Social Models and Engineering Self-Efficacy: What Engineers Do You Know?

Self-efficacy can be described as the perception of one’s abilities to accomplish a particular task and has been found to be predictive of students’ effort and achievement in various educational settings (Bandura, 1997; Zimmerman, 2000). Bandura (1997) hypothesized that self-efficacy develops from four sources: mastery experience, vicarious experience, social persuasions, and physiological and affective states. Vicarious experiences take place when people observe the actions of others and then evaluate themselves (Bandura, 1997). Intervention studies have shown that social models (a type of vicarious experience) can increase students’ academic self-efficacy (Bartsch, Cade, & Meerham, 2012). However, few known studies have investigated the influence of social models on students’ self-efficacy in depth, especially in the domain of engineering. Therefore, this study aimed to explore students’ prior exposure to social models in engineering and how these different social models relate to the students’ engineering self-efficacy. As self-efficacy can be measured in varying levels of specificity (Bandura, 1997), this study also aimed to observe any differences in more specific engineering skills self-efficacy.

Method

First-year undergraduate engineering students ($N = 594$; 467 men, 127 women) from a research-intensive university in the southeastern United States completed an online survey developed to assess their engineering self-efficacy, as well as their exposure to social models and/or experiences related to engineering during the fall of 2013. Students reported their race/ethnicity as predominantly White (82.3%).

General Engineering Self-Efficacy was assessed as students’ perceptions of their abilities in their current engineering course (5 items; $\alpha = .91$; e.g. “I can master the content in the engineering-related courses I am taking this semester.”; Mamaril et al., in press). A Skill Specific
Engineering Self-Efficacy scale (Mamaril et al., in press) was used to measure three types of skills self-efficacy: research skills self-efficacy (4 items; $\alpha = .83$; e.g. “I can perform experiments independently.”), tinkering skills self-efficacy (4 items; $\alpha = .86$; e.g. “I can work with machines.”), and engineering design self-efficacy (4 items; $\alpha = .91$; e.g. “I can develop design solutions.”). All four measures of self-efficacy used a 6-point Likert response format ranging from 1 (Completely Uncertain) to 6 (Completely Certain). Mean levels of engineering self-efficacy were calculated.

Students were also asked to report their exposure to social model types prior to college. They were asked to “check all that apply,” with options including having a parent, family member, and friend who is an engineer. An exposure score was then created on a 0 to 3 scale by tallying their exposure to social models. For example, a student having none of these social model types would have an exposure score of “0,” whereas a student with a parent and a family member who are engineers would have an exposure score of “2.”

A descriptive analysis was used to determine the prevalence of social models among our sample. Independent $t$ tests were conducted to examine mean differences in domain-general and skill-specific engineering self-efficacy reported by students who have a parent, family member, or friend as engineers and those who do not. Correlations were conducted to examine the relationship between different engineering efficacy beliefs and the number of social model types that students reported being exposed to.

**Results**

Descriptive analyses showed that 18.2% of students surveyed have a parent who is an engineer, 43.6% of students have a family member who is an engineer, and 23.6% of students have a friend who is an engineer.
We found no significant difference in mean levels of general engineering self-efficacy between students with or without each type of social model. However, there were significant differences in specific engineering self-efficacy levels. Students whose parent is an engineer were found to have higher self-efficacy with design skills in engineering compared to those without parents who are engineers, \( t(593) = -2.62, p = .01 \). Those with family members who are engineers had a higher sense of tinkering skills self-efficacy than those without, \( t(593) = -2.17, p = .03 \). Moreover, those with friends who are engineers reported a higher sense of research, tinkering, and design skills self-efficacy than did those without friends who are engineers, \( t(536) = -2.49, p = .01 \), \( t(536) = -2.14, p = .03 \), and \( t(536) = -2.47, p = .01 \), respectively.

Significant positive relationships were found between exposure scores (number of social model types) and self-efficacy in research skills, \( r = .10 \), tinkering skills, \( r = .12 \), and design skills, \( r = .14 \). There was no significant correlation between the exposure scores and general engineering self-efficacy.

**Discussion**

These findings suggest that social models may have some influence on more specific levels of individuals’ engineering self-efficacy (i.e., research, tinkering, and design skills self-efficacy), but not on the individuals’ domain-general engineering self-efficacy levels. Implications should be addressed concerning the study’s deficits before making further conclusions, as the current study did not address the nature (e.g., importance, perceived similarity) of the relationship between the students and their friend, family member, or parent engineers. Researchers should next investigate whether the manner in which students perceive the social models around them may be more influential as a source of self-efficacy (Bandura, 1997; Usher & Pajares, 2008).
References


