



Factors that Influence Faculty Motivation of Effective Teaching Practices in Engineering

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Factors that Influence Faculty Motivation to Adopt Effective Teaching Practices in Engineering

At many institutions, the adoption of effective teaching practices by engineering faculty is limited (e.g., [4]). Our own research confirms these findings at the University of Michigan (U-M, a large, public research university) where we recently observed a random sample of undergraduate, lecture-based engineering classes and discovered that the use of active learning and effective student questioning was surprisingly low [2]. To achieve wider adoption of effective teaching practices at our college of engineering, we are working to develop an institutional change plan. This paper describes one part of that change plan: a series of faculty focus groups we conducted to explore factors that influence faculty motivation to adopt effective teaching practices.

We use the Expectancy-Value Theory (EVT, [1, 6]) to identify factors that influence faculty motivation to adopt effective teaching practices. This theory posits that an individual's motivation is influenced by both his/her expectancy of being able to succeed at the task and by the values he/she ascribes to completing it. In our context, we apply EVT to a faculty member's motivation to adopt effective teaching practices. Figure 1 shows the elements of the EVT.

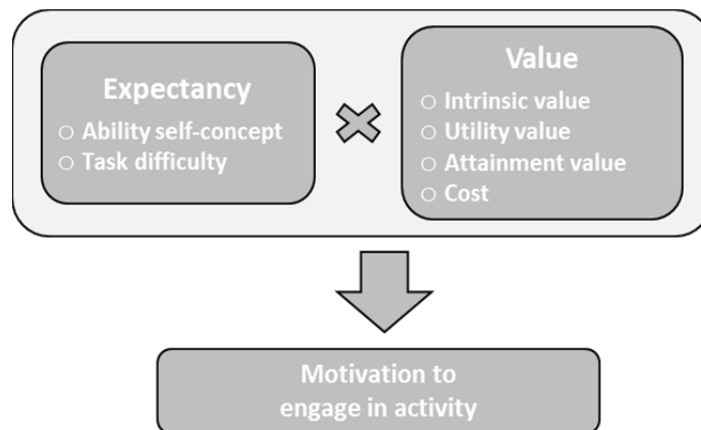


Figure 1. *The Expectancy-Value Theory (EVT) of motivation.*

We conducted a series of 90-minute faculty focus groups to study the local factors that influence adoption of effective teaching practices at our engineering college, particularly as the factors align with the EVT. During our focus groups, we probed faculty's expectancy (i.e., ability self-concept and perception of task difficulty) and value (i.e., intrinsic value, utility value, attainment value, and cost) related to adopting effective teaching practices. Twenty-six full-time engineering faculty participated in the focus groups, and their gender, rank, and department demographics (shown in Table 1) are representative of the faculty in our U-M college of engineering.

Table 1. Demographics of faculty focus group participants (N=26)

Gender	Male	22
	Female	4
Rank	Lecturer	6
	Assistant Professor	8
	Associate Professor	5
	Professor	7
Department	Aerospace Engineering	2
	Atmospheric, Oceanic, and Space Sciences	2
	Civil and Environmental Engineering	2
	Chemical Engineering	1
	Electrical Engineering and Computer Science	4
	Industrial and Operations Engineering	2
	Mechanical Engineering	5
	Materials Science and Engineering	2
	Naval Architecture and Marine Engineering	3
	Nuclear Engineering and Radiologic Sciences	1
Technical Communication	2	

Data and Results

The focus group data were transcribed and imported into NVivo for qualitative analysis, and we combined both inductive and deductive approaches for our analysis (an approach recommended by [5]). In our initial inductive data coding process, we conducted a line-by-line analysis of the transcripts to identify emerging themes. We did this iteratively to confirm existing themes, discover new ones, and cluster related themes into categories. Then, in our deductive analysis we aligned the themes and categories with primary factors of the EVT.

