period with the same participants. The interview data was triangulated with Persistence In Engineering (PIE) survey data for the same participants. This study is part of a larger body of work, the Academic Pathways Study (APS), conducted by the NSF-funded Center for Advancement of Engineering Education (CAEE). Data collection strategies have been previously described for APS and specifically for Technical Public Institution (TPub, pseudonym). Consequently, methods described herein relate specifically to the ten cases analyzed as part of this study.

What We Found

Based on the data analysis, two assertions can be made. First, women with consistently high grades can still doubt their engineering ability and have uncertainty about practicing engineering. Second, as part of the process of choosing to persist or not, some women redefine what it means to be an engineer to match their perceived abilities. The evidence for these assertions is provided in detail in the full text of this paper (see link below). Results focus on “Anna” and “Leslie” because they show the most complex patterns in their continued choice to stay in engineering. However, their results are presented in the context of all ten participants. Although this study was not conceived as a means to look at differences in how men and women experience the persistence process, gendered patterns emerged and are reported as such.

All of the women had higher cumulative GPAs than the men. Of the five women participants, two are uncertain about what engineers do for career work. Two women express doubts about their engineering skills. Of the five men in this study, only Tim remains uncertain about what engineering is and he, like the other men in the study, was confident in his ability. These findings suggest women trail men in perceived engineering-related ability despite receiving better grades than the men.

These results are consistent with prior research related to gender differences in competence beliefs and measured competence in STEM fields which generally show women feeling less competent but not having lower course grades than men . The current research also supports Sax’s suggestion that competence, as measured by grades, does not relate directly to self-assessments of ability. Finally, this research is also consistent with the finding that “college grades may well be the single best predictor of student persistence, degree completion, and graduate school enrollment.”

What is new about these findings is the longitudinal aspect of negotiating engineering-related competence beliefs exemplified by two of the participants. Related findings by Pascarella and Terenzini show declines in academic self-concept (a perception of current competence) in the first year of college followed by a general increase. However, they report no mechanism or causality. This current study contributes evidence towards a mechanism of change in self-perceptions of ability during college, including changing definitions of ability . During the four years, Anna and Leslie evaluated their competence and regularly adjusted their definitions of what it meant to be successful. Although confident in their classroom learning, these two women doubted their engineering abilities.