AC 2012-4344: FUTURE ENGINEERING PROFESSORS' VIEWS OF THE ROLE OF MOTIVATION IN TEACHING AND LEARNING

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Future Engineering Professors' Views of the Role of Motivation in Teaching and Learning

Abstract

As part of a larger study, doctoral students were interviewed about their perspectives on teaching and learning engineering. Participants were enrolled in engineering schools across the U.S. and expressed interest in becoming engineering professors. In their reflections, fifteen of the participants talked about the role of motivation in teaching and learning engineering.

This paper explores how these future engineering educators viewed the role of motivation in learning engineering and how they thought that, as professors, they will motivate students. To achieve this, a qualitative approach was used to analyze interview transcripts. Emerging themes included: the importance of motivation in teaching and learning engineering, motivation as a student responsibility, motivation as a teacher responsibility, and strategies to motivate students to learn. Themes are discussed and implications for the preparation of future engineering educators are considered.

Introduction

The preparation of future engineering educators, whether in graduate school or professional development programs, rarely incorporates any education theories. Without formal preparation for teaching, most new engineering educators rely on their preconceptions of teaching and learning to shape their instructional practices and their interactions with students. This situation presents a challenge to try to understand future engineering educator's views of teaching and learning.

As part of a larger study[1], doctoral engineering students were interviewed about their experiences and conceptions of teaching and learning engineering. In the interviews, the topic of motivation emerged as a concern for the participants. Although motivation was not the primary focus of the original study, this data set provides an opportunity to do an initial exploratory analysis of an aspect of future engineering educators' views that is not well understood. This paper explores how these future engineering educators viewed the role of motivation in teaching and learning engineering.

Literature Review

According to prior research, motivation is key to helping students learn[2]. It can contribute to students' higher levels of engagement and achievement by influencing choice of tasks, persistence in those tasks, and quality of effort. Motivation "generates, directs, and sustains" learners do[3].

Although students can be extrinsically motivated by grades or fear of other's opinions, students learn best when they are intrinsically motivated. People have "the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn"[4]. Self-determination theory suggests that intrinsic motivation can be increased when three basic human

needs are addressed: the need to perceive one's behavior as self-determined (*autonomy*), the need to feel effective when expressing one's capacities (*competence*), and the need to feel a sense of belonging with others (*relatedness)*.

Other factors that contribute to student motivation are perceptions of the value of a task[5] and the expectation of succeeding in a task[6]. How a person interprets causes (attributions) for success or failure affects that person's future expectations of success. These causes may be: 1) internal or external, 2) stay the same or change over time, and 3) controllable or not controllable by the person. A more extensive review of motivation theories for graduate teaching assistants can be found in the conference proceedings[7].

Attributions of success or failure are important not only for students but also for faculty. Dweck's research identifies two mind-sets[8] that students and teachers may hold. They may have a fixed mind-set in which they believe intelligence is a static, predetermined trait. Or they may have a growth mind-set in which intelligence can be developed through effort and other means. She argues that students perform better in school when they *and their teachers* have a growth mind-set that foster the idea that intelligence is not fixed and focuses on effort and motivating students to overcome challenging work[9]. Because teachers who had a growth mind-set thought intelligence could be "grown" they encouraged students to try harder, and gave them more specific formative feedback. On the other hand, teachers who had a fixed mind-set responded differently to student difficulties, they were not inclined to offer advice to help the student improve their efforts. Because in their view ability is pre-determined, these teachers assumed that not every student can succeed in a task and the only thing left to do was try to comfort the student for his or her inevitable failure. Fostering a growth mind-set in both students and teachers may be especially powerful for students who belong to underrepresented groups that are often stereotyped or who may have lower self-efficacy.

Method

In the larger study, 20 doctoral engineering students from universities across the U.S. were interviewed by phone. The criteria used to select participants was that they had: 1) completed one year of doctoral studies in an engineering program, 2) interest in pursuing an academic career, and 3) experience in at least one of four activities in preparation for an academic career. These activities were either one semester or more as a teacher assistant (TA) or teacher, participation in the American Society of Engineering Education (ASEE), taking credited coursework on teaching, or taking teaching or TA workshops

Semi-structured interviews were conducted and recorded. Background information, teaching and learning were discussed for 30-90 minutes. Sample questions included: How do you define learning? How do you define teaching? What are the responsibilities of engineering students? What are the responsibilities of engineering teachers?

In their reflections, fifteen of the participants talked about the role of motivation in teaching and learning engineering. Among those fifteen participants that spoke directly or indirectly about motivation, five were female, ten male. These doctoral students were enrolled in one of six engineering schools across the U.S. and expressed interest in becoming engineering professors.

Five participants were international students, including two from Latin America and three from Asia. All participants were given pseudonyms to protect their identities.

