# Bridging the Research-to-Practice Gap: Designing an Institutional Change Plan Using Local Evidence

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## Abstract

**Background** Ample research provides evidence about the influence of effective teaching practices on student success. Yet the adoption of such practices has been slow at many institutions. Efforts to bridge the gap between research and practice are needed.

**Purpose** We describe an institutional change plan we developed to bridge this research-to-practice gap. Our plan is grounded in research and theories about faculty motivation and organizational change, and we designed it using local evidence from the University of Michigan College of Engineering.

**Design/Method** We collected local data from three sources to provide context for our institutional change plan. First, faculty focus groups allowed us to determine factors that influence faculty adoption of effective teaching practices. Second, classroom observations allowed us to ascertain current teaching practices. Third, a student survey allowed us to identify teaching practices perceived by students to enhance their success. We used this local evidence with a "who/what/how" decision-making process to design our change plan.

**Results** Our institutional change plan for accelerating the adoption of effective teaching practices comprises a faculty action plan and an administrative change plan. Although still evolving, there is evidence of the success of both parts.

**Conclusions** Local evidence is critical in our change plan. Change agents wishing to bridge the research-to-practice gap at their own institutions can design a plan that adapts our process and integrates relevant research and theory with their own local data.

**Keywords** effective teaching practices; expectancy value theory; faculty development

## Introduction

The need to improve undergraduate science, technology, engineering, and mathematics (STEM) education has been repeatedly stressed in numerous reports, including the Boyer Commission's *Reinventing Undergraduate Education: A Blueprint for America's Research Universities* (1998); the Royal Academy of Engineering's *Educating Engineers for the 21st Century* (2007); the American Society for Engineering Education's *Creating a Culture for Scholarly and Systematic Innovation in Engineering Education* (Jamieson & Lohmann, 2009) and its recent companion *Innovation with Impact* (Jamieson & Lohmann, 2012); and the National

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Academy's reports *The Engineer of 2020* and *Rising Above the Gathering Storm* (National Academy of Engineering, 2004; National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2007). Of the many elements involved in improving STEM education, here we focus on faculty use of effective teaching practices.

Ample research has demonstrated that faculty teaching practices can have a significant influence on student success – some practices can improve student learning, engagement, and interest in engineering, while others can significantly affect whether students leave engineering (Felder, 1993; National Research Council [NRC], 2012; President's Council of Advisors on Science and Technology [PCAST], 2012; Prince, 2004; Seymour & Hewitt, 1997; Smith, Sheppard, Johnson, & Johnson, 2005; Tobias, 1990). In spite of this evidence, translation of research to actual classroom practice has been slow (Friedrich, Sellers, & Burstyn, 2007; Froyd, Borrego, Cutler, Henderson, & Prince, 2013; Handelsman et al., 2004; Jamieson & Lohmann, 2012; NRC, 2012; PCAST, 2012; Prince, Borrego, Cutler, Henderson, & Froyd, 2013), and lecturing remains the dominant teaching method currently used at many institutions (Hora, Ferrare, & Oleson, 2012). Various reasons have been hypothesized for the slow diffusion of innovation. For instance, Handelsman et al. (2004) noted that lack of awareness about effective practices, distrust of the educational data, and apprehension about learning new approaches may contribute to the slow adoption of effective teaching practices in the science education community. Henderson and Dancy (2011) found that faculty are generally aware of research-based ideas and are interested in implementing them, but they struggle with relevant situational constraints such as expectations of content coverage, lack of instructor time, departmental norms, student resistance, and limitations about the physical classroom and course structure.

The issue, then, is not that we need more research about effective teaching practices. Rather, we need a more complete understanding of how to bridge the gap between research and practice in an effort to accelerate the adoption of effective teaching practices (Jamieson & Lohmann, 2012). Henderson and Dancy (2011) concluded that "the biggest barrier to improving undergraduate STEM education is that we lack knowledge about how to effectively spread the use of currently available and tested research-based instructional ideas and strategies" (p. 1).

Many approaches have been suggested to accelerate the adoption of effective teaching practices (Anderson et al., 2011; Fairweather, 2008; Handelsman et al., 2004; Hora, 2012; Lattuca, 2011; PCAST, 2012; Varma-Nelson, Hundley, & Tarr, 2012). Some of these approaches include strategies to change faculty practices, such as creating teaching discussion groups, educating faculty about research on learning, providing venues for experienced instructors to share best practices, and designing programs to engage faculty beyond the "usual suspects" (faculty who do not normally participate in activities related to teaching improvement). Other approaches include broader-based strategies to influence the institution's culture, such as requiring excellence in teaching for promotion and tenure, engaging institutional leadership in reform efforts, and implementing policies to reduce risk for faculty who implement and refine new ideas.

The University of Michigan College of Engineering has embraced strategies to change faculty practices and made long-term investments for improving teaching and learning. In 2004, the college established the Center for Research in Learning and Teaching in Engineering (CRLT-Engin), a branch of the university-wide CRLT that provides instructional development specifically for engineering faculty and teaching assistants. CRLT-Engin has a physical presence on North Campus (the engineering campus located about three miles from the main campus). It is staffed by instructional consultants who have engineering Ph.D.'s, professional faculty development training, and joint appointments in the College of Engineering and the main CRLT. Engineering faculty and teaching assistants make regular and continuous

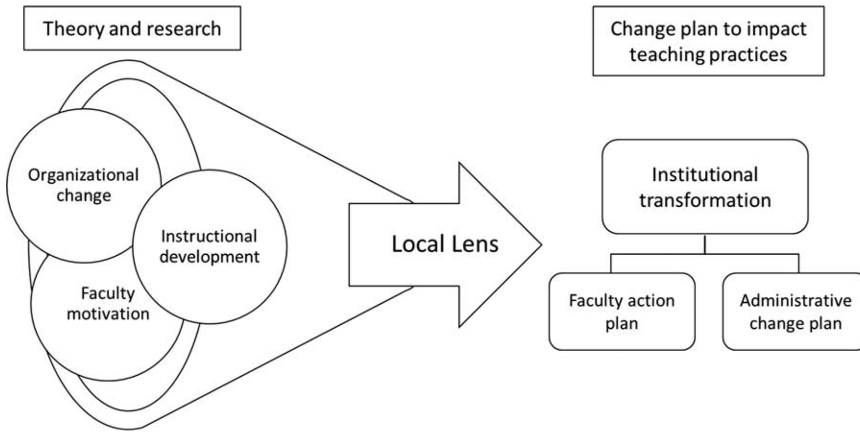


**Figure 1** Project overview.

use of CRLT-Engin. In the past academic year, staff from CRLT-Engin conducted over 300 individual consultations on teaching and learning and 90 midterm student feedback sessions (all of which were initiated by engineering instructors who recognized an opportunity to improve their own teaching), and CRLT-Engin workshops and orientation programs on teaching were attended by more than 1,200 individuals (University of Michigan, Center for Research in Learning and Teaching in Engineering, 2013). The work we describe in this article builds on these ongoing instructional development efforts and proven strategies for accelerating the adoption of effective teaching practices.

Our approach to institutional transformation, represented in the project overview of Figure 1, is grounded in research and theories about faculty motivation, organizational change, and instructional development. Importantly, to bridge the gap between research and practice, we used a local lens to view the theory, and we designed a change plan that is situated in the local context of our College of Engineering. Our plan for institutional transformation includes two parts: a faculty action plan comprising an instructional development program to accelerate the adoption of effective teaching practices, and an administrative change plan to influence policies and procedures of our engineering college. Together, the two parts are a means to transform the broader institutional culture.

There is precedent for a two-part change plan that focuses on both the faculty and administration. Browne (2005), for instance, stressed that successfully accelerating the adoption of effective teaching practice requires buy-in from both the faculty and administration, and Graham (2012) emphasized that most successful curriculum change initiatives require a common purpose among both faculty and senior management. Theoretical work on organizational change (Henderson, Beach, & Finkelstein, 2011) also supports our two-part change plan and highlights the importance of affecting both the members of an organization and its culture. Thus, a program to influence individual teaching practices is rightly coupled with a plan for administrative change, and both should be based on local practices and experiences.

