Scaling Up: Lessons for Persuading Science Faculty to Adopt an Evidence-Based Intervention

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IN PRESS J of College Science Teaching

Type of Submission: Feature

Body Word Count: 2,999

Keywords: science education, faculty, pedagogical intervention, implementation, motivation

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Abstract

The science education community is deeply vested in growing the next generation of scientists. One way to do this is through evidence-based interventions that support the motivation and performance of students in introductory classes. The literature is replete with interdisciplinary research presenting such interventions. Unfortunately, the process of developing and evaluating pedagogical practices is not the same as the process required to scale those efforts into actual university classrooms. Efforts to spread the word about successful practices often move slowly, through relatively small personal and professional networks. We present a complementary proactive strategy designed to raise awareness of one exemplar intervention across a broad swath of U.S. biology faculty. Our 30-minute anonymous engagement (in three 10-minute asynchronous virtual sessions) resulted in this particular intervention being adopted in some form by more than 4 in 10 of faculty who learned about it, reaching an estimated 7,500 students across the U.S. We describe the three phases of our intervention adoption process, each informed by social psychology theories of persuasion and decision-making, and provide a detailed guide and ready-to-use resources to replicate the process using other evidence-based interventions ready for scale.

For decades now, the United States has grappled with how to meet the demands for a thriving, diverse, and expansive scientific workforce that contributes to emergent discoveries and innovations that improve the human and world condition. Growing the scientific workforce requires motivating the next generation of students to pursue degrees in science fields. As motivational scholars, our work has focused on projects systematically testing ways to catch and hold university student's motivation for science (Allen et al., 2015; Smith et al., 2013; Thoman et al., 2015). Each year we attend annual meetings that bring science education scholars together. Anecdotal accounts, confirmed by systematic program evaluation research (Austin, 2011; Kezar, Gehrke, & Elrod, 2015), reveal two common themes: first, simple, low-cost "wise" interventions can have powerful and long-lasting effects on student's science motivation, achievement, persistence, and even health outcomes (Walton & Crum, 2020). Unfortunately, the second theme is that these evidence-based pedagogical interventions are not typically adopted outside the study context (Brownell & Tanner, 2012; Froyd et al., 2017; Kezar, 2011; Thoman et al., 2021).

How can we scale up evidence-based classroom interventions beyond the original study development context? This is an essential empirical question to answer; otherwise, investing in additional "scalable" efforts is unlikely to yield the desired outcomes.

The Utility Value Intervention as an Exemplar

The utility-value intervention (UVI), is one such example of a "wise" pedagogical intervention with more than a decade of empirical evidence behind it (for review see Hulleman & Harackiewicz, 2021). The UVI was designed from the tenets of Expectancy-Value Theory (Eccles & Wigfield, 2002) and is based on the premise that is possible to "add value" to a classroom task that will increase student's motivation and self-efficacy (Canning et al., 2018). The UVI is embedded in course curriculum and involves students writing three essays

throughout the term (worth a small percent of the grade) that summarizes current course content *and* discusses how the topic is relevant (i.e., has "utility") in their own life. This intervention was developed and refined based on laboratory studies that revealed the importance of multiple instances of the assignments, the need to provide students with specific examples of relevancy, and giving students a choice on essay content (Rosenzweig et al., 2018).

Research on the UVI showed a significant positive effect on course grades and motivation for all students enrolled in introductory biology classes and was particularly beneficial to students with lower levels of past achievement (e.g., Harackiewicz et al., 2016; Hulleman et al., 2010). The UVI also retains a positive impact over time, both via positive indirect effects on grades and direct motivational effects on persistence (Canning et al., 2018; Hecht et al., 2019). Results from dozens of studies leave little doubt that the UVI works to improve students' performance and motivation (e.g., Harackiewicz, et al., 2015; Thoman et al., 2015; Hulleman et al., 2010; Harackiewicz, et al., 2012). The UVI helps students discover connections between course topics and their lives and allows them to make connections between what they are studying (e.g., in biology) and their personally important goals (Harackiewicz et al., 2016). Discovering these connections helps students appreciate the value of the work, leading to a deeper level of engagement and involvement, which in turn, improves career motivation and persistence over time (Canning et al., 2018; Harackiewicz, Smith, et al., 2016).