To familiarize myself with the data, I conducted and recorded all interviews and either transcribed them or verified the transcription for each interview. Each recording was heard at least twice and often four times before coding of the interview began. Structural coding was done to identify quotes on teaching, learning or background information. This was followed by initial coding in which important words or phrases were identified and marked. Codes were then sorted into themes. This is when the theme of motivation emerged.

Quotes on motivation and other related codes were extracted and more finely coded. Thematic analysis was used to explore this particular aspect of the participants' view of the role of motivation. Thematic analysis is a method for "identifying, analysing, and reporting patterns (themes) within data."[10] [11] Although thematic analysis is more of a recursive process than a linear process, several general phases have been identified[12]. These phases are: 1) familiarization with the data, 2) generation of initial codes, 3) search for themes, 4) review of themes, 5) definition of themes, and 6) writing the results. The themes that emerged were further refined and are presented in the next section.

Findings

Importance of motivation in teaching and learning engineering

Participants intuitively knew that motivation plays an important role in teaching and learning engineering. An example of this is Feng, an international doctoral student, who talked about how important it was for students to be passionate for learning.

> I think that [passion] is the basic drive for people to learn. Also there are some other drivers like pursuing degrees, but those jobs are not so influential for students as the passion because passion makes the students actually learn something, and they will enjoy the learning. And make the learning process more efficient. (Feng)

Even though he was not familiar with motivation theories or their terminology, Feng believed that it was students' passion and goals that drove them to learn. Like Feng, some of the participants did not mention motivation directly but referred to 'interest' or 'passion'.

Participants talked about the centrality of motivation in the learning and teaching processes. At least for one participant, motivation is part of his definition of learning:

> … [learning is actually drilling down deeper into a subject based upon your own self-motivated curiosity, you want to know more …" (Brent)

For Sergio, another international student, motivating students is a central teacher responsibility. He believes that motivation can help students persist and spend more time studying on their own.

> I think your main responsibility is to motivate your student to learn. Because with the numbers of hours that you're supposed to teach some of these complicated topics, it's impossible that you are able to teach that in the classroom. But if you motivate your student right, then they're going to be able to go by themselves, and look at that material and practice, and improve themselves. (Sergio)

The effect of very complex, and sometimes boring, engineering courses was also a concern for these future professors. This situation also seemed to influence participants' views on the importance of motivation in learning and teaching.

Motivation as a student responsibility

Motivation was viewed by some of these future engineering educators as a student responsibility. It assumed to be a prerequisite for learning. These future professors expect students to come to class eager to learn. Four participants spoke directly about this theme.

> To some extent I think that students have to come to the table wanting to learn. That is something that can't be taught. You know it's something that through mentoring they can maybe see what the advantages that learning can give them but really I think it is their responsibility as an engineering students to come to the table wanting to learn … I think it is also up to students to commit to the learning process which is kind of the same as wanting to learn but there is a difference in my mind in that they are willing to put in the effort and the work. It is something that's not just going to land in their brain, in their heads. They have to work for it and that commitment to working. The wanting to do it … because I've seen the difference, there are students who want to learn but they are not willing to do the work. (Layla)

Several participants expressed that students cannot be taught if they are not motivated. These future professors felt that motivating students is out of their control because it is only the students themselves who can commit to do the necessary work.

> Well, I guess this is just my opinion but I think it is much harder to learn something when … what's the word… resistance to wanting to learn it. I say that because it is one of those things that frustrate me the most in teaching thing when people don't care about the material. I can deal with people who don't understand, and you need to … have to explain several times different ways but people who don't care. Not sure what the teacher wants to do about that though. (Laura)

Laura expresses the frustration that teaching assistants and faculty often experience when faced with unmotivated students. It is important to note there is hesitation among future engineering professors about how to respond to unmotivated students.

Motivation as a teacher responsibility

While some of these future professors saw motivation as a student responsibility, other participants saw it as a responsibility of the teacher.

> I think that good teaching motivates students to get involved and to take responsibility of their own learning to an extent. (Brenda)
>
> Well, I expect from them a lot of interest on the subject, but it's not something that I wouldn't - how to say this - as I mentioned from the beginning, I - part of my teaching is motivating them. And then I expect them - the interest after the motivation. But basically I want them to - I expect them - just the willingness to learn, to understand and apply whatever they learn in the field. (Luis)
>
> [My philosophy is] you're not here to fail a student, you're here to teach them and to motivate them. (Sergio)

For these future teachers, motivating student is part of their own conception of good teaching. Implied here is the assumption that motivation is within the professor's control which means they can take actions to help motivate students to learn.

Strategies to motivate students to learn

Participants repeatedly mentioned three strategies for motivating students: emphasizing the relevance or future utility of what is learned in class, using interesting 'real-world' examples, and modeling passion for the course. Each strategy is discussed in this section.

