# Catalyzing Advances in Undergraduate STEM Education

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We face profound global challenges, including providing adequate food, clean water, and energy; responding to changing weather patterns; supporting a growing world population; delivering health care; and addressing strife and inequalities. Understanding and addressing these challenges demands ingenuity, knowledge, wisdom, and compassion. Research on improving learning and building intrapersonal and interpersonal competencies can be used to prepare STEM graduates to address these complex, multidimensional problems. These graduates need both deep disciplinary understanding and the capacity to work synergistically across domains extending beyond science, mathematics, and engineering. Discipline-based education research (DBER) has contributed substantially in the areas of conceptual understanding, conceptual change, developing expertise in problem solving, using representations, and instructional strategies. Effective instruction includes a range of well-implemented, research-based approaches that actively engage students in their own learning. These strategies are more effective in enhancing learning than traditional lecture. Learning through undergraduate research and developing the skills needed to contribute to a team also prepare students for productive careers. Competencies beyond cognitive skills can boost students' persistence and completion. A new study from the U.S. National Academies for Science, Engineering, and Medicine concludes that brief, low-cost interventions can support a student's sense of belonging, belief that her intelligence and ability to learn is malleable, not fixed (growth mindset), and perception that her academic work is leading to a desired end. As a result, these students are more likely to complete their degrees and lead financially sound and healthier lives. Together, the growing body of evidence on STEM learning provides guidance for redesigning the undergraduate experience to support students' success as learners and as adaptive contributors in the workforce.

Relevant readings:

1. Discipline-based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering - https://www.nap.edu/download/13362

2. Reaching Students – practitioner guide for faculty to support their use of evidence-based teaching practices - https://www.nap.edu/download/18687

3. Supporting Students College Success: Role of Assessment of Intrapersonal and Interpersonal Competencies - https://www.nap.edu/download/24697

4. Undergraduate Research Experiences for STEM Students: Successes, Challenges, and Opportunities - https://www.nap.edu/download/24622

5. Enhancing the Effectiveness of Team Science - https://www.nap.edu/download/19007