Our analysis resulted in 26 individual themes that faculty report as influencing their adoption of effective teaching practices, and we grouped related themes into seven categories. The themes and categories are defined in Table 2, and the relevant EVT factor and number of times each theme is mentioned in the focus groups are included on the table as well. For example, one commonly cited theme (mentioned 26 times) is that *teaching evaluations* are an important factor in faculty decisions to adopt (or not adopt) effective teaching practices. We categorize this theme as “Infrastructure and Culture,” and note that it is aligned with “Utility Value (U)” in the EVT framework. Similarly, having *personalized support* while learning how to adopt effective teaching practices is a factor in faculty decisions to use those practices (mentioned by 17 faculty). We categorize this as “Knowledge and Skills of Effective Teaching Practice” and note that it aligns with the “Expectancy (E)” factor of the EVT.

Table 2. Factors that influence faculty adoption of effective teaching practices. Definitions of the 26 themes (in seven categories) are listed, as are the related EVT factor (E=Expectancy; I=Intrinsic Value; U=Utility Value; A=Attainment Value; C=Cost) and number of references for each theme.

	EVT factor	# refs
Infrastructure and Culture		
<i>Teaching evaluations.</i> Standard course and teaching evaluations submitted by students at the end of a term	U	26
<i>Incentives and rewards.</i> Types of external benefits including monetary awards, grants, and release time	U	19
<i>College teaching policies.</i> University rules and regulations regarding teaching	U	17
<i>Didactic teaching tradition.</i> Traditional teaching style with a teacher-centered focus	U	17
<i>Tenure criteria and documentation.</i> Necessary documentation for a tenure casebook and the relative emphasis on each	U	15
<i>Institutional emphasis on research.</i> Weight placed by the university on research success	none	9
Knowledge and Skills of Effective Teaching Practices		
<i>Access to information about effective teaching practices.</i> Level of regular exposure faculty get to articles and scholarship on effective teaching practices	E	37
<i>Credible research evidence.</i> Convincing research demonstrating impact of effective teaching practices	E, A	18
<i>Personalized support.</i> Having an experienced mentor guide one through the implementation process	E	17
Student Experience		
<i>Student reaction.</i> Real or perceived student response in the classroom to the use of effective teaching practices	A	14
<i>Student learning outcomes.</i> The extent to which students learn essential skills and knowledge	A	14
<i>Responsiveness to student feedback.</i> The extent to which faculty use student feedback to influence teaching	A	12
<i>Student attentiveness and participation.</i> The level of student attentiveness, engagement, and participation	A	11
<i>Rapport.</i> The relationship faculty build with students through effective teaching practices	A	2
Time		
<i>Time (general).</i> Lack of time to change	C	19
<i>Time to restructure a course</i> Time required to revise a course that does not include effective teaching practices	C	8
<i>Time to learn about effective teaching practices.</i> Investment time required to learn basic principles of effective teaching practices	C	5
<i>Preparation time for class sessions.</i> Time required to prepare for class sessions that include effective teaching practices	C	3
Classroom and Curriculum		
<i>Curriculum flexibility.</i> The extent to which faculty have control of the content and structure of the course(s) they teach	E	17
<i>Physical classroom layout.</i> The structure of the physical classroom space	E	8
<i>Class size.</i> The number of students in the classroom	E	3
Personal Disposition		
<i>Passion for teaching.</i> The level of interest faculty have for teaching	I	16
<i>Confidence in teaching ability.</i> Degree of confidence that faculty have in their abilities as instructors.	E	7
<i>Comfort with role change.</i> Level of comfort with taking on a different role in the classroom	A	4
Networking and Community		
<i>Discussion with colleagues.</i> Communication with fellow faculty about effective teaching practices	E, I, A	13
<i>Opening the classroom to others.</i> Opportunity to observe other faculty teaching and vice versa	E, I, A	4

Infrastructure and Culture

As seen in Table 2, faculty participants in our focus group most often discussed the infrastructure and culture of the university as a factor impacting their motivation to adopt effective teaching practices. While some faculty discussed these factors as supporting adoption, most themes in this category were barriers. Additionally, many cultural aspects were seen as being a direct impact of administrative priorities; thus to lower this barrier, the administration would have to play a role in changing the culture of the university. For example, faculty are reluctant to try new practices that may negatively impact their teaching evaluations; thus teaching evaluations were largely viewed as a barrier. Faculty support administrative interventions to reduce the risk inherent in adopting new teaching practices by withholding any penalties for decreased teaching scores during the experimental process.