Emphasizing the value or utility of course topics was frequently mentioned by participants. Several participants described a common scenario in undergraduate engineering education and the effect it had on the learners.

> There were a lot of classes, as an undergraduate I sat through and I said 'Why in the world are we learning this? We are never going to use this.' (Janna)
>
> I think it can be very hard when you are in a class and you are learning equations and you don't really know how or why to use them. I've had experiences like that and it's really like I hear what you are saying but I don't understand at all why it's relevant to me or why should I care. I think that motivation is huge … (Brenda)
>
> So, I've had some classes where the professor would just kind of ... made a note of where they left off last time and they just jump right back in. You know, like whoa! what are we doing today, why is it important, why should I pay attention? I mean, I will, but not everybody will. I think it is important for the professor to get people's attention and it is more like a motivation, I guess, for why what we are doing today is worth looking at. (Laura)

From their own student experiences, participants knew that not understanding the future use of what is being learned had a negative effect on student motivation. These bewildering experiences influenced how participants plan to communicate with their future students. Lee elaborates:

> … I think my own experiences having been in a class or a situation where those expectations are not met have colored my view on trying to make things in the classroom more transparent: like what's the motivation, or the learning objective, or why things are setup in the way they are. (Lee)

For these future educators, making explicit the learning objectives of their classes as well as the future use of what is being learned are important strategies to motivate students and part of their teaching responsibilities.

As previously mentioned, participants were also concerned about the negative impact boring or overly complex courses may have on students. Several participants described the *use of interesting examples or projects* to draw in student interest.

> I use real case studies. I use - I put example when - going back to the case of the bridge when the I-35 bridge in Minneapolis collapsed. And I showed the picture and they were so engaged in talking and thought. To me using real case and motivate them is for me a very important ingredient for learning process. (Luis)

This strategy of using 'real-world' examples seems to be a response to concerns over making explicit the relevance of course material. Contextualizing engineering concepts in this matter is a common strategy used by engineering faculty[13].

Finally, a few participants talked about *modeling interest or passion for the subject*. This strategy assumes that students will be motivated to learn if they perceive their professors as enthusiastic about the material.

> Because when a professor's passionate about a topic, it's infectious. It makes the class passionate. It doesn't matter how boring of a class it is, how boring the topic is. If the professor's passionate, that's amazing. (Alan)

Beyond these three strategies, participants expressed hesitation on what they could do to motivate students.

Conclusion and Implications

This exploratory analysis suggests that future engineering professors intuitively understand the importance of motivation for teaching and learning engineering. They knew motivation could influence students to work harder and longer, as well as persist when faced with academic challenges. For the most part, participants in this study coincided in their individual intuitions about the importance of motivation in learning and teaching engineering and the strategies they discussed were in line with theories of motivation. Where there was variation among these future professors, was on their assumptions about their own role in motivating students. It was evident that although a number of participants saw motivation as part of their teaching responsibilities, some viewed student motivation as a fixed pre-condition that was out of their control. This runs contrary to what prior research on learning and motivation indicates[14].

The findings of this analysis also suggest the possibility that future faculty members have a limited repertoire of teaching strategies to motivate students. While participants discussed strategies to motivate students that took into consideration value of the task and interest, they did not consider strategies that could address other aspects of motivation like goal setting, expectations, relatedness, competency or autonomy.

Interpretations of these findings are limited by the conditions of this analysis. As previously discussed, motivation was not the primary focus of the original study therefore further research is needed to explore this aspect more thoroughly. Some of the questions that should be systematically studied include: How do future educators conceptualize motivation in learning and teaching engineering? Which strategies future faculty members plan to use to motivate students? How do teaching assistants or new faculty members respond to unmotivated students? What are the most frequent student motivation problems new faculty face? How can motivation theories help future or new faculty find effective ways to motivate students?

Finally, findings from this research have implications for the preparation of future and new engineering faculty. Dealing with unmotivated students is clearly a concern for these future educators and a source of frustration. Motivating students is central to their job as a teacher but their understanding of how to do this is limited by their lack of formal preparation for teaching and limited opportunities to think and talk about these issues. Although these professors did discuss some strategies to motivate students, their teaching repertoires lack the variety that comes to those who have studied theories of motivation and have reflected on how to put them into practice.

Programs to prepare future or new engineering faculty should include the goal of facilitating a deeper understanding of motivation theories and of factors that affect motivation. These programs should also provide time for people to reflect and discuss how motivation theories can be implemented in their classes.

Efforts to help future faculty better understand motivation should begin with the training of Teaching Assistants and could even be included as part of the professional development of all doctoral students. A better understanding of what motivates people can be beneficial to any engineering student who takes on a leadership position whether it is in academia or other settings.

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