Difficulty in Bringing an Intervention to the Masses

We know the UVI works in a biology classroom to improve student learning and motivation. What we don't know is how to convince instructors to implement it (and other evidence-based practices)widely. Faculty are primary change agents (Kezar et al., 2015) and have a wide latitude over their curriculum and are encouraged by many reform initiatives to improve student science

learning (e.g., the Vision and Change in Undergraduate Biology Education, see for example, Auerbach & Schussler, 2017). Yet, critical barriers exist to bringing such evidence-based interventions to the masses (Froyd et al., 2017; Handelsman et al., 2004; Henderson et al., 2011; Kezar, 2011).

We've seen this intervention adoption barrier in (second author) Thoman's project to scale up the UVI. This project implemented UVIs to over 6,000 undergraduate students across six different science courses (including biology, chemistry, and physics courses). The project began with all the key elements for a successful implementation, including institutional support, faculty members in the relevant departments on the research team, and support structures in place for managing the assignments (to minimize time and effort by instructors). However, even after receiving evidence about the effectiveness of the UVI, some instructors remained skeptical about whether to include the assignments. A few instructors even voiced annoyance with assignments that made students spend time writing about connections that were, in the instructor's view "irrelevant to actual science." We learned that a few instructors and teaching assistants translated these resistant views into displays of displeasure or annoyance with the essay assignments when students in class asked about the essays.

This kind of intervention adoption barrier is problematic because students learn from these signals and can internalize others' beliefs about the culture of science (Thoman et al., 2017). When scaling up interventions, it is not possible to work only with instructors who enthusiastically support the intervention prior to implementation. As this example makes clear, it is important to develop persuasive strategies that can both minimize resistance (Thoman et al., 2021) and lead to successful adoption. Add to this, the daunting task of convincing a wide range of faculty, from universities across the nation, to pay attention to and consider the adoption of

any given intervention (Handelsman et al., 2004). With thousands of science departments across the country, what strategies can we use to expand the reach of an intervention beyond one's personal networks or professional/institutional connections?

Theory-Informed Strategies for Encouraging Faculty to "Help" with a Classroom Intervention

Our investigation of these strategies was embedded in a larger project with three aims: firstly, to gain input from faculty about barriers to adopting an intervention such as the UVI, and these findings are reported elsewhere (Thoman et al., 2021). Secondly, we surveyed faculty about their opinions of the UVI after learning about different UVI elements (e.g., that the evidence shows it benefits minority students, that the UVI research was federally funded), and these findings are also reported elsewhere (McPartlan et al., 2022). The final goal, which was the focus of our reporting here, was if our communication plan could compel biology faculty from around the U.S. to adopt the UVI.

We utilized social psychological theories of decision making to inform our approach. We first drew from persuasion and social influence research to determine how to initially reach a faculty audience (Wood, 2000). Then, we drew from Thomas and Plaut's (2008) inspired adaption of Latané and Darley's (1970) decision model of helping to describe the intervention in a way that would prompt a decision to "help" students by trying the UVI in their introductory biology classroom. Using the well-articulated model of helping (Darley & Batson, 1973; Darley & Latane, 1968; Garcia et al., 2002), was a useful tool to inform our strategy use. Our approach resulted in more than 4 out of 10 biology faculty who learned about the UVI, adopting it in their classroom. Considering we had no personal connection to the participants, and indeed are not even biology faculty ourselves, we felt this low-touch, theory-informed persuasive approach was

worth sharing as inspiration to other science educators who are interested in scaling up the adoption of their own evidence-based classroom intervention.

