

Effectiveness of an Intervention to Increase Physics Students' STEM Self-Efficacy: Results of a Quasi-Experimental Study

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Abstract : Increasing the number of US university students who attain degrees in STEM and enter the STEM workforce is a national priority. Demographic groups vary in their rates of participation in STEM, and the US produces just 10% of the world's science and engineering degrees (2014 figures). To address these gaps, we have developed and tested a practical, 30-minute, single-session classroom-based intervention to improve students' self-efficacy and academic performance in University STEM courses. Self-efficacy is a psychosocial construct that strongly correlates with academic success. Self-efficacy is a construct that is internal and relates to the social, emotional, and psychological aspects of student motivation and performance. A compelling body of research demonstrates that university students' self-efficacy beliefs are strongly related to their selection of STEM as a major, aspirations for STEM-related careers, and persistence in science. The development of an intervention to increase students' self-efficacy is motivated by research showing that short, social-psychological interventions in education can lead to large gains in student achievement. Our intervention addresses STEM self-efficacy via two strong, but previously separate, lines of research into attitudinal/affect variables that influence student success. The first is 'attributional retraining,' in which students learn to attribute their successes and failures to internal rather than external factors. The second is 'mindset' about fixed vs. growable intelligence, in which students learn that the brain remains plastic throughout life and that they can, with conscious effort and attention to thinking skills and strategies, become smarter. Extant interventions for both of these constructs have significantly increased academic performance in the classroom. We developed a 34-item questionnaire (Likert scale) to measure STEM Self-efficacy, Perceived Academic Control, and Growth Mindset in a University STEM context, and validated it with exploratory factor analysis, Rasch analysis, and multi-trait multi-method comparison to coded interviews. Four iterations of our 42-week research protocol were conducted across two academic years (2017-2018) at three different Universities in North Carolina, USA (UNC-G, NC A&T SU, and NCSU) with varied student demographics. We utilized a quasi-experimental prospective multiple-group time series research design with both experimental and control groups, and we are employing linear modeling to estimate the impact of the intervention on Self-Efficacy, with-Mindset, Perceived Academic Control, and final course grades (performance measure). Preliminary results indicate statistically significant effects of treatment vs. control on Self-Efficacy, Growth-Mindset, Perceived Academic Control. Analyses are ongoing and final results pending. This intervention may have the potential to increase student success in the STEM classroom—and ownership of that success—to continue in a STEM career. Additionally, we have learned a great deal about the complex components and dynamics of self-efficacy, their link to performance, and the ways they can be impacted to improve students' academic performance.

Keywords : academic performance, affect variables, growth mindset, intervention, perceived academic control, psycho-social variables, self-efficacy, STEM, university classrooms

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