Designing an effective change plan involves a myriad of decisions, and we adopted a "who/what/how" framework for the decision-making process (Figure 2), as did Jamieson and Lohmann in *Innovation with Impact* (2012, p. 6). We applied that framework by considering the questions:

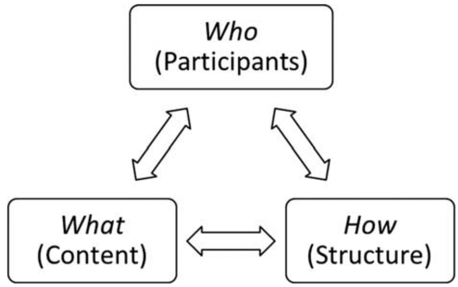


**Figure 2** Who/what/how framework for the decision-making process.

> **Who** should lead the change initiative and who should be engaged? Should we aim to influence faculty, administrators, or both? Should we engage early adopters (those with limited knowledge of evidence-based teaching practices) or those who regularly and frequently use effective teaching practices? What other characteristics should the participants have?
>
> **What** needs to be changed? What should the content of our faculty action plan and our administrative change plan encompass? Should we address basic pedagogical practices like student-centered learning or more advanced active learning approaches such as problem-based learning? What research evidence and other data should we include?
>
> **How** should the programs seek to influence change? Should this be a one-time or ongoing initiative? Should it involve a passive presentation format or an interactive discussion? Should the initiative comprise individual consultations or should it be cohort based? Should we incentivize participation, and if so, how?

As a framework for our decision-making process, we developed guiding questions that were grounded in the literature on faculty motivation and organizational change, and we used local data to answer the questions.

This article is organized as follows. We begin by providing an overview of previous research and relevant theories about faculty motivation and organizational change. We summarize literature that emphasizes the importance of local context, and then we describe each of the three sources of local evidence we collected. Next, we discuss our two-part change plan, describing ways the local evidence guided our decision making, and we offer some early evidence about the success of both parts. We conclude by discussing how our work might be adapted by others interested in designing their own change plan.

## Background

Research and theories about faculty motivation and organizational change provided an important foundation for our work. In this section, we present background information relevant for our efforts.

### Faculty Motivation

Other researchers have studied faculty motivation to adopt effective teaching practices, and they have identified both barriers to and enablers for adopting effective teaching practices

(Dancy & Henderson, 2010; Froyd et al., 2013; Hora, 2011, 2012; Jamieson & Lohmann, 2012; Prince, Borrego, Cutler, Henderson, & Froyd, 2013). Among the findings, lack of time has frequently been raised as one of the most salient barriers. Other barriers include lack of familiarity with research-based teaching practices, lack of skills and knowledge, lack of resources and support for faculty, resistance to change, characteristics of an instructor's environment, restrictive course syllabi and content structure, institutional policies (especially as related to tenure and promotion), institution type and research emphasis, teaching evaluations, heavy workload, and reward systems.

Factors enabling faculty wishing to adopt effective teaching practices have also been suggested (Froyd et al., 2013; Hora, 2012; Prince et al., 2013; Seymour, DeWelde, & Fry, 2011; Sunal et al., 2001). These include collegial and administrative support, the opportunity to engage with others, potential time savings, improvements in student learning, student perceptions of the class, and financial incentives. Blackburn and Lawrence (1995) reported that faculty are more likely to devote time and energy to efforts in which they have an interest, have confidence in their own abilities, believe they can make an impact, are supported by their colleagues, and perceive their institution's reward structures to be aligned.

Expectancy value theory (EVT) can be used to describe faculty motivation (Eccles, 2005, 2009, n.d.; Eccles, Barber, Updegraff, & O'Brien, 1998; Wigfield & Eccles, 2000). According to EVT (top of Figure 3), the decision an individual makes about a potential course of action is based on an interaction between expectancy (the degree to which the individual expects to succeed) and the anticipated value (including costs) associated with the action. Expectancy is composed of two factors: ability self-concept represents the extent to which an individual believes he or she can succeed, and task difficulty describes an individual's perception of how challenging the activity will be. There are four kinds of values: intrinsic value describes one's personal enjoyment in performing the activity, utility value pertains to the benefit one ascribes to the activity in achieving future goals or rewards, attainment value represents the alignment between one's personal identity and the activity, and cost is the level of sacrifice involved in participating in the activity.

For our purposes, we applied EVT to understand factors that influence faculty adoption of effective teaching practices. Our interpretation of EVT (bottom of Figure 3) allowed us to answer the who, what, and how questions of our decision-making framework by taking advantage of both beliefs faculty might have in their ability to successfully implement effective teaching practices and values they might place on using these practices. Our project involved ascertaining through a series of focus groups those factors that could influence faculty adoption of effective teaching practices and then tailoring our plan on the basis of this data.

## Organizational Change

Research about organizational change theories also provides important guidance for our institutional change plan. Henderson and his colleagues conducted a comprehensive review of change strategies in STEM educational reform (Beach, Henderson, & Finkelstein, 2012; Henderson et al., 2011). They identified patterns in reported change strategies that they classified along two dimensions: the target of the intended change efforts (individuals versus structures) and the nature of the intended outcome (prescribed versus emergent). Drawing on their findings, they described a Four Categories of Change Strategies model:

**Curriculum and Pedagogy** (individuals, prescribed): Strategies based on the use of specialized knowledge to teach others specific ways to organize or teach a subject.

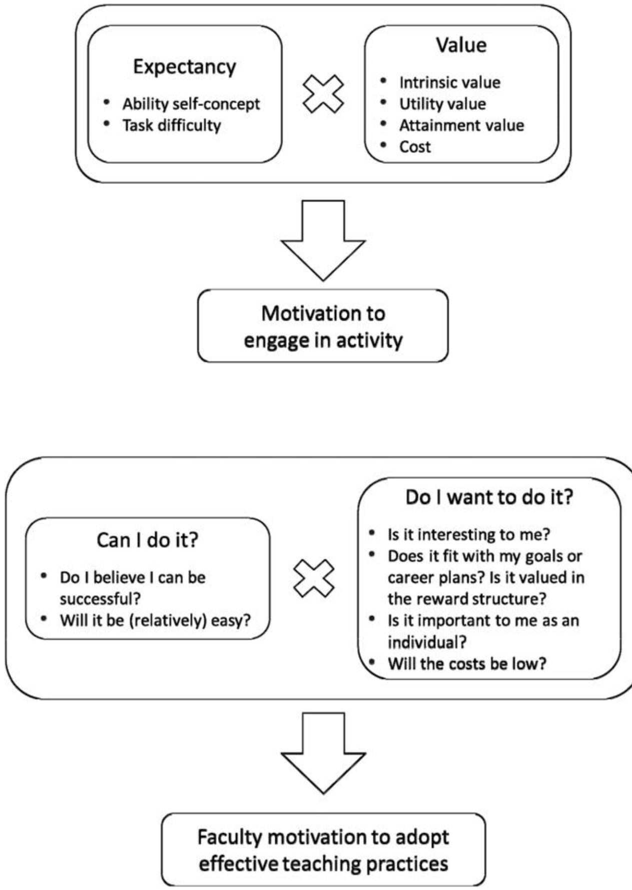


**Figure 3** The expectancy value theory of motivation. The top part of the figure shows the standard theory and the bottom part shows our context-specific interpretation of the theory.

**Reflective Teachers** (individuals, emergent): Strategies based on encouraging and supporting reflective practices by individual instructors that lead to instructor-identified and defined change outcomes.

**Policy** (structures, prescribed): Strategies based on the use of specialized knowledge to develop new environmental features.

**Shared Vision** (structures, emergent): Strategies based on catalyzing or empowering individuals to come together and work towards collectively envisioned change.

According to Henderson et al. (2011), most ongoing institutional change efforts typically are one or a combination of the first two categories. These efforts often take a bottom-up approach to institutional transformation, whereby faculty members are directly engaged in change efforts. The policy and shared vision strategies are also prevalent and often involve a top-down approach in which managers implement a new structure or policy. They concluded by noting three characteristics of successful change efforts (p. 952). First, effective change strategies must be aligned with or seek to change the beliefs of the individuals involved. Second, change strategies need to involve long-term interventions, lasting a semester, a year, and longer. Third, colleges and universities are complex systems, so developing a successful change strategy means first understanding the system and then designing a strategy that is compatible with this system.

Following Henderson et al.'s (2011) suggestion that "change strategies that span multiple categories appear to be fruitful" (p. 979), we designed a two-part change plan that includes a combination of the four categories of change strategies. It uses both a bottom-up approach, focusing on faculty knowledge and motivation, and a top-down approach, focusing on administrators and policy.

