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Research Note

Dominican Female Undergraduate Engineering Students: Experiences and Self-Efficacy Enhancement

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According to the Dominican Republic's Ministry of Higher Education, Science and Technology, during the 2013-2014 academic year, women accounted for only 35% of the students enrolled in engineering undergraduate degrees. The underrepresentation of women in science, technology, engineering, and mathematics (STEM) (Cheryan, Ziegler, Montoya, & Jiang, 2016; Edzie, 2014; Hutchinson, Follman, & Bodner, 2008; Newman, 2017; Rudroff 2007) has become has become an important subject of study over the last decade or so. Diverse lenses, such as self-efficacy beliefs, have been used to explore the persistence of women in STEM fields (Grunert, 2013; Newman, 2017). The beliefs women have about their capabilities are important (Bandura, 1997; Zeldin & Pajares, 2000), since self-efficacy has been found to be an influential factor in their success in these programs (Aryee, 2017; Hutchinson, Follman, & Bodner, 2008; Edzie, 2014). Women who left STEM programs were less confident in their ability in these areas of knowledge compared to those that persisted (Hutchinson, Follman, Sumpter, & Bodner, 2006). Nevertheless, in-depth descriptions of self-efficacy development of women in STEM fields are scarce in the literature. In the context of Dominican students, there is an absence of research that explores women in these programs. For this reason, the purpose of this qualitative study was to better understand the contributions made by self-efficacy sources to the development of self-efficacy beliefs and the persistence of female undergraduate engineering students.

Theoretical Framework

Self-efficacy is "the belief in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3) and can be weakened or enhanced through enactive mastery experiences, vicarious experiences, verbal persuasions, and physiological states.

Method

Interviews with ten female undergraduate students took place at a four-year college in the Dominican Republic that specializes in engineering programs. The women were in the last year of their programs of study. Undergraduate student enrollment at this institution was approximately 5,000; of this 1,816 were registered in engineering programs. Of those students, 416 (23%) were women.

Table 1

Demographic Characteristics of Participants

Participant Pseudonym	Age	Major
Lucia	20	Industrial engineering
Laura	21	Software engineering
Cinderella	20	Industrial engineering
Aileen	20	Industrial engineering
Maria	22	Industrial engineering
Juana	21	Software engineering
Camilla	20	Civil engineering
Chantal	22	Industrial engineering
Sarah	21	Civil engineering
Marie	22	Mechatronic engineering

Data Collection

Semi-structured interviews took take place with available participants who chose their pseudonyms. The interview protocol looked at self-efficacy in the context of female undergraduate students. The semi-structured nature of the interviews allowed for flexibility when exploring each of the sources of self-efficacy (Bernard, 2006; Brinkmann & Kvale, 2015).

Data Analysis

Data was coded in first cycle which consisted of aligning question responses with self-efficacy theory and each question in the interview protocol. The purpose of this coding cycle was to summarize segments of data from each of the interview transcripts and allow for any additional codes that emerged be included in subsequent coding cycles. After the first cycle, data summaries were grouped into smaller number of themes through pattern coding (Saldana, 2016). The purpose of pattern coding was to advance the reorganization of the data from the initial cycle. This meant developing a coherent summary of the data across interviews.

Results

Female Dominican undergraduate engineering students' self-efficacy were enhanced through verbal persuasions, vicarious experiences, and enactive mastery experiences, which ultimately contributed to persistence in their programs of study.

Verbal Persuasions

Verbal persuasions were essential for the students' self-efficacy development and persistence within their degrees. For example, Juana emphasized the importance of constant messages throughout her degree:

> One thing that boosted my beliefs in being successful in engineering was that my parents would always tell me that I could do it, that I could pursue any degree that I wanted and that I was going to be good at it [translation the respondent's]

Other students indicated that when they were faced with academic hurdles, having others express confidence in their capabilities was essential. As Cinderella described,

> I had several crises where I would say that I couldn't do it anymore. I have to change degrees, maybe go into a business degree. I would cry and get depressed. My parents would tell me that I couldn't give up, to dedicate more time and effort [to my studies], and things would be alright [translation the respondent's]

Vicarious Experiences

Students' descriptions emphasized the combination of positive messages, being guided, learning, and comparing themselves to others. Laura described the importance of being provided with positive messages and being guided by one of her friends during her academic struggles:

