

Chapter 75

Barriers to a STEM Career: Math Anxiety and the Adult Female

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ABSTRACT

Inequality of gender representation in science, technology, engineering, and mathematics (STEM) careers continues, despite the narrowing of the gender achievement gap. This chapter showcases original qualitative research that provides clearer insights into origins and effects of math anxiety as the reason females are less likely to choose (STEM) majors and related careers. The role of instruction methodology of the academic organization in perpetuating marginalization practices limits women's STEM achievement. The stage environment fit (SEF) theoretical model probes the relationship of the policies and procedures of the academic organization to the likelihood of female adult-student success in higher education. The American Statistical Association's (ASA) funding of the Guidelines for Assessment and Instruction in Statistics Education Report (GAISE) mandates reforms for mathematics instruction among the information about new research opportunities and the current state of STEM education in the United States.

INTRODUCTION

In a U.S. Congress Joint Economic Committee Report entitled *STEM Education: Preparing for the Jobs of the Future*, Senator Robert Casey (D-PA), committee chairman, noted that the United States is “failing to produce an ample supply of workers to meet the growing needs of STEM employers” (Casey, 2012, p. 3). The report states that for the United States to remain competitive in the global marketplace, prospective employees will require the core competencies found in college and university graduates with STEM degrees (Casey, 2012, p. 4). However, despite the growth and demand in STEM-related job opportunities that the U.S. Department of Labor Statistics reports, graduation rates for STEM disciplines remain stagnant, especially compared to the creation of STEM professionals in other nations (Doerschuk et al., 2016, Jones et. al., 2018). The shortage of skilled workers in U.S. STEM professions is attributed to the

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underrepresentation of females and other marginalized groups among STEM majors and those applying for STEM careers after graduation (Davison, Jew, & Davenport, 2014; Ing, 2014; Ortiz & Sriraman, 2015; Doerschuk et.al., 2016). Current statistics cite that approximately 40% of all students who enter into a higher education STEM degree program will actually graduate (Stanberry, 2018).

Although 21st-century global research has reported a significant narrowing of the gender divide in STEM course achievement, societal influences still favor males in fostering understanding of STEM concepts, sustained by academic organizational policies and educational practices (Williams, 2013; Ceci, 2018). The theory of a gender divide has been widely disproved, yet research studies confirm that women globally continue to encounter dysfunctional beliefs and gender stereotyping that ultimately contribute to lower self-esteem and negative self-efficacy beliefs among females (Kapitanoff & Pandey, 2017). Exposed to negative societal and academic perceptions, many females will also suffer from math anxiety, a psychological reaction that results in diminished learning capacity, especially when women engage in the complex subjects found in the STEM curriculum (Ashcraft, 2002; Ashcraft & Kirk, 2001, p. 226). Females are more susceptible than males to math anxiety, since its origins are linked to gender bias that favors males. Such bias is perpetrated during early childhood, reinforced through elementary and secondary education, and affects perceptions of learning ability, especially when students are confronted during higher education with complex course content (Finlayson, 2014). Widespread research outcomes have linked societal beliefs, academic context, and math anxiety to self-defeating behaviors, poor performance, and academic failure of females (Ashcraft, 2002; Kapitanoff & Pandey, 2017). As a result, females experiencing negative influences and math anxiety will avoid college majors—especially in the STEM field—where they have a greater risk of failure (Rinn, Miner, & Taylor, 2013; Sass, 2015).

This chapter has three objectives that will provide greater insights into the root cause of lack of female representation in STEM coursework and occupations. These objectives focus on new perceptions based on qualitative research results into math anxiety as a barrier to degree attainment; the role of the academic organization in supporting achievement and its failure to do so; and recognition of the need for reform by the American Statistical Association (ASA), the guidelines provided, and the measurement of success in adoption of new practices to support degree attainment.

First, the chapter explores original research from an in-depth case study with marginalized adult females pursuing their higher-education degrees in a large urban university in the northeast region of the United States. Interviews with this population, their instructors, and college administrators, followed by qualitative data analysis, survey data analysis, and interviews document the origins and definition of female marginalization, and the onset of math anxiety due to influences of society and the environment in one institution. The chapter highlights the findings of behavioral researchers, which validate math anxiety as a “bona fide and phobic reaction to mathematics” (Ashcraft, 2002, p. 184), especially for females who exhibit low self-confidence in mathematics courses mainly because of societal pressures that create gender disparity, in this case related to knowledge of concepts found in STEM coursework. This social domination begins in early childhood and extends through elementary, secondary, and higher education. It contributes to the development of a flawed personal and academic identity, due to the perpetuation of dysfunctional beliefs that tout male superiority in mathematics, and stereotyping that convinces females to conform to negative behavioral interpretations proposed by the stereotype (stereotype threat) (Galdi, Cadinu, & Tomasello, 2014; Flore & Wicherts, 2015, p. 25).

The chapter’s second objective is to focus on how the policies and procedures of the academic organization that emphasizes traditionalist teaching methodologies exacerbate negative societal and environmental influences. Prior research supports the Stage Environment Fit (SEF) theory as a model

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