Factors Associated with Students Leaving Quantitative STEM Majors: A Case Study.

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Introduction

Selecting and changing a college major is a deeply personal process that is influenced by family, friend, mentor, geography, and discipline-related experiences. STEM attrition occurs when a student drops out of college or switches to a non-STEM major.

Because of STEM attrition, only 50% of students who declare an initial STEM major will graduate with a STEM degree. STEM attrition has a large economic impact and has lead to a growing deficit in graduates to fill 600,000 new STEM job openings. Factors reported in the literature as contributing to STEM persistence are pre-college, college academics, disciplinary, college skills, and intrapersonal.

The purpose of this exploratory study is to identify why college-bound students became interested in quantitative STEM majors (Q-STEM: physics, chemistry, mathematics) and what factors caused them to switch out of these majors.

Materials and Methods

School Science Teachers

Twenty teachers participated in a brainstorming activity about how students decide on STEM majors and why they may switch out of them. The activity was part of a workshop offered at the Kentucky Science Teachers Association. Teacher responses were transcribed, and analyzed following qualitative techniques.

STEM Switchers

Students who started as Q-STEM majors (n = 11) volunteered to participate. Semi-structured interviews were recorded, transcribed, and analyzed following standard qualitative techniques. Participants described: (a) factors that contributed to their decision to select the original major upon entering college (b) experiences in the original major; (c) factors that contributed to their decision to switch; and (d) satisfaction with their decision to switch out of Q-STEM.

In addition, participants completed a demographic survey. Data were compared with survey data from a control group, STEM persisters (Q-STEM seniors, n = 7). Factors of interest were: (a) class rank; (b) initial science major; (c) time in the initial major; (d) mother and father level of education; (e) average family income; (f) SAT scores, math and science sub-scores; (g) high school and college GPA, highest math completed; (h) completion of early college/dual credit; (i) 10+ hours of part-time work.

Findings: Perceptions of Science Teachers and STEM Switchers

PULL Factors - High School Science Teachers

* Passion for science – Curiosity; fun; rewarding and hands-on career; tech-savvy.
* Career perks – Good salary; scholarships; status and prestige; good job outlook.
* Diversity – Reduced barriers for females and people of color in STEM careers.
* Support and mentoring – Family, faculty, peers.

PULL Factors –STEM Switchers

* High school academic factors – Good grades, success in high school science and math classes; “good at it”.
* Passion for science – Love, passion, excitement, emotional connection when at high school.
* Support and mentoring – “Good” science, math teachers provided encouragement, guidance.

PUSH Factors - High School Science Teachers

* Inadequate HS preparation – Few AP and Honors classes; limited labs; “easy” math, science classes.
* Low grades – Struggling in math; college science classes are too difficult.
* Negative faculty interactions – Lack of empathy and support; inadequate teaching strategies; few role models.
* High stakes testing – ACT, SAT for college; GRE, MCAT for grad school.
* Personal issues – Lack of confidence, grit, study skills, self-discipline, focus; afraid of challenges, failure; unaware of career options.
* Career issues – Length of career preparation; heavy workload; liability.

PUSH Factors –STEM Switchers

* Intrapersonal factors – “Falling out of love” with science; lack of passion, effort, interest; bored with original major.
* Academic issues – Struggle in college due to upper level classes, more abstract content; higher academic demands.
* Negative faculty interactions – College faculty discourage student from major, lack of empathy and support.
* Career issues – Unawareness of career options; limited access to internships and real-world experiences in STEM.

Quantitative Analysis of Demographic Surveys

* Data from switchers and persisters were compared using non-parametric statistics, including Chi-square and Mann-Whitney U tests, and p < 0.05. No statistically significant associations were found. Sample size is likely too small.

Concluding Remarks

Interest in Q-STEM among high school graduates was associated with passion for the discipline, teacher encouragement, and success in academic coursework. Upon entering college, students faced more difficult courses, higher-level mathematics, and college faculty who were perceived as less supportive and who emphasized passive teaching strategies. As a result, students felt inadequate, unprepared and overwhelmed. A naïve understanding of study-habits, the expectations of Q-STEM preparation, and test-taking strategies may have worsened the students’ negative experiences. Future plans include expanding the literature review, interviewing more students, and developing a model of Q-STEM retention that can provide research-based and implementable strategies.

Selected Bibliography

* Mervis, J. (2010). Better intro courses seen as key to reducing attrition of STEM majors.

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