Methodology

Phase 1: Finding the faculty

We began with a list of over 40,000 schools obtained from the IPEDS Database of institutions of higher education and narrowed it down to 4-year universities that offer a biology bachelor's degrees. From the remaining list of 2,279 universities/colleges, we randomly selected 1,000 universities/colleges and culled publicly available websites for faculty names, titles, and if the faculty taught introductory biology. This resulted in contact information for 5,545 faculty (which is available for use by others with a data agreement at https://adapt.sdsu.edu/?page_id=554).

Phase 2: Initial Invitation

We randomly selected 1,866 faculty from the list and sent them a welcome email to introduce our goals for "Adapt – A pedagogical decision-making study." Our aim was to convey that this was a low-pressure opportunity to learn about an intervention and give feedback, with no presumed expectation that anyone was *required* to adopt it. The consent form stated "Participants in this study are asked to evaluate a newly developed classroom activity/ strategy designed to improve student outcomes in foundational undergraduate biology courses. We are interested in finding out how faculty make decisions about whether or not to consider using the strategy in their classes." The IRB at two universities approved our study protocol.

For the initial invitation we used the "validate-persuade" social influence method (Werner et al., 2002) with a small incentive (Singer & Ye, 2013). To do this, faculty were emailed with the following elements:

1) **A personal appeal from a credible source:** (in our case the email was from our actual post-doctoral researcher using his real university-email) for a low-pressure, anonymous opportunity to learn about an intervention and possibly adopt it : *My name is XXX. I am a post-doctoral fellow working on a study researching Biology faculty perceptions about course materials and teaching practices… In particular, we are interested in recording faculty perceptions of a specific classroom assignment and how faculty might choose to implement such an assignment in their course.*

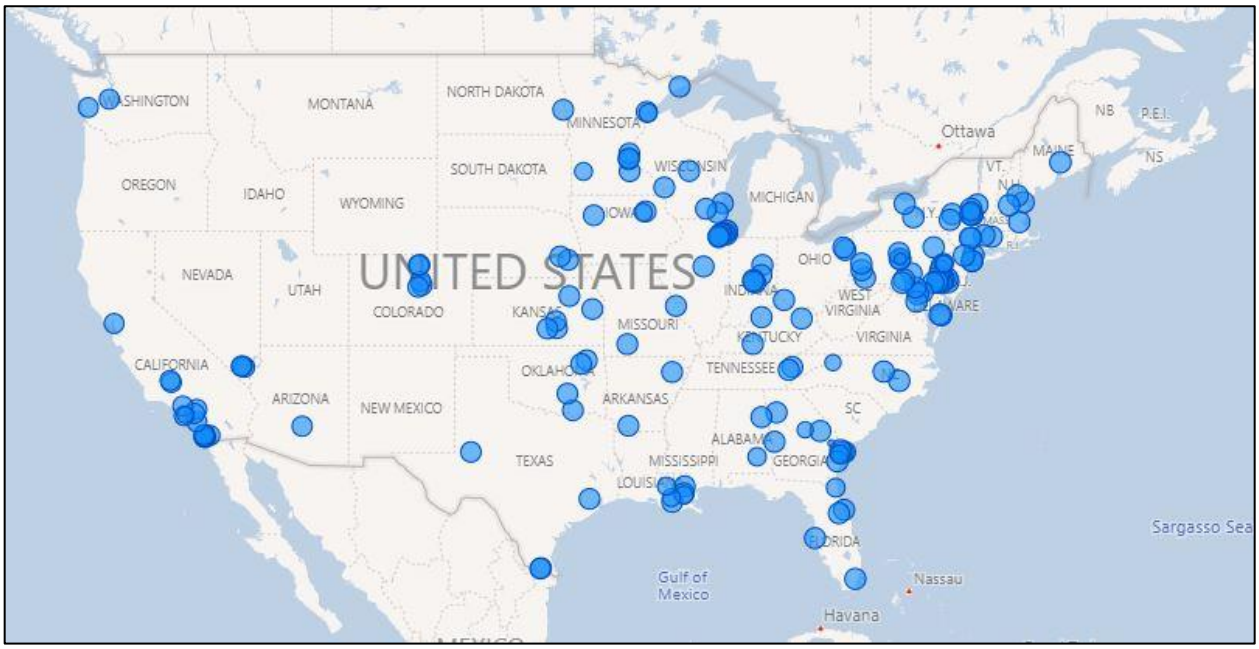
2) **Validated faculty time**: *My team understands you are likely busy with many other commitments, but your expert opinions in the field of Biology education is incredibly valuable*.