## Importance of Local Context

National research alone is often not sufficient to motivate faculty to change their teaching practices – local evidence has an important role in organizational change and instructional development (Bergquist, 1992; Henderson et al., 2011; Kezar & Eckel, 2002; Singer, 2008). Henderson and Dancy (2011) noted that "data collected elsewhere does not typically cause faculty to change their minds" (p. 7) and suggested that change agents aim to understand the local teaching environment and its effect on instructors' ability and inclination to be innovative. Graham (2012) cited the need for gathering local evidence as part of the preparatory work in educational reform. Singer (2008) similarly emphasized that "the legitimacy of a given form of evidence depends on the context of the question being asked" (p. 1), and McKenna, Froyd, King, Litzinger, and Seymour (2011) highlighted the importance of being explicit about the context for change. According to Hora (2012),

> Local ways of thinking, decision-making, and acting will influence how a particular reform or innovation is interpreted, adopted, or rejected; . . . and one way to increase the prospects for program success is to design interventions that reflect a grounded understanding of local practice and experiences. (p. 230)

Our local context is that of a large, public, doctoral research institution in the Midwest. The University of Michigan is categorized by the Carnegie Classification as having very high research activity. In 2012, the undergraduate and graduate enrollments of the university exceeded 40,000 (27,979 and 12,714, respectively), and the College of Engineering enrolled 5,741 undergraduate and 1,617 graduate students (American Society of Engineering Education, 2013). The college comprises more than 350 tenured or tenure-track faculty and 120 research faculty.

Providing further context for our university was a critical element of our project that guided the design of our two-part change plan. To do this, we collected local data from three sources. First, we conducted faculty focus groups to determine factors that influence adoption of effective teaching practices at the University of Michigan College of Engineering. Second, we performed classroom observations to ascertain teaching practices currently in use by our faculty. And third, we developed and administered a student survey to identify teaching practices that our students perceive to enhance their success.

## Factors Influencing Faculty Teaching Practices

To determine factors that influence faculty adoption of effective teaching practices at the University of Michigan College of Engineering, we conducted a series of faculty focus groups. We chose a focus group approach, rather than individual interviews, because we could accommodate more faculty, and because we expected that hearing others' perspectives would stimulate a broader, richer discussion among the participants. Focus groups allowed us to hear about the range of barriers and enablers faculty perceived in their adoption of effective teaching practices. Although faculty might have been influenced by responses of others in the group, we set the stage for candor by emphasizing that there were no right or wrong answers and by ensuring that each person would likely have different experiences, values, and challenges. We designed the focus groups around existing research on barriers to and enablers for adoption, and we used the lens of EVT. Some details of our study have been presented elsewhere (Finelli, Richardson, & Daly, 2013).

## Methods

**Focus group protocol** We designed a 90-minute focus group to elicit faculty perspectives about factors that influence adoption of effective teaching practices and to identify how the factors aligned with EVT (Wigfield & Eccles, 2000). In the focus groups, we described EVT as a framework for faculty motivation, and we discussed each element of the theory separately. (Because ability self-concept and task difficulty are highly correlated, we presented only the broader factor of expectancy.) This framework provided a structure for discussion and helped clarify that our intent was to hear faculty's perceptions about using effective teaching practices rather than to judge whether or not they employed the practices. We presented three effective teaching practices (using active student-centered learning strategies, having students work in groups, and incorporating authentic problems and activities), and we probed faculty members' expectancies and values related to adopting those practices. To achieve consistency, each of four focus groups was conducted by the same pair of researchers: an experienced instructional consultant with an engineering Ph.D. (first author) and a research assistant (third author).

**Sample** All full-time engineering faculty who were teaching undergraduate courses during the time of our study ($N = 186$) were identified as possible focus group participants, and we used a rolling recruitment process to invite a random subset of the eligible population. Altogether, we invited 96 faculty members, and 26 (27%) attended one of four separate focus group sessions we conducted. Demographics for the 26 faculty members in the focus groups and the 186 faculty members in the University of Michigan College of Engineering are shown in Table 1.

The gender composition of our focus groups (15% females) was essentially the same as that of our engineering college (16% females). The department representation was also similar. Full professors were somewhat underrepresented in our focus groups (27% versus 44%), assistant professors were somewhat overrepresented (35% versus 20%), and other ranks were equivalent (associate professors composed 15% of both groups, and lecturers composed 23% of the focus groups versus 20% of the college). Though there may have been a slight bias in focus group for responses from junior faculty, our data included a full range of responses.

**Analysis** After the focus group data were transcribed and imported into NVivo for qualitative analysis, we studied the data through a combination of both inductive and deductive analyses. This integrated approach has been recommended by Patton (2002) and used by many other researchers (e.g., Turns, Eliot, Neal, & Linse, 2007). Our initial inductive data coding process was guided by the constant comparative analysis method, and it consisted of an iterative, line-by-line analysis to identify emerging themes. We discovered patterns in how participants discussed barriers and enablers through multiple readings of the focus group transcripts, and we confirmed the patterns through careful review and discussion as a team at regular intervals. We concluded our inductive work when no new patterns emerged. Next, we defined themes from the resulting patterns, clarified the distinguishing features of each,

**Table 1** Faculty Demographics

| Characteristic | Focus groups (*N* = 26) % | Eligible population (*N* = 186) % |
|---|---|---|
| Gender | | |
| Male | 84.6 | 84.4 |
| Female | 15.4 | 15.6 |
| Department | | |
| Aerospace Engineering | 7.7 | 5.4 |
| Atmospheric, Oceanic, and Space Sciences | 7.7 | 5.9 |
| Biomedical Engineering | 0.0 | 4.8 |
| Chemical Engineering | 3.8 | 4.8 |
| Civil and Environmental Engineering | 7.7 | 7.0 |
| Electrical Engineering and Computer Science | 15.4 | 28.0 |
| Industrial and Operations Engineering | 7.7 | 9.1 |
| Materials Science and Engineering | 7.7 | 4.8 |
| Mechanical Engineering | 19.2 | 14.0 |
| Naval Architecture and Marine Engineering | 11.5 | 5.4 |
| Nuclear Engineering and Radiologic Sciences | 3.8 | 4.8 |
| Other | 7.7 | 5.4 |
| Rank | | |
| Professor | 26.9 | 43.5 |
| Associate professor | 15.4 | 15.1 |
| Assistant professor | 34.6 | 19.9 |
| Lecturer or adjunct professor | 23.1 | 21.5 |

*Note*. All full-time engineering faculty who were teaching undergraduate engineering courses during the time of the study are considered the eligible population.

and identified overarching categories. Finally, we applied a deductive approach by aligning the themes with primary factors of EVT.

## Findings and Discussion

Our analysis produced 26 individual themes of factors that influence faculty members' decisions to adopt effective teaching practices, and we grouped the themes into seven categories. Our code table (Table 2) gives definitions for the 26 themes and lists the EVT factor with which each theme was primarily aligned (some of our themes aligned with multiple EVT factors, and one theme did not align with any). For example, one prominent theme cited in all four focus groups is that teaching evaluations can be an important factor in faculty decisions to adopt (or not adopt) effective teaching practices. This theme is categorized as Infrastructure and Culture, and it is aligned with utility value in the EVT framework. Similarly, having personalized support while learning how to adopt effective teaching practices was mentioned in all groups as a factor in faculty decisions to use those practices. This theme is categorized as Knowledge and Skills of Effective Teaching Practices, and it is aligned with the EVT factor of expectancy. In the next section, we summarize the overarching categories of our analysis and present some sample data excerpts.

**Infrastructure and Culture** Faculty participants most often cited the infrastructure and culture of the University of Michigan as a factor influencing adoption of effective teaching

**Table 2** Code Table from Faculty Focus Groups

| Category | Theme and definition | EVT factor |
|---|---|---|
| Infrastructure and Culture | | |
| | *Teaching evaluations*. Standard end-of-term student evaluations of teaching | U |
| | *Incentives and rewards*. External benefits including money, grants, and release time | U |
| | *College teaching policies*. University rules and regulations regarding teaching | U |
| | *Didactic teaching tradition*. Traditional teaching style with a teacher-centered focus | U |
| | *Tenure criteria*. Required elements for the tenure casebook and relevant emphasis on each | U |
| | *Institutional emphasis on research*. Importance placed on research success by university | n/a |
| Knowledge and Skills of Effective Teaching Practices | | |
| | *Access to information*. Perceived availability of material about effective teaching practices | E |
| | *Credible research evidence*. Convincing research on positive influence of effective teaching | E, A |
| | *Personalized support*. Individualized guidance of an experienced mentor during implementation of new teaching practice | E |
| Student Experience | | |
| | *Student reaction (real or perceived)*. Student response to use of effective teaching practices | A |
| | *Student learning outcomes*. Essential skills and knowledge that students learn | A |
| | *Student attentiveness and participation*. Level of student engagement | A |
| | *Responsiveness to student feedback*. The way an individual uses student feedback (3) | A |
| | *Rapport*. The positive student-faculty relationship (2) | A |
| Time | | |
| | *Time (general)*. Time required to change practices | C |
| | *Time to restructure a course*. Time required to transform an existing course | C |
| | *Time to learn about effective teaching practices*. Investment of time needed to learn about effective teaching practices (3) | C |
| | *Preparation time for class sessions*. Time required to plan class sessions that include effective teaching practices (2) | C |
| Classroom and Curriculum | | |
| | *Curriculum flexibility*. Control an individual has (or doesn't have) over the content and structure of his/her course | E |
| | *Class size*. The number of students in the classroom (3) | E |
| | *Physical classroom layout*. The structure of the physical classroom space (2) | E |
| Personal Disposition | | |
| | *Passion for teaching*. The level of an individual's interest | I |
| | *Confidence in teaching ability*. An individual's degree of confidence in his/her teaching abilities (3) | E |
| | *Comfort with role change*. Level of comfort with taking on a different teaching role (2) | A |
| Networking and Community | | |
| | *Collegial discussions*. Ability to communicate with fellow instructors about teaching | E, I, A |
| | *Openness of classroom*. Opportunity to observe teaching of others and vice versa (2) | E, I, A |

*Note*. E = expectancy; I = intrinsic value; U = utility value; A = attainment value; and C = cost. Each theme was mentioned in all four focus groups unless noted in parentheses.

practices. While faculty sometimes noted that Infrastructure and Culture could enable them to adopt effective teaching practices, usually these were cited as barriers. One participant observed: "The reality is, what's important in the casebook [the materials prepared for the promotion and tenure dossier] is the external letters about what an eminent scholar you all are. There really is not an effective way to give us equal credit for becoming effective teachers."

