How Engineering Educators Take Student Motivation into Account

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***Abstract**: In this project, we are addressing the question: how do engineering educators take student motivation into account in the context of teaching decisions? Using educator self reports of teaching decisions as our data source and theories of student motivation to guide our identification of places where the educators were explicitly or implicitly addressing motivation, we have been able to identify a number of patterns in how the educators in the study addressed motivation. For example, we have found little explicit emphasis but much implicit emphasis on motivation. Addressing the relevance of the material is one prominent type of implicit emphasis on motivation.*

Introduction

In this project, we are addressing the question: how do engineering educators take student motivation into account in the context of teaching decisions? Motivation—generally speaking, the level of will, want, or desire that someone has toward taking some action—has long been considered an important issue in teaching and learning. A student's level of motivation relative to class-related activities (which we assume to be a changing, able-to-be-influenced state rather than a fixed individual feature) can affect time on task, a student's ability to persist in the face of difficult tasks, and other factors that are positively linked to learning outcomes. Specific links between motivation and learning have been explored within the realms of self-determination theory, social-cognitive theory, and achievement goal theory.

As a result of research in these areas, a great deal is known about student motivation and how such motivation affects learning. While most of the work has not been done with engineering students, some studies have explored factors that affect engineering student motivation. For example, Marra and Wheeler (2000) demonstrated the positive impact of using authentic problems to increase student motivation with undergraduate engineering students. The authors found that the authentic project increased intrinsic, as contrasted to extrinsic, motivation relative to a traditional course which did not include the authentic project. In addition, Baillie and Fitzgerald (2000) showed that failure to see the relevance of engineering coursework was de-motivating to engineering students and contributed to student attrition.

However, much less is known about how faculty think about and take student motivation into account. Information on how faculty think about and enact motivation, including how their thoughts and actions align with different theories, will be valuable in efforts to help faculty more effectively address student motivation in their teaching. We seek to address this gap in our knowledge base.

In our project, we have been exploring this issue in the context of educator reports on their teaching decisions. Focusing on teaching decisions has provided us with a way to blend an emphasis on teacher action with an emphasis on teaching conceptions. In the context of this analysis, the focus on decisions means that our results provide insight into how motivation is actually taken into account rather than merely about how they believe they should take motivation into account. To operationalize motivation, we turned to prominent theories of motivation that addressed important factors related to motivation, e.g., relevance and social environment, in order to frame our analysis. We were particularly interested in those factors where we were aware of some empirical support for the relationship of the item with student motivation. As discussed below, we distilled these theories of motivation into seven lenses that, in addition to explicit references to motivation, helped us address the overarching question of how the educators were taking motivation into account in their teaching decisions and specific questions concerning the prevalence of behaviour, and the nature of the behaviour, associated with each theoretical lens.

The remainder of this extended abstract is organized as follows. In the next section, we introduce the theoretical ideas about student motivation that guided this analysis. The methods section provides details on our approach for gathering reports on decisions from educators and then coding these reports to address our motivation questions. Our results focus on quantitative results of the overall analysis and qualitative results on one of the motivation lenses we addressed, *relevance*. Our final section addresses the significance of these results and also our plan for completing this work.

Theoretical Framework

There is no one overriding theory for motivation but rather a collection of overlapping theories. The three theories chosen most prominently (self-determination theory, social-cognitive theory and achievement goal theory) were suggested by a recent article by Urdan and Schoenfelder (2006). Svinicki (2004) suggests that all models of motivation focus on both the value of a goal and the learner's expectation that the goal can be achieved. Drawing on this and an additional overview of motivation theory provided by Urdan and Schoenfelder (2006), the following distinct categories of factors potentially related to motivation were identified for inclusion in this study:

- Factors which affect the value of goal such as its *relevance* and the degree of student *autonomy* in selecting or pursuing that goal
- Factors which affect students' perception of the achievability of a goal such as task *difficulty* and the level of encouragement provided through *interaction* with others
- Factors which reflect the nature of the force driving students' motivation, whether it is intrinsic student *interest* or external *rewards and punishments*.