Knowledge and Skills of Effective Teaching Practices

Increasing access to scholarship on effective teaching practices, disseminating credible research evidence, and providing opportunities for personalized support are motivators to faculty adoption. These themes were largely related to influencing faculty expectancy for success. Faculty also talked extensively about their need to learn these practices through efficient ways, which in some cases meant faculty wanted personalized support when making the transition to effective teaching practices.

Student Experience

Faculty were also concerned about the student response to changes in their teaching practices. They felt that if students would truly learn more material, would learn it more deeply, and would be more engaged in the material, then they would be motivated to change. However, faculty were not convinced this was the case, and they feared that their attempts to adopt new practices would prompt negative feedback from students.

Time

Not surprisingly, lack of time was discussed as a primary reason that faculty chose not to implement new teaching practices in their courses. They felt they did not have time to learn the practices, nor did they have the time to redesign their courses. Faculty mentioned that research activities contributed to their time constraints.

Classroom and Curriculum

Faculty perceived effective teaching practices to be a better fit with a more flexible curriculum. They noted that smaller class sizes and a physical classroom structure which allowed chairs to be moved around the room would be factors influencing adoption of effective teaching practices.

Personal Disposition

Faculty acknowledged aspects of their personal disposition as playing a role in implementing effective teaching practices. For instance, faculty would be more likely to try effective teaching practices if they were passionate about teaching and comfortable with taking on a new role in the classroom.

Networking and Community

Faculty discussed colleagues as both supporters and barriers to adoption of effective teaching practices. If their colleagues had a bad experience and warned them against using specific practices, they would be less likely to implement them. Conversely, if faculty felt encouraged by colleagues, they would be more willing to try. They also said that observing colleagues using effective teaching practices or having fellow faculty observe them could be helpful.

As evident in Table 2, each component of the EVT aligned with at least one of our themes. Interestingly, themes within a particular category often align with the same EVT construct. For instance, the “Infrastructure and Culture” themes all related to utility value of implementing effective teaching practices. Unfortunately, most faculty did not feel that adopting effective teaching practices fit within the current reward structure.

The focus groups allowed us to explore faculty expectations of success in adopting effective teaching practices, elicit the values and costs faculty place on using them, and identify ways to increase the value and decrease the costs. Appendix A lists sample quotes for each theme.

Next Steps

Our next steps involve designing an institutional change plan for our college of engineering that leverages findings from the faculty focus groups. Our change plan will be comprised of two distinct parts: a faculty professional development initiative to impact the teaching practices of individual faculty, and an administrative change plan to influence policies and procedures of our engineering college. Our change plan situates the relevant research literature in our *local* institutional context, builds on *local* evidence that includes the perspectives of both students and faculty, and incorporates the *local* reward structure and motivators for faculty change.

The underlying goal of our faculty professional development initiative, described elsewhere [3], is to accelerate adoption of effective teaching practices by our faculty through a continuous model of change. Our intent is to increase faculty awareness of and interest in effective teaching practices and to enable faculty to evaluate and practice the techniques. We also aim to affect faculty attitudes and behaviors about teaching, thereby resulting in sustained changes in teaching practice.

Our administrative change plan is intended to result in changes in the broader culture of our college. For instance, data about the types of teaching practices most prevalent in our college, identified through objective classroom observations conducted by trained consultants using consistent rubrics, will allow us to influence administrators’ about the importance of encouraging more widespread adoption of learner-centered teaching practices. And factors that faculty identify as barriers to adoption, such as tenure and promotion criteria and other college teaching policies, can be shared with administrators to influence changes in those policies.

Our faculty professional development initiative and the administrative change plan are both critical parts of our overall institutional change plan. When implemented in tandem, they will result in sustained transformation.