> In one of my classes I did poorly and that depressed me. I remember that my male friends motivated and supported me. They would often tell me that I could anything that I wished. He [referring to one of her friends] would constantly get together with me during my free time between classes and tell me that I could achieve any goal I would propose for myself. He would make me do school related exercises and would correct them afterwards telling me what was correct or not [translation the respondent's]

Other students mentioned how comparing and aspiring to be like their role models would influence their beliefs in their capabilities, as Sarah shared:

> During my degree, I met other student's parents; on one occasion, the mother of one of them visited my home. This lady was a successful engineer. During other opportunities I met several other women engineers that were successful. It was inspirational to meet women in engineering. I would tell myself if they did well, why couldn't I do the same? I could be the same, or even more successful [translation the respondent's]

Enactive Mastery Experiences

During challenges, students would often rely on previous experiences to boost their beliefs in their capabilities. For example, Marie mentioned

> When I was in high school, I participated in a countrywide science olympiad. I was very nervous because I doubted my success in it. Either way I studied and prepared. In the end I came in fifth place. I took the same stance with my engineering degree. There was a lot I didn't know when coming into to my degree, but I decided to do the same I did back then [translation the respondent's].

Discussion and Conclusion

Consistent with previous research in other contexts, the underrepresentation of women in STEM disciplines (Cheryan et al., 2016; Edzie, 2014; Hutchinson, Follman, & Bodner, 2008; Newman, 2017; Rudroff 2007) is evident in the Dominican Republic as well. Because women's self-efficacy beliefs are important in their persistence in completing their degrees (Aryee, 2017; Grunert, 2013; Hutchinson, Follman, & Bodner, 2008; Hutchinson, Follman, Sumpter, & Bodner, 2006; Edzie, 2014; Newman, 2017; Zeldin & Pajares, 2000), this study's purpose was to better understand the contributions made by self-efficacy sources to the development of self-efficacy beliefs and persistence of these students. Undergraduate female engineering students' experiences have practical implications. When female students are dealing with barriers in their academic programs, institutional efforts might focus on three things: a) they could give students verbal affirmations of their skills, b) they could provide students guidance on how to create lasting experiences and c) remind students about their talents and positive past events to give them confidence when they are facing challenges.

References

Aryee, M. (2017). College students' persistence and degree completion in science, technology, engineering, and mathematics (STEM): The role of non-cognitive attributes of self-efficacy, outcome expectations, and interest. (Unpublished doctoral dissertation). Seton Hall University, South Orange, NJ.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: W. H. Freeman.

Bernard, H. (2006). *Research methods in anthropology: Qualitative and quantitative approaches*. Lanham, MD: Altamira Press.

Brinkmann, S., & Kvale, S. (2015). *Interviews: Learning the craft of qualitative research interviewing* (3rd ed.). Thousand Oaks, CA: SAGE.

Cheryan, S., Ziegler, S., Montoya, A. K., & Jiang, L. (2016). Why are some STEM fields more gender balanced than others? *Psychological Bulletin, 143*(1), 1-35.

Edzie, R. L. (2014). *Exploring the factors that influence and motivate female students to enroll and persist in collegiate STEM degree programs: A mixed methods study*. (Unpublished doctoral dissertation). University of Nebraska, Lincoln, NB.

Grunert, L. M., & Bodner, M. G. (2013). Pedagogical environments in chemistry: Effects on women's self-efficacy beliefs. *ASQ: Advancing the STEM agenda*. Grand Rapids, MI. Retrieved from https://www.researchgate.net/publication/277011580

Hutchison, M. A., Follman, D. K., Sumpter, M., & Bodner, G. M. (2006). Factors influencing the self-efficacy beliefs of first-year engineering students. *Journal of Engineering Education, 95*(1), 39-47.

Hutchison, M. A., Follman, D. K., & Bodner, G. M. (2008). Providing a voice: Qualitative investigation of the impact of a first-year engineering experience on students' efficacy beliefs. *Journal of Engineering Education, 97*(2), 177-190.

Newman, J. M. (2017). *Self-efficacy beliefs, stereotype threat, and the learning environment as influences in the decision to leave a STEM major*. (Unpublished doctoral dissertation). California State University, Stanislaus, CA.

Rudroff, A. F. (2007). *Success in the sciences: Potential influences of sex role conflict, self-efficacy, and role modeling on women's career aspirations*. (Unpublished doctoral dissertation). Iowa State University, Ames, IA.

Saldana, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Thousand Oaks, CA: SAGE.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37*(1), 215-246.

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