Separating Facts from Fads: How K–12 Educators' Choices Impact Students' College Performance and Persistence in STEM

Background

Pre-college teachers and administrators hold many theories about how best to interest and prepare students for success as STEM majors in college. Effective or not, based in fact or in faith, these beliefs play out in our nation's classrooms. While many research studies have shown large and statistically significant effects of particular interventions or innovations, most often they examine small, homogeneous populations such as single schools or classrooms. They are commonly carried out as "hot house" studies with generous support and attention under the auspices of the original development team. In spite of the wide variation in teaching methods and materials used in U.S. schools, there is little in the way of large-scale, rigorous study of educational practices and technologies that compares the effectiveness of these approaches on a national scale.

While pre-college teachers make much of their choice of methods and materials, college professors are less sanguine about the preparation that high school provides in math and science. Many are dismayed by the difficulty that students have in their introductory college courses despite their preparation. Dropout and failure rates are high in introductory college science and math "gatekeeping" courses. Many students find themselves shunted off to remedial courses. While success in introductory college science courses opens the door to opportunities in engineering, health, scientific research, and other technical careers, poor performance in these courses closes those career options and channels students toward non-science fields, negating years of preparation and aspiration.

Our research team has utilized epidemiological methods to mine the backgrounds of more than 20,000 college students taking introductory science and mathematics courses for predictors of performance and persistence while controlling for demographic differences. Some of the findings include:

- Female students lose interest in STEM during high school. Presenting STEM careers with an emphasis on people (i.e., of working on teams and helping society) is more effective than focusing on extrinsic rewards (e.g., money, status, fame of discovery).
- STEM AP courses rarely substitute for college coursework and often are ineffectual in preparing many students for future success.
- AP courses offer no advantage in increasing student interest in STEM careers over other advanced level (i.e., home-grown or dual-credit) non-AP courses.
- High school courses that cover fewer topics in greater depth prepare students better for introductory college courses in science and math than courses with greater coverage.
- Students who are best prepared for college calculus have high school math courses that emphasize the specialized language of mathematics; memorization of key procedures, terms, and facts; mathematical reasoning; and the use of hands-on activities.
- The use of technology (e.g., graphing calculators, MBL computers) for labs, simulations, and graphing in high school STEM courses has no impact on later college success.
- Reduced class size and block scheduling does not alter the choice of pedagogies used by STEM teachers.

- Changing the order of high school science courses (i.e., Physics First) has no impact on student learning in other sciences, while increasing math content does.
- Teacher awareness of common student misconceptions has a profound impact on student learning.

For More Information

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Other Resources

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