Because faculty saw many of these factors as directly related to institutional priorities, lowering the barriers they present would require that the administration play a role in changing the institutional culture of the college. Finding ways to reduce these barriers became the main substance of our administrative change plan.

**Knowledge and Skills of Effective Teaching Practices** Faculty described their interest in learning about effective teaching practices, and they noted that having credible research evidence was critical. As one participant commented, "If I really understood that there was a particular approach or technique that would be effective in my classes, I don't think I would have any trouble investing the time to learn it." For this participant, having a deeper knowledge about effective teaching practices would motivate him to invest in changing his teaching style.

Faculty also expressed a desire for being supported through personalized assistance when making the transition to effective teaching practices. One participant stated:

> One way to mitigate the fear is [for the teaching center] to do more handholding and saying, "If you want us to try this in your course, we will come and help you and essentially show you how to do it, help set it up, and shield you from the negative aspects that might occur as a result of trying it."

**Student Experience Category** Faculty expressed concern about the Student Experience and agreed they would be more motivated to adopt effective teaching practices if they were convinced that students would truly learn more material, would learn it more deeply, and would be more engaged. As one participant commented:

> If faculty had a clear sense of what the positive outcomes are of doing this – that you see students who have a higher level of understanding or, you know, more investment in the class or something like that – that might be a strong motivator.

Thus, having a clear sense that using effective teaching practices would improve the student experience would be an enabler for this participant. On the other hand, faculty feared that if their attempts to adopt effective practices might prompt negative student feedback, they would be less likely to try.

**Time** Not surprisingly, lack of time was a common barrier. One faculty member commented on the lack of time to learn about effective teaching practices: "I don't have the time to go through the literature for the newest teaching . . . or research-based efforts or teaching methods myself." Other time-related barriers included the time required to restructure a course and the heavy time pressures of doing research.

**Classroom and Curriculum** Faculty noted that having smaller classes or modular classrooms could influence their willingness to adopt effective teaching practices. They also believed that a more flexible curriculum might better accommodate their use of effective teaching practices, often on the basis of a belief that effective teaching practices are inefficient: "The course I teach in mechanical engineering has a fairly well-defined, tight schedule. I can't even keep up with the schedule. I usually don't get everything done I'm supposed to."

**Personal Disposition** Faculty acknowledged that aspects of their personal disposition played a critical role in their decisions to adopt effective teaching practices. For instance, one faculty member noted that being passionate about teaching would be a positive motivator: "I really like teaching also, so that's . . . that's a big motivation . . . it really doesn't matter to me if it fits in the reward structure . . . but I really like teaching and want to improve on my teaching."

**Networking and Community** Faculty discussed colleagues as both potential barriers to and enabler for adopting effective teaching practices. One participant noted the power of community building in this regard: "I've found that talking to peers is a lot more motivating and a lot more enlightening than sort of hearing an expert talking about the research."

Faculty participants implied that they would be more willing to adopt a new teaching practice if their colleagues were encouraging, while they would be less likely to do so if their fellow faculty had a negative experience and warned against it. Participants also noted that observing colleagues using effective teaching practices or having fellow faculty observe them trying these methods could be enablers. One participant noted:

> I think the chance to see and be seen by colleagues who have thought about their teaching skills and developed them would be very useful. So evaluating and being evaluated by colleagues and having frank discussions about tools that we've tried and failed and tools that we've tried and succeeded with would be very useful.

**Alignment with EVT** Each EVT factor aligned with at least one of our 26 themes, and most themes within a given category clustered around a specific factor. Themes in the Infrastructure and Culture category all aligned with the utility value of EVT. In this case, most faculty felt that the University of Michigan College of Engineering's existing policies – emphasizing research and employing traditional teaching metrics and tenure criteria – could lessen the utility value they placed on adopting effective teaching practices and thus could decrease their motivation to do so.

Themes in the Knowledge and Skills of Effective Teaching Practices and the Classroom and Curriculum categories were primarily related to expectancy. Faculty felt that having access to good resources about effective teaching practices, having personalized support as they implemented them, and having flexibility in the classroom and curriculum could increase their expectation to succeed.

Themes in the Student Experience category aligned primarily with faculty's attainment value. Faculty noted that the potential ability to improve student learning, attentiveness, and participation could improve the value they placed on using effective teaching practices, as could the possibly positive student reaction and the ability to be responsive to student feedback.

Finally, themes in the Personal Disposition and Networking and Community categories were aligned with various factors of EVT. Having a passion for teaching appealed to faculty's intrinsic value, being confident in the ability to implement effective teaching practices aligned with expectancy, and being comfortable with taking on a new role was related to faculty's attainment value. And not surprisingly, all themes in the Time category aligned most closely with the cost factor of EVT. Faculty felt that the time required to learn about and implement effective teaching practices could be a barrier to adoption.

## Implications for Our Change Plan

Our focus group findings allowed us to explore barriers to and enablers for adopting effective teaching practices most relevant for our University of Michigan engineering faculty. Not surprisingly, many of the themes that emerged from our focus groups aligned with previous research (Dancy & Henderson, 2010; Froyd et al., 2013; Hora, 2011, 2012; Prince et al., 2013). However, because the themes represented the perspectives of our own participating faculty, they provided important context in the design of our plan. Table 3 shows the ways the data informed our decision-making process.

**Table 3** Decisions about Institutional Change Plan Based on Faculty Focus Groups

- Faculty action plan (FAP)
  - Who (Participants)
    - Because personalized support is a key theme, the FAP should include coaching from experienced faculty developers.
    - Because personal disposition is important, the audience of the FAP should be participants with an inherent interest in teaching.
    - Because networking and community building are critical, the FAP should include opportunities to interact with peers and like-minded faculty. It should also include a range of experience level so less-experienced faculty can learn from more-experienced colleagues.
  - What (Content)
    - Because having credible research evidence is a strong motivator, the FAP should include topics having the strongest research support such as active learning and rapport building.
    - Because time is a key barrier, the FAP should focus on pedagogies that can be easy to learn and implement, and it should emphasize the ways the pedagogies can save time in the classroom.
  - How (Structure)
    - Because incentives and rewards are key enablers, the FAP should include ways to incentivize participation.
    - Because knowledge and skills of effective teaching practices are important, the FAP should include easy-to-understand research-based pedagogies, providing direct access to credible research.
    - Because personalized support as faculty try new teaching practices is a theme, the FAP should be practice-based and should include reflections about what went well in the implementation and what could be improved.
    - Because improving the student experience is a powerful enabler, the FAP should highlight practices that increase student learning and engagement.
    - Because student reaction is a key theme, the FAP should include an opportunity for participants to review and act on midterm student feedback.
    - Because confidence in teaching ability is an important theme and faculty expressed vulnerability about using effective teaching practices, the FAP should provide a safe environment for participants.
    - Because networking and community building are important, the FAP should be based on a community of practice or a faculty learning community model.
    - Because the influence of colleagues is a key motivator, the FAP should include observations of good teachers in action.
- Administrative change plan (ACP)
  - Who (Participants)
    - Because infrastructure and culture play an important motivational role, the ACP should aim to influence high-level college administrators who review tenure casebooks, who establish tenure criteria, and who can affect changes to college teaching policies.
  - What (Content)
    - Because infrastructure and culture is the most common barrier, the ACP should seek to influence things like teaching evaluations, the reward structure, and tenure criteria.
    - Because time is a frequently-cited barrier, the ACP should focus on ways to recognize and reward the effort it takes to learn new teaching practices or restructure a course.
    - Because classroom and curriculum is a key theme, the ACP should advocate for classroom updates and curriculum flexibility.
  - How (Structure)
    - Because there is a wide range of barriers to and enablers for adopting effective teaching practices, the ACP should present examples of typical faculty experiences, possibly in the form of *personas*.
    - Because knowledge and skills of effective teaching practices are critical, the ACP should seek institutional support for faculty development and find opportunities to place value on the activities.