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Appendix A: Sample quotes from the faculty focus groups

Infrastructure and Culture

Teaching evaluations

- *So I guess like some very well publicized stories [like] Professor X used to be humdrum and boring in class; then he adopted approaches A, B, C and now, you know, they are on the beach showing off their muscles and have perfect teaching scores and, you know, right? You want people to really, I think, be willing to risk something for these higher results and right now it seems very kind of remote and, you know, not a pressing priority in a lot of cases.*
- *But I feel like at least the feedback that I've gotten from colleagues and...in my department as well as across the college, is that teaching isn't heavily weighted, and so as long as you get scores above a 4, then you're OK. Nobody cares whether you're getting a 4.9 or a 4.1, you know, it's...as long as you're getting above a 4, you're OK. So it's...there's really no incentive to put that extra time into learning new techniques.*

Incentives and rewards

- *Give them money. Give them release time. Give them five thousand bucks to do a little...give them a little research grant to apply those techniques to their courses. I mean, if you think it's so important that they do it, that's one way to do it. And there are sticks also—if they don't get good evaluations, then that reflects in their merit pay. If they are before tenure, they may not make tenure if they're bad instructors. I mean, there are all kinds of sticks that are available.*
- *I think that getting paid to do some of this. I mean, you know, a lot of these things take a certain amount of commitment and time and preparation that we don't necessarily get rewarded for. So I...it would be interesting to try to overhaul a class, but it would be something that I'd want to take on, maybe, in the summer and I'd want some support...*

College teaching policies

- *I'm not being evaluated on how effective my teaching is or how hard I'm trying to improve; I feel like it's just...it just boils down to "do students like the class, do they want to be there, are you entertaining, are you easy." So I would like to see some reward structure for paying attention to the pedagogical thing too.*
- *... better systemic motivation and incentives, the institutional barriers to not being rewarded for it or having focus and priority on other things ... would motivate us to do it.*

Didactic teaching tradition

- *...the tradition of the lecture, that that's how we were taught, that's how everyone teaches it.*
- *And of course our junior faculty has its role models, what they have experienced in their primarily graduate education where they see the professor go through a traditional lecture. So what are they going to do when they come out? They're going to repeat that pattern, right, and so the most effective way of changing the teaching culture is to do this in the first few years, but that's the high risk period where you can't afford it.*

Tenure criteria and documentation

- *And the reality is, what's important in the casebook 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 and I think that's...you know, you said that...whatever the rules are, then that's what the game turns out to be.*
- *Are we on the same page that we say teaching matters? Well, my experience in the tenure-track stuff is good teaching doesn't matter in tenure, OK, it's research, but bad teaching will—it could be...you could not...you may not get tenure because of bad teaching, but you will not get tenure because of good teaching. That's been my observation.*

Institutional emphasis on research

- *Actually, when we go through tenure or evaluation, I feel—and maybe other people will prove me wrong—that teaching, yes, 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.*
- *... but as it is, you know, if you're a big shot researcher, you're important. And if you're not a big shot researcher, you're not.*

Knowledge and Skills of Effective Teaching

Access to information about effective teaching practices

- *I would appreciate if I could learn more about those tools that are out there, because I don't think I'm fully informed. So that is, I think, a personal interest.*
- *Understanding, you know, lowering the barrier to personal understanding of what's the right thing to do and just practical information of how does this work in a large classroom setting...*
- *... seminars or an opportunity to sit down and speak with specialists who know how to implement these things and to help overcome some of the hurdles. So seminars or workshops, something to that effect would be useful.*

Credible research evidence

- *Give local examples, especially. They speak more strongly. I think if you say, "This faculty member in your department or in this college did this and it was effective," I think that's especially convincing.*
- *I think what would motivate me more than anything else to adopt new methods is if I really was convinced that there's a silver bullet that, you know, if I use this technique, it's really going to work well for my students. I guess I'm not convinced of that. You know, you started by saying there's research-based, effective teaching practices, but my experience says some methods work well with some students and some work well with others and I...I'm not convinced that there's something out there that we could be doing that really works well with all students and will really make a big difference. If I was convinced of that, I think that would really motivate me to adopt that*
- *... 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 pick that up and learn it.*

Personalized support

- *One way to mitigate the fear is 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."*
- *...if I can almost be hand held through the process, would be helpful. It would still have to be customized for classes that I teach.*

Student Experience

Student reaction (real or perceived)

- *So there's also uncertainty how students will respond to these drastically different approaches, right. If students are already doing well following the conventional approaches, you know, then there's a certain reluctance in moving to something that's very different.*

