
Designing a Mindset Intervention to Help Underrepresented Students Thrive in Introductory College Science Courses

Cameron A. Hecht, Anita G. Latham, Ruth E. Buskirk, Debra R. Hansen, and David S. Yeager

INTRODUCTION

Demand for professionals with skills in science, technology, engineering and mathematics (STEM) fields continues to grow in the United States. But many undergraduate STEM majors drop out or change majors before graduating. This attrition of STEM students is especially pronounced among underrepresented minority and first-generation college students.

Some of the barriers to success for underrepresented minority and first-generation college students in challenging STEM courses are structural. For example, students from lower-income families may need to work one or more jobs to cover tuition and living expenses, which leaves them less time to devote to coursework. Students' *mindsets*, or their assumptions, beliefs, or perspectives that shape how they interpret and respond to their academic environment, are also potential barriers to success.

Students' mindsets can be the accumulated result of prior experiences with discrimination or underrepresentation. They can also be a cause of ongoing underperformance. For example, when students perform poorly on the first exam of a gateway science course, they often form the belief that they simply don't belong in the sciences. This belief, in turn, can lead to a pernicious cycle of worry, failure, and disengagement from STEM courses.

Mindset interventions, which shift students' beliefs about themselves as learners and about their classroom experiences, have been incorporated into undergraduate STEM courses, including biology, developmental math, and physics, with increasing regularity in recent years. They have shown promise for improving undergraduate students' academic outcomes and promoting diversity in STEM.

Mindset interventions are often short, self-administered exercises crafted by social psychologists to target and address students' most pronounced fears and are easy to administer. However, for mindset interventions to be the most successful, they must be customized for each course to address the specific challenges students face as well as incorporate the resources available to them in the course.

This research brief reports on a recent paper [1] in which the authors designed a protocol to develop customized mindset interventions for specific college courses. The protocol – designed by a research-practice partnership team of three biology instructors and two social psychologists – resulted in a *peer-modeled mindset intervention*.

The protocol used a targeted series of questions, rooted in social-psychological theory, to elicit advice from former students of an introductory biology course. The former students' responses, which were filmed and edited to focus on specific topics, allowed peers to model the changes in thinking that helped them to be successful in the course.

Using a randomized controlled trial design, half the students in the same introductory biology course received the intervention to test its impact on students' experiences and outcomes in the course. At key points during the semester (i.e., before exams), current students watched a short (~7 minute) video and then completed a short writing activity to reflect on what they saw and heard. Each of these three intervention activities took about 15 minutes to complete.

KEY FINDINGS

- ▶ The authors **designed a protocol to develop customized peer-modeled mindset interventions for specific college courses**, in which current students hear from former students about the changes in thinking that helped them to be successful.
- ▶ The authors **used the protocol to create a customized intervention** for three sections of introductory biology at a large, public university. *See figure for a description of the intervention activities and representative responses.*
- ▶ The **intervention improved students' experiences and outcomes**. It improved students'
 - ▶ approach to studying,
 - ▶ feelings of belonging,
 - ▶ performance in the course; and
 - ▶ persistence in biology.
- ▶ These **intervention effects were strongest among first-generation college students and underrepresented racial/ethnic minority students**, groups that have historically been underrepresented in the STEM fields.

Reflecting on what they heard from former students, current students described how initial struggle in their STEM course could be overcome through a different approach to studying

Intervention activity 1: First, describe why you think it is common for students to struggle when they first begin [this university's introductory biology course]. Then, describe how and why you think students overcome these initial struggles as they find new and better ways to learn and understand the material.

"Students in college realize that they need to find different study strategies to have the same success they did in high school. In high school, common study strategies included cramming, which is difficult to do in college because there's so much material [to learn] in depth that it isn't possible to cram it all in one night."

Intervention activity 2: First, describe why you think it is common for students to struggle on the first exam in intro bio. Then, describe how and why you think students overcome this initial struggle as they find new and better ways to learn and understand the material.

"I think the reason students overcome the initial struggle is because they're able to reflect on what went wrong, and then implement new strategies going forward. One method I started to implement was self-testing and self-assessment, so that I could gauge how much of the content I knew and what I still needed to learn."

Intervention activity 3: First, describe why you think it is common for students to feel stress as they approach the final exam. Then, describe how and why you think students overcome these concerns and are able to succeed as they find new and better ways to learn and understand the material.

"I believe it is common for students to feel stress during finals because a lot of information was covered throughout the semester. Students overcome this stress by discussing studying methods with peers, joining a study group, and planning their study schedule for other finals as well."

On the left side of this figure are questions social psychologists developed for intervention activities that introductory biology students completed before each major exam. For each activity, students watched a short video clip in which former intro bio students discussed specific course challenges and how they overcame them. These self-administered activities helped current students to reflect on what they heard and think about how it related to their own experiences (see right side of figure). *Quotations have been edited for brevity.*

POLICY IMPLICATIONS

This research provides a formalized approach to guide the process of customizing mindset interventions for specific college-level courses. This customization is essential to maximizing the impact of mindset interventions.

The intervention approach highlights the positive impact of students hearing the right story at the right time from a trusted source. Importantly, these mindset interventions show promise for improving experiences and outcomes for students who have been historically underrepresented in the STEM fields, which may help to broaden participation in these fields.

The positive contributions of the mindset intervention are reflected in the words of the instructors who contributed to the protocol development and who saw the positive outcomes firsthand. One focused on the impact of students hearing from a trusted source: “it’s the power of peers who mirror and validate their own experiences. We [instructors] can talk for hours about changing study strategies, but when they see a kid in a video saying ‘I got a C- on my first exam and I didn’t know what hit me,’ they pay attention because it speaks to them.” Another noted the positive impact of hearing from students like them who used existing resources: “We provide students with resources but listening to others who have actually used some of these resources and become successful in the course is very helpful.” Finally, this instructor was most impressed by the potential for the intervention to broaden inclusion and participation in STEM: “I also think that a major contribution is that the effects were documented to be greater on first-generation college students and under-represented minority students in our classes.”

REFERENCE

[1] Hecht, C.A., Latham, A.G., Buskirk, R.E., Hansen, D.R., & Yeager, D.S. (2022). Peer-modeled mindsets: an approach to customizing life sciences studying interventions. *CBE - Life Sciences Education*. <https://doi.org/10.1187/cbe.22-07-0143>

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ABOUT THE AUTHORS

Cameron A. Hecht (cameron.hecht@utexas.edu) is a National Science Foundation postdoctoral scholar at the Population Research Center, The University of Texas at Austin and a postdoctoral fellow with the [Behavioral Science and Policy Institute](#) (TxBSPI), UT Austin; **Anita G. Latham** is an associate professor of instruction, **Ruth E. Buskirk** is professor of instruction, and **Debra R. Hansen** is an assistant professor of instruction, all in the Biology Instructional Office, College of Natural Sciences, UT Austin; and **David S. Yeager** is an associate professor of psychology, faculty affiliate at TxBSPI and faculty scholar at the Population Research Center, UT Austin.

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