Findings from our focus groups helped us make important decisions about our faculty action plan and our administrative change plan. For instance, we found that having credible research that is situated in the local student context was a factor that informed the what element in the who/what/how framework and that could improve both expectancy and attainment value. Thus, we incorporated these factor into our faculty action plan. Similarly, because our faculty said networking and community building could enhance intrinsic value (how elements), we included these as critical factors of our faculty action plan; and because personal disposition was a key category we observed in the faculty focus groups, our faculty action plan involved an application process to select participants with an inherent interest in teaching (a who element). Further, our program aimed to decrease barriers to adoption by emphasizing the potential time-saving nature of effective teaching practices (a what element) and providing a safe environment for participants (a how element).

The focus group findings also had important implications for our administrative change plan. The data helped us identify high-level administrators as a potential audience for our efforts (a who element) and suggested issues such as teaching evaluations and support for instructional development initiatives to address in our efforts (what and how elements).

Additionally, our findings from the faculty focus groups identified two other types of local evidence that would be important to collect. First, they showed us that faculty in our focus groups did not have a clear understanding of their colleagues' teaching practices and did not recognize the genuine need for improvement. Thus, our work to develop a change plan included classroom observations to ascertain our faculty's current teaching practices. Second, faculty were very concerned about their students' responses to new teaching practices, and they were not convinced that national data would align with data from our campus. Thus, in the design of our change plan, we also included a student survey to determine our students' perceptions of supportive teaching practices.

## Current Teaching Practices

Because we aimed to accelerate the adoption of effective teaching practices in creating our plan for institutional change, it was important to investigate the teaching practices currently in use by our faculty. To collect this evidence, we observed a random sample of engineering undergraduate courses and studied the degree of student involvement in these courses. Some details of our study have been presented elsewhere (Finelli & Daly, 2011).

### Methods

**Observation Protocol** The Teaching Dimensions Observation Protocol (Hora & Anderson, 2012; Hora & Ferrare, 2012; Hora, Ferrare, & Anderson, 2009; Hora et al., 2012) guided our classroom observations. This standard protocol includes a list of items to code in each five-minute segment of the course: types of instructional method used, number and kinds of questions asked and answered, degree of student engagement, cognitive activity of students, and material artifacts. We added a code to document instances when students did not respond to a question asked by a faculty instructor. We were especially interested in the ways in which faculty used active learning strategies (i.e., made lectures more interactive by engaging students in activities such as reading, writing, discussion, or problem solving), so we added a category for types of active learning such as small group work, think-pair-share (where students first consider a question individually, then pair with a neighbor to discuss the question, and then prepare to share the answer), student presentations, and other forms of active learning. Two experienced instructional consultants, both of whom have engineering degrees, were trained to use the observation protocol and to apply it consistently.

**Sample** We used a stratified, random selection process to identify 30 typical engineering undergraduate courses taught by engineering faculty for possible observation. First, we excluded all courses with fewer than 10 students enrolled, all graduate courses, all courses not led by an engineering faculty member, and all laboratory, discussion, and independent-study courses. Then, to be sure we identified a broad range of courses to observe, we categorized each of the remaining 216 undergraduate courses as introductory or upper division (100/200-level and 300/400-level, respectively) and as small, medium, or large (enrollments of 10–40, 41–74, and 75 or more, respectively). Finally, we randomly selected classes in each of five categories: introductory, small or medium; introductory, large; upper division, small; upper division, medium; and upper division, large. We asked the primary faculty member for each of the resulting 30 courses to allow us to observe a typical class session, and 26 (87%) agreed. Our participants varied according to gender (two women and 24 men), department, and faculty rank (11 full professors, six associate professors, three assistant professors, and six lecturers). Because we implemented a systematic selection process and achieved a high response rate, the observed classes represent the College of Engineering well in terms of class level and size. Information about the respective courses of the 26 participants is shown in Table 4.

**Analysis** We analyzed the five-minute segments of our classroom observations to determine whether the faculty asked any type of question, the faculty asked any nonproductive questions (i.e., rhetorical questions or ones that were not answered by the students), the faculty asked any substantive questions that were answered by the students and therefore contributed to student engagement, the students asked any substantive questions, and the faculty used any active learning approaches we defined in our protocol. Then for each class, we computed the percentage of segments during which each of these events occurred (Table 5). For example, during one observation (No. 1), the faculty member asked at least one question during 81% of the five-minute segments, asked questions with no student response in 31% of the segments, and asked questions to which students responded in 81% of the five-minute segments. Similarly, students asked questions in 31% of the segments, and the faculty member used some type of active learning in 25% of the segments. Since a single five-minute segment could include multiple activities, the data do not necessarily sum to 100%.

## Findings and Discussion

Table 5 reveals the high variation in teaching style we observed among participants. During one observation (No. 22), the faculty member asked no questions, while during another (No. 20), 94% of the five-minute segments included at least one faculty question. The table also shows that some faculty asked numerous questions but did not always succeed in engaging students. For example, during one observation (No. 9) the faculty asked questions in 75% of the five-minute segments, but most of those resulted in no student response (only 6% of the 5-minute segments included a substantive question). Further, students asked questions in only 44% of the segments, and the faculty used no active learning in the observed class period. On the other hand, some faculty members with a high percentage of segments in which they asked nonproductive questions also had a high percentage with questions to which students did respond (No. 8). This combination of nonproductive and substantive questions could indicate the faculty rephrased questions or introduced new questions to facilitate student responses.

We observed limited use of active learning in our sample – 16 of the observed faculty, more than 60%, used none. Some faculty, though, did implement active learning successfully

**Table 4** Information about Observed Classes

| | Observation number and department | Students enrolled |
|---|---|---|
| Introductory, small or medium | | |
| 1 | Mechanical Engineering | 74 |
| 2 | Materials Science and Engineering | 60 |
| 3 | Aerospace Engineering | 43 |
| Introductory, large | | |
| 4 | Atmospheric, Oceanic, and Space Sciences | 75 |
| 5 | Atmospheric, Oceanic, and Space Sciences | 182 |
| 6 | Materials Science and Engineering | 189 |
| 7 | Biomedical Engineering | 91 |
| 8 | Mechanical Engineering | 92 |
| Upper division, small | | |
| 9 | Computer Science and Engineering | 31 |
| 10 | Biomedical Engineering | 24 |
| 11 | Atmospheric, Oceanic, and Space Sciences | 10 |
| 12 | Computer Science and Engineering | 31 |
| 13 | Atmospheric, Oceanic, and Space Sciences | 18 |
| 14 | Mechanical Engineering | 33 |
| 15 | Undergraduate Education | 28 |
| Upper division, medium | | |
| 16 | Industrial and Operations Engineering | 55 |
| 17 | Electrical and Computer Engineering | 63 |
| 18 | Computer Science and Engineering | 63 |
| 19 | Mechanical Engineering | 59 |
| 20 | Computer Science and Engineering | 48 |
| 21 | Industrial and Operations Engineering | 44 |
| 22 | Materials Science and Engineering | 55 |
| Upper division, large | | |
| 23 | Aerospace Engineering | 80 |
| 24 | Chemical Engineering | 75 |
| 25 | Industrial and Operations Engineering | 75 |
| 26 | Industrial and Operations Engineering | 93 |

*Note*. Class type includes class level (introductory or upper division) and class size (small = 10–40 students enrolled, medium = 41–74 students, or large = 75 or more).

in their teaching: a few used multiple active learning exercises or a single active learning exercise requiring significant time. These faculty members provided important examples of effective teaching that we integrated into our change plan.

## Implications for Our Change Plan

The data we collected about current teaching practices guided our decisions as we designed both our faculty action plan and administrative change plan. Table 6 shows how these data informed our who/what/how questions.