3) **Discussed the value of the work**: *Our team is interested in exploring how and why faculty 'adapt' new course assignments in their classes. Your expertise in Biology and teaching would be greatly beneficial to our project.*

4) **Offered a small incentive**: We offered faculty $35 for their first interaction with the intervention and $25 for each subsequent time ($85 total). The invitation read: *A gift card at a store or online site of choice or you may instead choose to donate to a charity*.

Our approach yielded an overall 16.7% response rate of 311 participants, of whom just over 200 were eligible (having recently taught introductory biology). All told, we connected with faculty from 182 different universities from across the US, as shown in Figure 1.

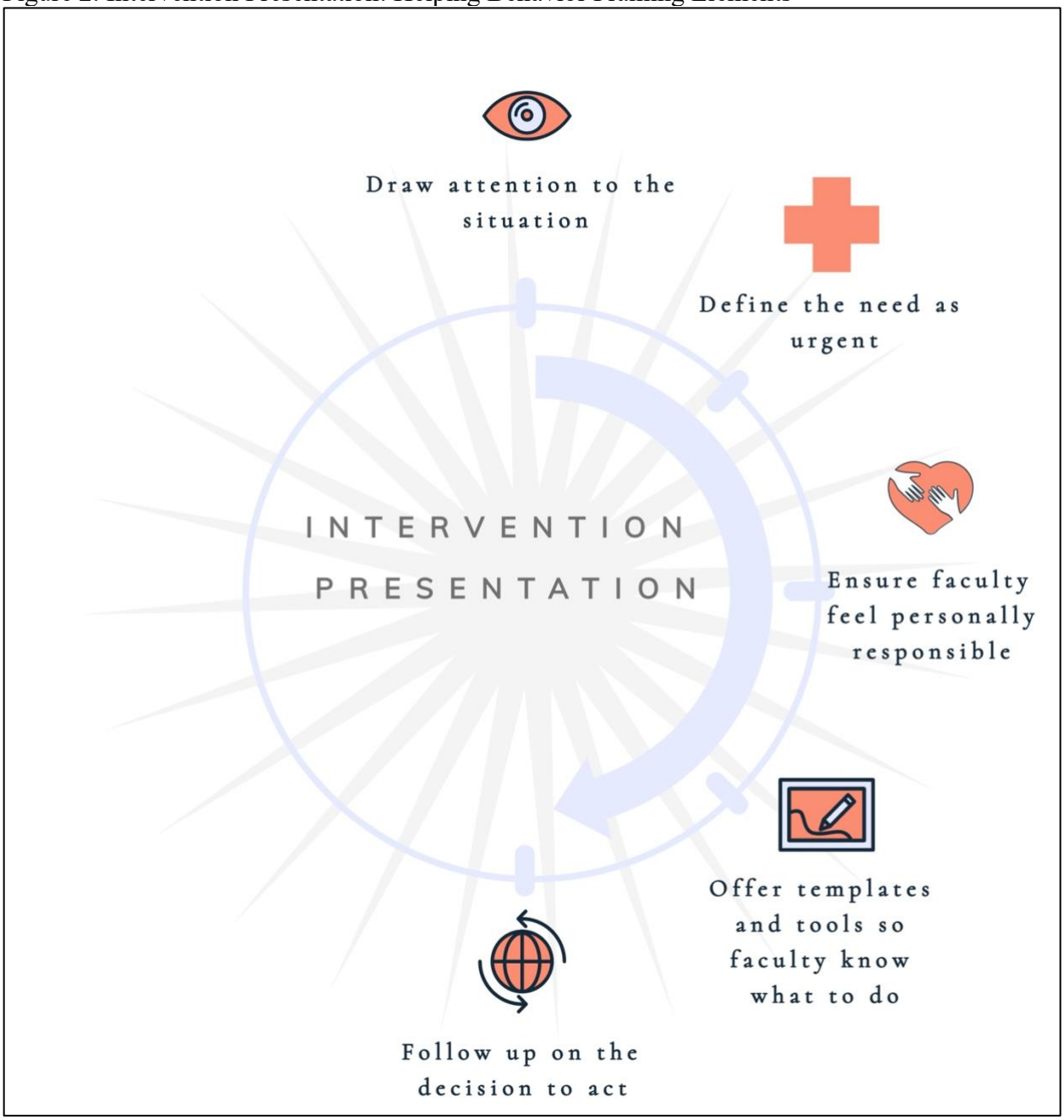
Figure 1. Map illustrating national sample of faculty participants who learned about the UVI:



Exemplar UVI Information Presentation

Next, we followed the central tenants of Latané & Darley's (1970) decision model of helping applied to presenting information about the UVI (see Figure 2). Faculty received information via a combination of a short video with supplemental text information to reinforce the video content (which are available for viewing here, https://adapt.sdsu.edu/?page_id=483). The information can be adapted to fit most evidence-based interventions.

Figure 2. Intervention Presentation: Helping Behavior Framing Elements



Identify the situation and frame it as urgent. We framed both the introductory invitation and the beginning of the video to reinforce the urgent need to focus on educating the future biology workforce. Specially, faculty were told: "It is crucial for the future biomedical field to create a well-trained scientific community. This is an opportunity for reimagining the introductory biology teaching and learning landscape and establishing new course assignments that benefit our students."

Ensure faculty feel responsible. We next needed to persuade faculty that the power to make changes was in their hands (versus, for example, the responsibility of the university or the profession). We did this by stating: "You serve an important role in making sure students gain the knowledge and thinking skills they need to effectively contribute to science in the future and keeping these students engaged in the classroom can enhance their learning and scientific thinking."

Offers tools and templates so faculty know how to act. Here, we spent the most time both convincing the faculty that the intervention was evidence-based, impactful, and showcasing the intervention is do-able by following step-by-step directions. We conveyed: "Psychological science has demonstrated that one way to get students more involved with classroom material is called the utility-value intervention or UVI. Research using this evidence-based intervention shows that biology students learn better when they find their own connections between what they are learning in the classroom and their personal goals, hobbies, and their future. In fact, in classrooms where the UVI was used, students improved their grades, increased their interest, and signed up for more science classes in the future. The assignment asks students to generate their own question about a biological topic covered in your class at three separate times during the course. In a 500-600-word essay, the student then answers their question and describes how that

concept applies to their own life.

The assignments are implemented online on the student's own time and are compatible with all online course management systems, so the UVI works the same way for both in-person and remote classes. We are interested in helping more faculty adopt this intervention in their courses and our team has compiled several resources to help you implement the UVI in your classes. These resources include several tailored assignment templates for biology courses, sample syllabus integration, sample student essays, an easy-to-use grading rubric, and a checklist to ensure proper implementation."

Follow up on the decision to act. Following the initial email sent out by our post-doctoral associate, faculty were sent an automated email from a cloud-based survey platform (Qualtrics) at the end of summer that contained a link to watch a short video about the UVI (containing the information above). They were also provided a toolkit (available https://adapt.sdsu.edu/wp-content/uploads/2022/03/UVI-Resource-Manual.pdf) and were asked to reflect on their opinion of the UVI by asking a series of introspective questions, such as *What is your opinion of the UVI?* and *Could you see yourself leading this classroom intervention?* (see results in McPartlan et al., 2022). Each engagement lasted approximately 10 minutes. Faculty participants were asked to do this a total of three times spread out over one academic year: in summer term, the end of the fall term, and the end of the next spring term. At every point we asked faculty to reflect on the UVI and report their motivation to adopt it, and if they did report adopting it, we asked them to provide details of their adoption and, when possible, to upload their syllabi to the platform. By the end of the study, our response rate was 79.3% of those faculty who had participated in at least one of the other previous timepoints (n=172).