These factors provided theoretical lenses to help us "see" motivation in our data, as described in the following section. In this paper, we specifically address how educators addressed relevance. *Relevance* relates directly to the perceived value of a goal and thereby influences the motivation to achieve it. Relevance is a recognized motivational factor in most theories of motivation. Svinicki (2006) describes all motivation theories as having an inherent focus on perceived task value. Achievement goal theory, a model which focuses on what is motivating students to try to succeed, also emphasizes the importance of assigning students meaningful (relevant) academic work in order to motivate them (Urdan and Schoenfelder, 2006).

Methodology

In this study, we coded transcripts from interviews with engineering educators in which they reported on prior teaching decisions for evidence of having taken student motivation into account, and analyzed the coding results to address our questions about the extent of taking motivation into account and the ways in which motivation was taken into account.

Data collection: The data for this study was collected as part of a larger endeavour to understand how engineering educators make teaching decisions generally. The interviews were conducted based on the Critical Decision Method developed by Klein, Calderwood, and MacGregor (1989) where participants were asked to identify critical incidents, i.e., specific, memorable decisions (see Flanagan 1954), and their decision-making process. The faculty participants in the study were 31 engineering educators at a large public institution in the Northwest. The participants came from 9 of 10 engineering departments and represented all academic ranks. Four of the faculty participants had high-level administrative roles. We deliberately oversampled for women in the study, with 23 male and 10 female participants, or 30.3% female faculty in our sample.

The interviews opened with an introductory period in which the educators were asked to talk about their teaching responsibilities and to react to the notion of "teaching decisions" as a way to talk about teaching. The participants were then invited to identify two specific, recent, memorable decisions: a planning decision (defined as a decision made in advance of interacting with students) and an interactive decision (defined as a decision made in the moment). Our analysis (described below) focused only on this part of the interview. The interviews ranged from 45 to 90 minutes, and each interview was recorded and transcribed.

Data analysis: The data analysis process closely parallels that reported by Chi (1997). The analysis was conducted in three phases: segmenting the transcripts, coding the educator segments based on whether or not the educators utterances could be linked to student motivation. The transcripts were segmented by turn taking event (TTE = each time the educator spoke). The coding process consisted of examining each TTE to determine if it represented a place where the educator was taking student motivation into account. Because we were interested in addressing motivation theory yet also staying close to the participants' language, the coding scheme was developed iteratively through attention to the theoretical lenses associated with motivation and also our early interactions with the data. The rules of recognizing motivation were ultimately formalized in a codebook. The codebook instructs coders to code a segment as motivation-relevant if it either: (1) alludes to motivation via an explicit use of the term *motivation or through use of* a phrase such as will or desire that can be replaced with the term *motivation* or 2) addresses ideas from motivation theories (i.e., self-determination theory, social-cognitive theory, and achievement goal theory) about what can influence motivation (e.g., addressing relevance of a topic, providing students with choice, helping students set goals, focusing on excitement and fun, and building relationships with students). Stemming from the theoretical ideas introduced earlier, eight theory-based lenses were used in analysing the data: (1) motivation (explicitly mentioned), (2) relevance, (3) autonomy, (4) difficulty, (5) interest, (6) extrinsic incentives, (7) intrinsic incentives, and (8) interaction.

The coding process involved analysing each TTE and applying all of the codes that pertained. As a result, a single TTE could be coded with multiple codes. For overall aggregation purposes in the analysis, a TTE was considered to be related to the general phenomena of "taking motivation into account" if one or more of the codes below had been applied to the TTE. To improve the quality of the results, all transcripts were coded by at least two coders.

Results: We are using the results of the coding process to determine both quantitative and qualitative answers to our research questions. From a quantitative perspective, we were able to identify two metrics for characterizing the prevalence of each motivation lens: the number of the TTEs that were coded as addressing student motivation in some way and the percentage of the educators whose decision making included something coded as related to the lens.