As part of our faculty action plan, we presented evidence of the limited degree of student involvement we observed as a way to facilitate need recognition (Rogers, 2003). The faculty observations also provided important exemplars of effective teaching that we integrated into our faculty action plan by recommending classroom visits of specific engineering faculty to participants in our program. In our administrative change plan, the representative snapshot of

**Table 5** Degree of Student Involvement in Observed Classes

| Observation number | Percentage of five-minute segments having at least one: Any type faculty question | Nonproductive faculty question | Substantive faculty question | Substantive student question | Active learning exercise |
|---|---|---|---|---|---|
| 1 | 81.3 | 31.3 | 81.3 | 31.3 | 25.0 |
| 2 | 68.8 | 37.5 | 62.5 | 31.3 | 25.0 |
| 3 | 92.3 | 53.8 | 76.9 | 38.5 | 0.0 |
| 4 | 93.3 | 26.7 | 80.0 | 13.3 | 26.7 |
| 5 | 25.0 | 12.5 | 18.8 | 12.5 | 18.8 |
| 6 | 60.0 | 30.0 | 50.0 | 20.0 | 0.0 |
| 7 | 62.5 | 50.0 | 37.5 | 0.0 | 0.0 |
| 8 | 90.0 | 80.0 | 70.0 | 20.0 | 0.0 |
| 9 | 75.0 | 75.0 | 6.3 | 43.8 | 0.0 |
| 10 | 50.0 | 41.7 | 16.7 | 16.7 | 0.0 |
| 11 | 50.0 | 18.8 | 43.8 | 25.0 | 18.8 |
| 12 | 26.7 | 13.3 | 13.3 | 33.3 | 0.0 |
| 13 | 60.0 | 40.0 | 50.0 | 40.0 | 0.0 |
| 14 | 90.9 | 81.8 | 72.7 | 36.4 | 0.0 |
| 15 | 80.0 | 50.0 | 80.0 | 30.0 | 30.0 |
| 16 | 35.0 | 15.0 | 25.0 | 0.0 | 15.0 |
| 17 | 66.7 | 58.3 | 25.0 | 8.3 | 0.0 |
| 18 | 56.3 | 43.8 | 37.5 | 12.5 | 0.0 |
| 19 | 62.5 | 43.8 | 25.0 | 37.5 | 0.0 |
| 20 | 93.8 | 56.3 | 87.5 | 50.0 | 12.5 |
| 21 | 78.6 | 35.7 | 64.3 | 21.4 | 42.9 |
| 22 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23 | 43.8 | 18.8 | 43.8 | 43.8 | 0.0 |
| 24 | 88.9 | 55.6 | 66.7 | 44.4 | 0.0 |
| 25 | 87.5 | 68.8 | 75.0 | 18.8 | 0.0 |
| 26 | 56.3 | 12.5 | 50.0 | 43.8 | 12.5 |
| **Average** | **64.4** | **40.4** | **48.4** | **25.9** | **8.7** |

current teaching practices was important contextual information that we used to help the administration establish policies for fostering college-wide changes in faculty teaching practice. We also used the data to establish a baseline from which to measure change.

## Student Perceptions of Teaching Practices

The identification of teaching practices perceived by our engineering students as supporting their success also helped guide the design of our faculty action plan. We collected this data by developing and administering a student survey and comparing the practices of supportive and nonsupportive instructors. Some details of our study have been presented elsewhere (Daly, Finelli, Al-Khafaji, & Neubauer, 2012).

There is extensive research on teaching practices effective in promoting student success (Ambrose et al., 2010; Chickering & Gamson, 1987; Felder, 1993; Felder, Woods, Stice, & Rugarcia, 2000; Murray, 1985; Smith et al., 2005; Svinicki & McKeachie, 2011; Tinto, 1994; Wankat & Oreovicz, 1993), and we began by categorizing effective faculty teaching practices:

**Table 6** Decisions about Faculty Action Plan Based on Classroom Observations

| |
|---|
| Who (Participants) |
| Because we observed mostly lecture-based teaching, our faculty action plan should engage faculty who are using mostly didactic teaching. |
| Because some faculty members we observed made effective use of active learning, our faculty action plan should include leadership from these faculty. |
| What (Content) |
| Because we observed limited good use of questioning and of active learning, our faculty action plan should focus on some of these easy-to-implement practices. |
| How (Structure) |
| Because we observed some highly successful faculty, our faculty action plan should highlight some of these key faculty, perhaps through a classroom observation program. |

**Rapport** Faculty can improve student success by creating a welcoming and supportive learning environment through such means as being accessible to students, learning student names, sharing personal enthusiasm and experiences related to course material, soliciting student ideas and feedback, communicating openly, and showing empathy. (Fleming, 2003; Granitz, Koernig, & Harich, 2009; Tobias, 1990)

**Instructional style** Faculty can promote students' engagement and deep thinking about content by incorporating learning activities in class that require student involvement and cooperation and by incorporating a variety of approaches to teaching. (Murray, 1985; Prince, 2004; Smith et al., 2005)

**Feedback and evaluation** Providing high-quality and timely feedback can increase student success. Good practices include communicating clearly about grading criteria and policies, providing multiple opportunities for students to check their own progress, and giving students frequent feedback on their work. (Angelo & Cross, 1993; Stiggins, 2002)

**Course goals** Instructors can support student progress in a course by setting clear expectations of what students should achieve and what work is expected, by stressing key points in each class, and describing how those connect to the larger goals. (Fink, 2007; Wiggins & McTighe, 2005)

**Content** Connecting content to students' prior knowledge and establishing the relevance of course material to applications in practical and everyday situations are critical teaching practices that have been linked to student success. (Svinicki, 2004; Tobias, 1990)

We used these five categories to provide a research-based framework for our student survey.

## Methods

**Survey instrument** We were not aware of any existing validated instruments for students to report teaching practices of specific instructors, so we operationalized effective teaching practices using our five categories. We also grounded survey items in students' actual experiences by asking students to reflect on two specific instructors they had in a typical engineering course. First, they were asked to consider a specific faculty member who had had a positive impact on their success (i.e., one who supported their learning, engagement, and interest in the field). If there was one, students then indicated whether that supportive faculty member had employed each of 41 specific teaching practices. Next, they were asked to reflect on a specific faculty member who had inhibited their success (if there was one) and to indicate whether that nonsupportive faculty member had employed each of the same 41 teaching practices.

Our survey did not include psychometric items, and our goal was not to consolidate items into scales, so to ensure that our instrument had content validity, we pilot tested it in two phases. First, we applied a think-aloud survey development technique (Collins, 2003) in which two engineering undergraduate students read the questions aloud and explained their thinking as they completed the survey. We revised the instrument accordingly. Second, we tested the instrument with six engineering undergraduate students. They completed the survey and provided feedback on the questions, and we finalized the instrument based on that feedback.

**Sample** We identified all undergraduate engineering students having at least a sophomore standing (we considered first-year students to have an insufficient number of previous engineering courses to participate), and we divided the resulting group of 4,153 students into four achievement-based quartiles using cumulative grade point average. We used a stratified, random selection process and invited 2,000 engineering undergraduates to participate. To increase the potential response rate, students received a $15 incentive for their participation, an amount we chose through our pilot tests. A total of 386 (19%) completed the survey, which we administered electronically using Survey Monkey.

**Table 7** Demographics of Student Survey Respondents

| Characteristic | Sample ($N = 386$) % |
|---|---|
| Gender | |
| Male | 64.2 |
| Female | 35.8 |
| Quartile | |
| Upper | 25.1 |
| Upper mid | 25.6 |
| Lower mid | 26.7 |
| Lower | 22.5 |
| Class level | |
| Sophomore | 27.7 |
| Junior | 36.3 |
| Senior | 34.5 |
| Other | 1.6 |
| Race/ethnicity | |
| White | 74.9 |
| Asian | 24.4 |
| Black | 2.6 |
| American Indian or Alaskan Native | 1.3 |
| Hispanic/ Latino | 3.6 |

*Note*. Students could check multiple race/ethnicity boxes; thus the total count here is greater than our population.

Table 7 gives the population demographics for our student survey respondents. The proportions of female students and non-white students responding to our survey were slightly different than those in our College Engineering during the same timeframe (University of Michigan Office of the Registrar, 2011; 36% female respondents versus 21% in College of Engineering; 25% nonwhite respondents versus 27% in College of Engineering). Because our sample was intended to reflect student perspectives across achievement level rather than across gender or race, and because our data were equally distributed across the four achievement levels, we were confident that the demographic variation would not affect the degree to which our data would be compelling to our faculty and administrators.

## Findings and Discussion

Of our 386 respondents, 309 (80%) identified a supportive and 172 (45%) identified a nonsupportive one. We aggregated the responses and computed the rate of occurrence among both supportive and nonsupportive faculty of each of the 41 teaching practices. Figure 4 shows the 10 teaching practices for which the difference between supportive and nonsupportive faculty was greatest.