Results

Success of the Strategies for UVI Adoption

By the end of the study, 43.5% of the 172 faculty adopted the UVI in their introductory biology classroom. Considering the number of students each faculty engages with in their introductory classroom, the impact on students who interacted with the UVI and received its benefits is impressive. For example, if we assume conservatively that any one faculty member teaches an average of 100 students in a classroom, that is nearly 7,500 students taking part in the UVI. Add to this, that 46% of our faculty participants reporting talking to another colleague about the UVI, and the potential for impact increases. Moreover, during the final time period we also presented faculty with the abstract from a different evidence-based intervention (the values affirmation intervention, from Jordt et al., 2017) and discovered that the more interested faculty were in the UVI in that initial summer engagement, the more interested they were in learning about a totally different intervention 9 months later (r=.30, p<.01). This suggests that catching and holding faculty interest in one intervention also bodes well for introducing them to another.

Discussion

Making the Case for Proactive Dissemination of Pedagogical Interventions

Bringing a particular intervention to scale requires getting the intervention into the hands of faculty across the country and engaging those faculty. Many barriers exist to such scaling efforts. Simply publishing results and relying on information to spread through personal professional networks is slow. Dissemination through SoTL (Scholarship of Teaching and Learning) outlets only reaches faculty already in the choir of the curriculum reform efforts. Solutions for scaling should include all these strategies, and more. Here, we have described a complementary approach to reach broad audiences of faculty using principles informed by social psychological

research on social influence and decision making. In our case, a 30-minute anonymous engagement spread out over three 10-minute sessions resulted in this particular intervention being adopted in some form in an introductory classroom. At the same time, we gained valuable insight on improvements to the intervention (McPartlan et al., 2022). To be sure, there are faculty who are more predisposed to be interested in and willing to try evidence-based classroom interventions that improve student outcomes (Bathgate et al., 2019), and we must simultaneously try to reach as many of these faculty as we can while also trying to convince those who may be on the fence.

We believe that this active approach to finding and engaging faculty using social psychological principles can contribute to scaling evidence-based efforts. It should not be thought of as a standalone approach. Efforts such as the "Research and Teaching" articles in this journal represent a different kind of strategy, which takes advantage of access to engaged readers in the science education community. This kind of tool successfully reaches those who are proactively looking for pedagogical supports, but of course misses the audience of instructors who are not proactively looking to change. To successfully scale interventions requires multiple strategies; and we see our proactive, social psychological approach as complementary to existing strategies. Just as educators need many tools in the toolbox to support student success, intervention researchers also need many tools for promoting evidence-based intervention adoption at scale. Too often we only use intuitive ways and approaches to getting the word out (Andrews & Lemons, 2015), and we hope people are inspired to use social science methods to scale up the impact of their pedagogical interventions.

Acknowledgements

We have no known conflict of interest to disclose. The research reported here was supported by the National Science Foundation, through Grant #1759947. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors.

We are grateful to our Adapt team, including Felisha Herrera, Jennifer Poe, Peter McPartlan, Melo Yap, Gabriela Kovats Sanchez, and the many undergraduate research assistants in the Motivation and Social Identity lab at San Diego State University.

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In Short

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- Efforts to spread the word about successful intervention practices often move slowly, through relatively small personal and professional networks. We present a proactive strategy designed to raise awareness of one exemplar intervention, called the utility-value intervention, across a broad swath of U.S. biology faculty.
- Our 30-minute anonymous engagement, in three 10-minute asynchronous virtual sessions, resulted in this particular intervention being adopted in some form by more than 4 in 10 of faculty who learned about it, reaching an estimated 7,500 students across the U.S.
- We describe the three phases of our intervention adoption process, each informed by social psychology theories of persuasion and decision-making, and provide a detailed guide and ready-to-use resources to replicate the process using other evidence-based interventions ready for scale.