Findings

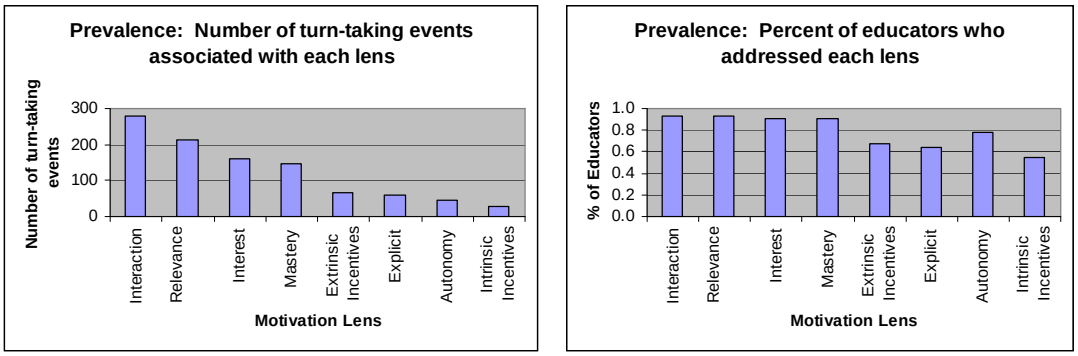
In this section we first present our results for all of the motivation lenses. We then discuss how one lens, *relevance*, was instantiated in our data. In this second section, we report on how the educators addressed relevance in their decisions, the types of relevance issues that came up, and the challenges educators introduced concerning this issue. Ultimately, we intend to address these issues for all of our lenses.

How did the educators take motivation into account? Overall results

Our coding resulted in just over 10% of the TTEs being coded a related to motivation, suggesting that the educators in this study were taking motivation into account. Specifically, we coded just over 700 of the over 6,700 TTEs as related to motivation. Less than 10% of these TTEs were linked to motivation explicitly (i.e., the TTE explicitly used the term motivation, a derivative of the term or a direct synonym). The remaining TTEs coded as motivation-related represent implicit connections to motivation via theoretical ideas.

While the results of our analysis suggest that motivation-related talk was quite extensive, there were clear emphasis areas in terms of the lenses we used. Figure 1 depicts the prevalence of each of the motivation lenses in our coded data. Figure 1a (to the left) operationalizes prevalence in terms of the total number of TTEs linked to motivation through our coding. Figure 1b (to the right) operationalizes prevalence in terms of the percentage of the study participants who had TTEs coded with each lens. In essence, these two measures capture how much we heard about motivation via each lens and how many people we heard from. As Figure 1a illustrates, we had quite a spread in terms of the first measure of prevalence (i.e., how much we heard, total number of TTEs). We had less of a spread in

terms of the second measure of prevalence shown in Figure 1b (i.e., most lenses were addressed by 50% or more of the participants).



Figures 1 (a and b): The prevalence of each motivation lens based on two different measures of prevalence.

Concerning specific categories, the eight lenses can be clustered in three groups based on the prevalence results. The first group consists of the two lenses—interaction and relevance—for which we identified a larger number of TTEs and which were addressed by almost all participants. The two lenses in the second group—interest and mastery—were addressed by almost all participants but the overall presence of these issues in the data was less than those lenses in the first group. The remaining four lenses were simply not as prevalent on either measure—with few TTEs overall and a smaller percentage of participants addressing the lens.

In our ongoing analysis, we are unpacking the themes associated with each of these lenses in order to better understand exactly how each was instantiated in the data. In the next section, we spotlight one such analysis—the analysis of how the educators in the study addressed the very prevalent issue of relevance.