These data highlight teaching practices that, from the students' perspective, have the greatest potential to increase student success. For example, 99% of the students noted that

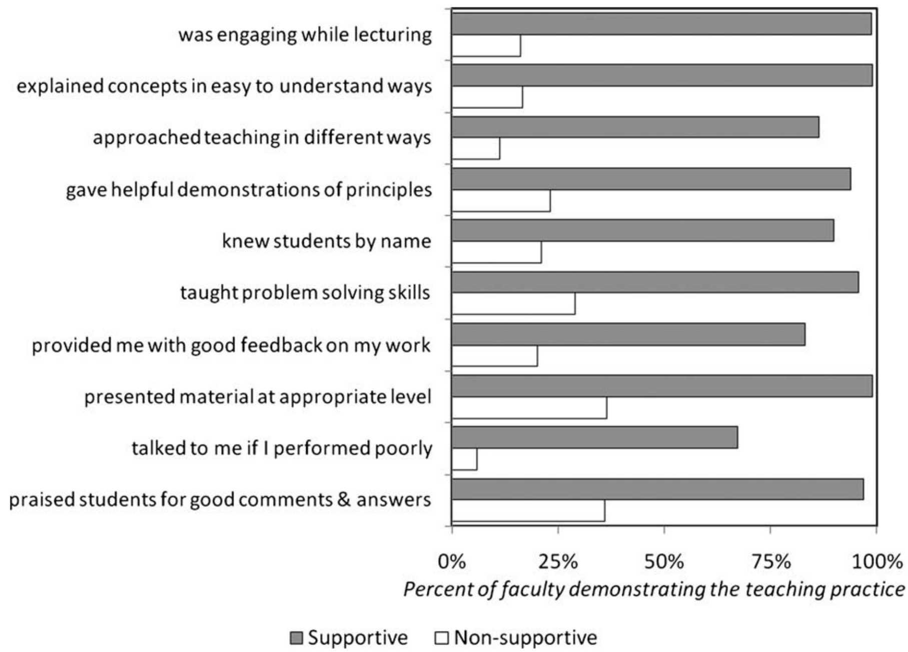


**Figure 4** Ten teaching practices for which the difference in rate of occurrence between supportive and nonsupportive faculty is greatest.

their most supportive professor "was engaging while lecturing," while only 16% noted that their most nonsupportive professor was. The difference for this item (83%) was the greatest of all 41 teaching practices. Similarly, 99% of the most supportive professors "explained concepts in easy to understand ways," while only 17% of the nonsupportive professors did.

### Implications for Our Change Plan

The data we collected through our student survey provided important information to guide our decision making. We used the data in the design of our faculty action plan, as shown in Table 8.

Key topics from the student survey guided decisions about content for our faculty action plan. These topics included using varied approaches in the classroom, giving students good feedback, and praising them for good comments and answers. And because our own local data from the student survey aligned well with national evidence, they strengthened the credibility of previous research and were useful additions to both the faculty action plan and the administrative change plan.

## Our Two-Part Change Plan

Our local data were essential in designing our two-part change plan, as described in Tables 3, 6, and 8. The information we gained from the faculty focus groups allowed us to take advantage of factors that influence our local faculty to adopt effective teaching practices while lowering barriers to adoption. Likewise, our classroom observations provided both baseline data regarding current teaching practices and examples of effective teaching in action, and data

**Table 8** Decisions about Faculty Action Plan Based on Student Surveys

| |
|---|
| Who (Participants) |
| Because the student data highlight teaching practices of faculty who had a positive impact on student success, our faculty action plan should include leadership from and observations of faculty who adopt those practices. |
| What (Content) |
| Because much of our student survey data reinforces national research, our faculty action plan should include topics where these data align especially well. These include: using varied approaches in the classroom, providing demonstrations of class principles, giving students good feedback, talking to students if they perform poorly, and praising students for good comments and answers. |
| Because students sometimes are resistant to new teaching practices, the faculty action plan should include ways for faculty to safely learn and practice these teaching techniques. |
| How (Structure) |
| Because research-based effective teaching practices are echoed by our students as being supportive for their success, the local student survey data should be integrated into the faculty action plan to further convince faculty of the influence of their teaching. |

from the student survey allowed us to strengthen national research and design a plan based on key teaching practices valued by our students.

## Faculty Action Plan

We have launched our faculty action plan and collected preliminary data about its effect on faculty attitudes and behaviors. We are continuing to refine and implement the plan and assess its effectiveness over time. It is a term-long instructional development program, co-facilitated by an experienced CRLT-Engin instructional consultant and a respected engineering faculty member. Faculty apply to participate in the program, and during the term they interact extensively with the two facilitators, with each other, and with other senior faculty who are invited guests at meetings. Participants attend four monthly sessions and are expected to read summaries of research on the influence of effective teaching practices and practical strategies for implementation prior to each session. Topics include building rapport in large classes, using active learning techniques and the flipped classroom, giving frequent student feedback, understanding student motivation, student misconceptions and preconceptions, and incorporating instructional technology The facilitators model effective teaching practices during the 90-minute sessions, and each session incorporates local data about current teaching practices and student perceptions.

Faculty are encouraged to observe effective teachers in action; to enable them to do so, we identify accomplished faculty who use effective teaching practices well and provide a list of class sessions available for observation. Because it is good practice in faculty instructional development and because it allows faculty to gauge student reaction, faculty are invited to have a midterm student feedback session carried out by an CRLT-Engin instructional consultant to assess the efficacy of their efforts and identify strategies to respond to student data (Finelli, Pinder-Grover, & Wright, 2011). Upon completion of the program, as an incentive and an indication of administrative support, participants are eligible for a $1,000 grant to support their teaching in large courses.

Besides being grounded in local data, our faculty action plan is built on the faculty learning community model, which is an effective approach to faculty instructional development

(Chism, Holley, & Harris, 2012; Cox, 2004; Felder, Brent, & Prince, 2011; Wlodkowski, 1999). A faculty learning community involves a group of faculty members that is organized around sustained activities and that intends to improve its teaching and to provide support and guidance to its members. An important element of the faculty learning community is formal and intentional community building. Facilitated peer exchange, combined with sharing of questions and answers, and regular task-oriented gatherings contribute to the success of these endeavors (Chism et al., 2012; Cox, 2004; Jungst, Licklider, & Wiersema, 2003; Layne, Froyd, Simpson, Caso, & Merton, 2004). Having ongoing, long-term interactions with a group of faculty members (Cranton, 1994) and engaging them as partners in the program (Dancy & Henderson, 2008; Froyd et al., 2013; Henderson & Dancy, 2011; Prince et al., 2013; Tagg, 2012) are other key characteristics that make learning communities successful. Like the faculty learning community, our faculty action plan includes sustained interactions, critical reflection, relevant content, and experienced instructional consultants who work with participants to address their specific needs.

Our faculty action plan is also grounded in Rogers's (2003) diffusion of innovations theory. For faculty at the awareness stage of adoption, our plan includes opportunities for them to learn about effective teaching practices; for faculty at the evaluation stage, we offer implementation strategies and research-based evidence that their efforts could positively impact students; and for faculty at the trial stage, we provide a safe place to practice the techniques and get useful feedback. Our goal is to provide access to faculty at all adoption stages, and Rogers's theory provided guidance about the types of content and activities that would be appropriate at each stage. Thus, we are able to incorporate content and opportunities like those mentioned above to tailor our plan for diverse faculty participants.

To date, we have implemented our faculty action plan for three terms and have invited all engineering faculty to apply for the program each time. Due to staffing and funding constraints, we limited each offering to six or seven participants, and these faculty members were selected from among the applicant pool to represent a range of rank, experience, and discipline. Twenty faculty members have participated. Because the program was oversubscribed, applicants who had fairly equivalent characteristics to the participants but who were not invited to join the program were asked to serve as a control group – 17 faculty members have participated in this way. Our preliminary findings indicate that, as a result of their involvement in the program, participants approached teaching differently and were actively altering their behavior in the classroom (Finelli & Millunchick, 2013). We are working to refine our faculty action plan and to study the long-term effects of the program on faculty's attitudes and behaviors towards teaching.

### Administrative Change Plan

Our administrative change plan is under development, and we are in the process of refining the plan on the basis of feedback from faculty and administrators. It is intended to influence policies and procedures of our engineering college and, as it is for our faculty action plan, local evidence was critical in its design. For example, our plan includes influential data about our faculty's currently limited use of active learning in order to garner administrative support for our faculty action plan. Our plan includes working to improve the design of future classroom spaces because we know that the physical classroom layout can make it difficult for faculty to implement effective teaching practices. Other foci of our administrative change plan include the time costs that faculty associate with learning about and implementing effective teaching practices and the lack of importance that faculty perceive to be placed on teaching in promotion and tenure.

**Sarah Klondike, Ph.D.**

Gender **Female**
Age **31**
Position **Assistant Professor**
**Electrical Engineering**

**Sarah's backstory**

Sarah earned her Bachelor's Degree in electrical engineering at a large state university and her Ph.D. in signal processing at a prestigious research university. She stayed there for two years as a postdoctoral researcher. During her five-year graduate school career, Sarah was a teaching assistant for one semester, leading two circuits laboratories and grading student lab reports. She joined the faculty here four years ago.