Student learning outcomes

- *I guess the thing is, if faculty had a clear sense of what the outcomes, 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.*

Responsiveness to student feedback

- *What motivated me was my first batch of...teaching evaluations where I got lots of feedback about how poor a job I was doing using white board and lecture*

Student attentiveness and participation

- *The thing is, I'm motivated more by are the students paying attention and are they alert.*
- *I can sort of gauge the student engagement in the class and the topic, based on the questions they ask of me during my lecture and based on their enthusiasm they express when I do adopt one of these active learning... 'cause I have—I've tried some pretty outlandish things—and some of them work, some of them fail, but when they work, they do seem to get more engaged. I can sort of read it—it's a little bit hard—and I'm happy. I will do it.*

Rapport

- *I think it's fun to just get to know all the students in the class and you get to have a personal relationship with many of the students of the class. OK, it turns out to be a lot of letter-of-recommendation writing later, but it...you know, you actually know these people rather than just being a face in the crowd. I think that's a worthwhile bonus.*

Time

Time (general)

- *The number one reason must be time. I mean, people here are really under heavy pressure and some have really heavy loads, just teaching alone if you don't have to sponsor research. So it's really hard to find the time to do the improvements.*
- *Time is the big issue, so if I have time, is it better for me to spend that interacting with students through office hours and other things or is it better to invest in trying to learn some new technique?*

Time to restructure a course

- *I'm very interested in these research-based teaching practices and have great desire to improve. The dilemma that I see is that we are over-committed and overloaded and it is very difficult to take a course that would be very easy to just update and revise and present again and really turn it upside-down.. It takes an enormous amount of time and effort and the challenge that I see is to find the right space in the calendar needed to do this.*

Time to learn about effective teaching practices

- *I also don't have the time to go through the literature for the newest teaching...or research-based efforts or teaching methods myself so I would appreciate if [the local center for teaching and learning] could maybe send out occasional reminders, even by...yeah, email to maybe point us to the resources.*

Preparation time for class sessions

- *Coming up with some of these [teaching practices]is not a...is not a simple or a fast process.*

Classroom and Curriculum

Curriculum flexibility

- *The course I teach in mechanical engineering is 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.*
- *You shoehorn it in and then you don't have any time...you know, most people feel like they have to cover all this material and if, you know, you do these active learning techniques, it takes a lot of time. So how do you reconcile that?*
- *It's my perception, I guess, that active learning is going to take away time from me on the chalkboard presenting the topics that I need to cover.*

Physical classroom layout

- *I think the physical situation is important too. All of our classrooms are theater set-ups, they're lecture halls, and what you can do in a lecture hall is lecture and we don't really have an ability to divide the people up. You know, the chairs are bolted to the floor in some of our cases.*

Class size

- *[Another] factor in my mind is class size. If you have large classes, it's hard to keep everybody engaged if you're focusing on smaller groups.*

Personal Disposition

Passion for teaching

- *...if I go through tenure, it means that I really like the job—that's the most important motivation for me. I really like teaching also, so that's...that's a big motivation. So liking teaching and...so it really doesn't matter to me if it fits my...if it fits in the reward structure I'm really not interested, but I really like teaching and want to improve on my teaching.*

Confidence in teaching ability

- *If you do it a lot and it becomes part of the culture of the classroom, then they accept it more. But there's always a kind of a terrifying moment when you first try it in the class where they just stare at you and, you know, you have this kind of flop sweat going on where you don't...this isn't going to work, and it's hard to persevere...*
- *Well, and I guess the price of failure is always a question, right? I like the idea of flipping the classroom, but if you flip the classroom and that goes poorly, now you're two or three weeks into the term, you're still expecting that the students who exit the class will have the same set of skills or knowledge level. So if you invest this time and things don't go as planned then you essentially have to catch up the rest of the term or truncate what the students are going to learn.*

Comfort with role change

- *It's partly a role thing, you know—you have a particular role with the students when you're primarily a lecturer, the kind of, you know, wise person dispensing knowledge, and when you get away from that, you're really changing your sense of who you are in the classroom, it feels like, you know, and that's not an easy...it's kind of threatening...*

Networking and Community

Discussion with colleagues

- *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.*

Opening the classroom to others

- *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.*