Chapter 30
Examining the Links Between Affect Toward 3D Printing Technology and Interest in STEM Careers Among Female Elementary Students

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ABSTRACT

Despite the exponential growth in STEM-related jobs, there is an acute shortage of people choosing to pursue STEM-related studies and careers. Compared with men, women are underrepresented in STEM-related courses and careers. The chapter, therefore, examined the associations of perceived usefulness of 3D printing technology, self-concept in using 3D printing technology, and interest in and enjoyment of using 3D printing technology with interest in science-, math-, and technology-related careers among 276 female elementary students enrolled in public schools in Abu Dhabi, United Arab Emirates. The results of path analyses after accounting for student demographic characteristics, revealed that perceived usefulness of 3D printing technology, self-concept in using 3D printing technology, and interest in and enjoyment of using 3D printing technology were significantly and positively related to interest in science-, math-, and technology-related careers among female elementary students. Implications of the findings for policy and practice are discussed.

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INTRODUCTION

The alarming underrepresentation of girls and women in science, technology, engineering, and mathematics (STEM) education and STEM-related careers is a major concern for countries across the globe (Organization for Economic Cooperation and Development [OECD], 2017; United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2017). Globally, only 31% of females chose to pursue STEM-related fields of study (UNESCO, 2017). Of these females, 3% were enrolled in information, communication, and technology (ICT), 5% in natural science, mathematics, and statistics, 8% in engineering, manufacturing, and construction, and 15% in health and welfare studies (UNESCO, 2017). However, the global average enrolment rate for females in STEM-related fields of study often mask the glaring regional and country differences in enrolment rates for females in these fields of study (UNESCO, 2017). For example, the proportion of females enrolled in ICT; natural science, mathematics, and statistics; engineering, manufacturing, and construction; and health and welfare studies varies tremendously across countries, from 9% in Netherlands to 74% in Sweden, 18% in Côte d'Ivoire to 86% in Bahrain, 11% in Mauritania to 47% in Brunei Darussalam, and 36% in Liechtenstein to 90% in Bermuda, respectively (UNESCO Institute for Statistics, 2015). Moreover, what is more alarming is the higher STEM attrition rates among female students, i.e., the probability of leaving STEM-related fields of study by switching majors (see Chen, 2013).

Given the dwindling numbers of girls and women choosing to study STEM-related subjects and choosing to pursue STEM-related careers, a growing body of research has examined the relations of a wide array of factors to girls' and women's underrepresentation in STEM fields. Factors attributed to the underrepresentation of girls and women in STEM fields can be broadly classified into four categories: individual-level factors, family- and peer-level factors, school-level factors, and societal-level factors (UNESCO, 2017). Individual-level factors include both biological and psychological factors (UNESCO, 2017), such as differences in cognitive abilities, including differences in spatial abilities (e.g., Reilly, Neumann, & Andrews, 2017a) and math and science reasoning (e.g., Lakin, 2013; Makel, Wai, Peairs, & Putallaz, 2016; Wai, Cacchio, Putallaz, & Makel, 2010); gender gaps in academic self-efficacy (e.g., Cheryan, Ziegler, Montoya, & Jiang, 2017; Heilbronner, 2013; MacPhee, Farro, & Canetto, 2013; Moakler & Kim, 2014; Reilly, Neumann, & Andrews, 2017b; Wang, Chan, Soffa, & Nachman, 2017), academic self-concept (e.g., Ackerman, Kanfer, & Beier, 2013), interest (e.g., Charles, 2017; Holmes, Gore, Smith, & Lloyd, 2017; Sadler, Sonnert, Hazari, & Tai, 2012; Su, Rounds, & Armstrong, 2009; Su & Rounds, 2015; Valla & Ceci, 2014), and motivation (see Moè, 2016; Wang & Degol, 2013); lack of female, relatable role models (e.g., Cheryan et al., 2017; Drury, Siy, & Cheryan, 2011; Herrmann, Adelman, Bodford, Graudejus, Okun, & Kwan, 2016; Stout, Dasgupta, Hunsinger, & McManus, 2011; Young, Rudman, Buettner, & McLean, 2013); women's effort expenditure perceptions (e.g., Smith, Lewis, Hawthorne, & Hodges, 2013), perceived identity compatibility (e.g., Rosenthal, London, Levy & Lobel, 2011), communal-goal endorsement and occupational as well as lifestyle preferences (e.g., Ceci, Williams, & Barnett, 2009; Diekman, Brown, Johnston, & Clark, 2010; Robertson, Smeets, Lubinski, & Benbow, 2010), and insufficient early educational experiences in some STEM fields (e.g., Cheryan et al., 2017; Young, Young, & Ford, 2017).

Family- and peer-level factors found hindering girls' and women's participation in STEM fields comprise parents' levels of educational and occupational attainment (e.g., Moakler & Kim, 2014; Sonnert, 2009, Xu, 2016), family income (e.g., Xu, 2016), lack of parental support (e.g., Buschor, Berweger, Keck Frei, & Kappler, 2014), child-rearing responsibilities (e.g., Kahn & Ginther, 2015), and exposure