**What drives Sarah**

Sarah wants to succeed, and to her this means earning tenure. She knows that those who review her casebook will want to see successful grant proposals and distinguished publications, so she spends as much time as she can working toward those goals. She also knows that her teaching evaluations will be important, so she gives students a reasonable amount of homework, adds extra office hours when students are struggling, and writes exam questions similar to her homework. Thus far, her students have given her good evaluations, so she is motivated to continue her current teaching practices.

**What frustrates Sarah**

Sarah is frustrated when it seems like she has to repeat the same core concepts again and again during class. She doesn't push back on students, though; because, she thinks repetition must be what they need to really learn the material. So if she has to lecture on the same topic multiple times, she will. She is also frustrated that there is not a better way to help students learn the material in depth; it seems to her that every time she asks them to translate what they've learned to a slightly different situation, she has to start from the beginning. If she knew there were some proven, efficient ways for her to help students learn better without making them mad, she would be all for it, but she doesn't have time to search, and she's not sure how hard it would be for her to learn a new method and put it into practice in her courses.

**In Sarah's words**

- "When we go through tenure or evaluation, I feel that teaching is a part of it, but it's doing me a better service to write a paper instead of revamping my class. So there's a little less motivation, at least at the junior level, to do it."
- "I'm not being evaluated on how effective my teaching is or how hard I'm trying to improve. Instead, it boils down to questions like: 'Do students like the class?' 'Do they want to be there?' 'Are you entertaining?' and 'Are you easy?'"
- "If I had a clear sense of the positive outcomes for incorporating active learning – that you see students who have a higher level of understanding – and if I thought it would be easy to do, that would motivate me."

**Figure 5** Example persona.

A unique element of our administrative change plan is the use of personas to convey the story of our faculty as a way to gain administrative support for our efforts. A persona is a fictitious character, based on actual data, created to represent needs, goals, values, and actions of a particular population (Cooper, 1999; Cooper & Reimann, 2003, Pruitt & Grudin, 2006). Personas bring target stakeholders to life by giving them names, personalities, and faces. Rather than representing an actual individual in the stakeholder group, personas embody representative characteristics of the group. Personas are often used in human-centered product and software design to illuminate the driving factors of customers and other stakeholders.

We build the personas from real data to represent the faculty stakeholders in a convincing way in our administrative change plan. Doing so gives them credibility and allows them to serve as concrete examples that illustrate both barriers to and enablers for adopting effective teaching practices. As an example, Figure 5 represents the persona of an assistant professor we named Sarah Klondike. The characteristics ascribed to this persona are based on data from our faculty focus groups, and "In Sarah's words" contains the essence of actual faculty comments. Sarah's experiences and priorities represent a trend across a collection of individuals with whom we interacted during our research. Key challenges that Sarah faces include her sense that the infrastructure and culture of the College of Engineering do not align with a large time investment to improve her teaching, her lack of training and experience teaching, her worries about student reactions to her use of new practices, and her lack of familiarity with research on effective teaching practices and their influence on student learning.

Feedback from engineering faculty administrators who have seen our initial persona has been positive. One senior faculty member noted how Sarah's frustrations resembled her own experiences, and an engineering administrator commented that the persona made things feel real without adding the complexities of preconceptions about the individual. Another administrator noted that the persona was an effective way to show general issues encountered by faculty with respect to teaching, while putting a personal face to it.

We will broaden our administrative change plan to include a series of faculty personas reflecting the range of factors that influence faculty adoption of effective teaching practices in our college. During meetings with department heads, deans, associate deans, and other administrators, we will use the personas to provide a shared basis for communication. We will be able to ask questions such as, "Can you identify with this persona?" "What would you suggest she do in this situation?" "How can the administration help him to improve in teaching?" We will couple the personas with data about current teaching practices and student perceptions of effective teaching at our institution to influence policies and procedures of our engineering college.

## Discussion

Our two-part plan for institutional transformation aligns with all seven recommendations of the *Innovation with Impact* report (Jamieson & Lohmann, 2012). It involves professional development for engineering faculty and administrators (Recommendation 1 of the who element of the report); expands the partnership between our engineering college and our center for teaching and learning (Recommendation 2, who); aims for more engaging, relevant, and welcoming classrooms and environments (Recommendation 3, what); leverages resources such as teaching and learning centers and the support of administrators who aim to enhance the culture for teaching and learning (Recommendation 4, how); raises awareness of best practices (Recommendation 5, how); opens our college to self-assessments (Recommendation 6, aligns with a fourth element of the report "creating a better culture"); and establishes the ground work for community-wide self-assessments (Recommendation 7, culture).

Two features that distinguish our plan from other efforts for institutional transformation are the foundational nature of the expectancy value theory framework and the central role of local data. We deliberately designed our change plan to appeal to our own community by capitalizing on factors that motivate our local engineering faculty to adopt effective teaching practices and lowering the barriers to adoption, and we used EVT to frame these factors. We used data about the limited degree of student involvement in engineering classes to help faculty and administrators recognize the need for more widespread adoption of effective teaching practices. Similarly, we used data about student perceptions of supportive teaching practices to introduce the student voice, thereby highlighting the types of teaching practices valued by students and validating the extensive national research.

We used the local data extensively to guide decision making for both parts of our change plan. For instance:

> We found that community building could be an important enabler for faculty, so we designed our faculty action plan to include a cohort element. If community had not been such a prominent theme in our focus groups or if we found that faculty would be hesitant to share their lack of knowledge with their peers, our faculty action plan would have involved primarily one-on-one interactions with faculty.
>
> Our classroom observations provided important information about the content of our faculty action plan. Since the primary pedagogy we observed was lecture, we designed our faculty learning community around easy-to-implement active learning techniques and rapport-building strategies rather than advanced topics like problem-based learning, team teaching, or in-depth student assessment.
>
> Since classroom structures and lack of flexibility in the curriculum were common barriers for faculty, we developed our administrative change plan using personas that introduce these barriers and offer solutions to them. If we had found, for instance, that lack of well-trained teaching assistants or poor lab facilities were common barriers, our plan would have evolved differently.

### Next Steps

As of this writing, we have already launched our faculty action plan and have collected preliminary evidence of its success (Finelli & Millunchick, 2013). Faculty response has been overwhelmingly positive, and administrators at our College of Engineering are convinced that it has already resulted in positive and important faculty change. We will continue to refine and implement the program and will conduct a more comprehensive evaluation of it. These steps will involve collecting more evidence, such as objective classroom observations and student feedback about faculty teaching practices, so that we can triangulate data from multiple sources using multiple methods. We also plan to expand our evaluation dataset by including participants from future iterations of the program and by following participants over time to study longitudinally the lasting impacts on their teaching attitudes, behaviors, and practices.

Our administrative change plan is still under development. We are crafting additional personas, soliciting more feedback to see how faculty relate to them, and piloting their use with administrators. The personas will allow us to emphasize local barriers to and enablers for adopting effective teaching practices and inform administrators' decisions that could support faculty. Future work includes fully implementing the administrative change plan and evaluating its effectiveness.

## Conclusion

In this article we described how we designed a two-part institutional change plan. The plan bridges the gap between research and practice, and it integrates research and theories about faculty motivation and organizational change with local data to accelerate faculty adoption of effective teaching practices. Both our faculty action plan and our administrative change plan position the literature in the local institutional context, build on local evidence, and incorporate the local barriers and enablers for faculty change. Importantly, the who/what/how framework we applied to the decision-making process is a model that can be adapted by others.

Although our efforts involved a single institution, change agents wishing to accelerate the adoption of effective teaching practices at their own institution can draw important implications from our work. Situating a change plan in the local context is likely be most successful; thus the ideal case involves collecting local evidence. But if that data collection is not feasible, and if the culture and faculty populations are similar to the University of Michigan College of Engineering, then change agents might apply some elements of our work directly while collecting a subset of local evidence. For example, our data about student perceptions of supportive teaching practices are likely to be relevant at other highly-selective research institutions, but change agents should seek to understand current teaching practices at their own institution by collecting baseline data. Additionally, change agents should adjust our list of barriers and enablers to address differences at their own institution. For instance, the importance of teaching evaluations might be radically different at teaching-focused institutions or community colleges; faculty action plans for such institutions should, therefore, emphasize different motivators.

Bringing about institutional change to bridge the gap between research on effective teaching and actual faculty practice can be a difficult process. Nonetheless, such transformation is critical to improving STEM education. Applying a who/what/how framework to design the plan and using local data to inform design decisions are important ways to contribute to the success.

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