How did the educators take motivation into account? Unpacking Relevance

Faculty comments suggest a number of different facets to how engineering faculty think about how to use relevance to motivate students. One of the most frequent themes was how faculty shared real-world expectations for what engineers need to do in the workplace as a way to motivate students to become prepared. For example:

> *"It's a matter of what's acceptable professional conduct once you leave this institution, and it's my job to prepare you for the real world…."* (TTE 1944)

> *"I hope we can help students…making decision in the face of imperfect or incomplete information, which is, you know, life as a professional anywhere."* (TTE 2465)

Related to this are examples of faculty using their own experiences outside of academics to both enhance their credibility and motivate students to learn. The second very common theme in this category of coded transcripts segments is faculty's use of the real-world examples to motivate students in their class by making the course more interesting. These two themes were both the most common and perhaps the most direct examples of faculty attempting to motivate their students by connecting their classes to the real world. For example:

> *"Well, I thought the fact there was this obvious case study that people were familiar with would also give it a little more immediacy."* (TTE 2011)

> *"I try and tie it in to very – and this is a term that way overused in the universities, but real-world situations. Our students, a lot of engineering student, tend to respond really well to that."* (TTE 2517)

Other related themes, however, did emerge. Some faculty illustrated how students' classroom accomplishments would lead to success in the real world and attempted to both motivate and empower students. While this theme obviously relates in part to those mentioned above, there is a stronger emphasis on students' self-efficacy than earlier examples of using the real-world to set learning outcomes or simply interest students in course material. For example:

> *"So I said [student name] that was a very nice solution. You'll be pleased to know that's exactly the way the problem was solved and that led to a patent…. So you want to build up in the students a confidence that they can solve problems."* (TTE 1218)

While faculty comments indicate that by and large they consider attempts to bring the real world into their classes to be positive, there were some indications of possible tensions. One was the tension between theory and practice. For example:

> *"That they understand the theoretical implications of things. I've actually had students on some occasions say that there was absolutely – that they could not agree with the need to provide more theory in class, that all they wanted was the nuts and bolts. Someone I wouldn't care to hire."* (TTE 455)

In addition, some faculty saw difficulties in attempting to integrate real-world learning experiences because of the complexity of real world problems. Finally, faculty comments indicate a perceived gap between what the faculty believe students need to do to be successful and what they think their students believe are realistic professional expectations. For example:

> *"I see that many of them…come to the program without really their adroit understanding of the world…and they want to graduate and like start-finish, and they don't really know what's outside."* (TTE 9624)

The fact that discussions of real-world applications and other aspects of relevance were frequent elements of faculty talking about their teaching is perhaps not surprising given the practical nature of engineering education and the professional orientation of many engineering faculty. In our ongoing analysis, we are unpacking the subthemes that emerged regarding the different ways in which faculty think about relevance as it relates to student motivation.

Discussion and Concluding Remarks

The contrast between faculty's extensive *implicit* discussion of motivation and the scarcity of segments with an *explicit* focus on student motivation might suggest that motivation *per se* is not prominent in faculty decision making about their teaching. However, faculty do frequently take into account factors which affect motivation, such as the relevance of coursework and faculty interactions with students. This raises a question about whether faculty take these topics into account primarily to motivate students or for other reasons such as believing that real-world examples are simply good preparation for engineering students or that interacting with students is enjoyable or leads to higher student evaluations. Since relevance can influence students' perception of the value of a goal, and therefore motivation, being cognizant about the potential to influence motivation might help educators be more effective in their practice.

Faculty's perception of their role in motivating students is a significant educational issue. As noted in the introduction, students' motivation can be influenced by the educational environment and does impact their learning. Therefore, faculty who make an effort to motivate students have the potential to be more effective teachers. If a significant number of faculty assume that student motivation is either beyond their influence or irrelevant for learning, this may identify a significant opportunity for faculty development. For example, the low prevalence by both measures of talk about autonomy and intrinsic incentives suggests an opportunity to encourage educators to be more student-centered.

Because of space limitations, this document has not reported this study in its entirety. The archival manuscript for this study will provide much more extensive information on motivation theory, and also situate our approach in broader work on teacher thinking. In addition, our method will provide more information on the decisions that were being reported by the participants and our results will

address the themes associated with all of the lenses that we used. We will also illustrate these themes through judicious use of excerpts from our interviews.

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