

AC 2007-1288: DECISIONS ABOUT TEACHING: WHAT FACTORS DO ENGINEERING FACULTY CONSIDER?

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Decisions about teaching: What factors do engineering faculty consider?

Abstract

This current research paper uses a cognitive science methodology for investigating the phenomenon of teaching decision making in engineering education. We ask engineering educators to identify two memorable, recent teaching-related decisions in terms of pre-active (planning) and interactive (in-class) stages. They then describe the situation, the process of making the decision, the factors that they took into account, and the outcomes of their teaching-related decisions. In this paper, we focus on time as the one specific factor that emerged across all the participants in this research study.

Introduction

Decision making is central to the teaching of engineering, however, little has been written about the teaching decisions of engineering educators. We believe that the engineering educator community can benefit from insights into how to better prepare for teaching decisions in order to be an effective instructor because engineering educators are faced with teaching-related decisions on a daily basis.

We are particularly interested in studying engineering educator decision making because of the link between teaching decisions and critical issues in engineering education. In particular, teaching decisions represent a context for the use of information such as information about student diversity, student prior knowledge and misconceptions, and the variety of available pedagogies. We believe that the results of our study will enable the engineering education community to develop more effective ways to educate the educators about such information and how to use it. Further, we anticipate that by asking educators about their teaching decisions, we may trigger reflection, which in and of itself may lead to improvements in teaching practice.

By exploring the processes through which engineering educators make teaching decisions and the factors they consider, we can use decision making as a lens to understand their teaching practices and gain a better understanding of how to help engineering educators make more effective decisions about their teaching. We believe that this approach is particularly appropriate because it is a framework used extensively in the field of engineering (i.e., design decision-making) and thus may be a more familiar framework to discuss their teaching practices.

We chose to emphasize teaching decision-making using the following educational and psychological definitions. Sutcliffe and Whitfield¹ have defined a teaching decision as “a decision made during the execution of the professional responsibilities of the teacher” (p. 16). In addition, teaching decision making also references the notion of “a decision as a commitment to act. Action is therefore the irrevocable allocation of valuable resources.”²

There are many challenges to studying decision-making because it is a subjective activity, making it difficult to research and study directly. While most engineering educators acknowledge that they make some explicit decisions, most of their decisions are invisible and

unspoken of. As researchers, we cannot “see” or “witness” a decision, and therefore must infer from observable behavior or participants’ self-reported comments that a decision has been made. The study of the decision-making process is also made more difficult by the ephemeral nature of decisions which happen quickly in people’s minds. The challenges related to conducting research about making decisions may have contributed to the paucity of studies that examine teacher thinking, teacher conceptions and teacher decision-making.

Despite these challenges, educational scholars like Shavelson and Stern³ clearly state the need for this type of research, especially regarding teacher’s pedagogical thoughts, judgments, decisions and how these are linked to their behavior. A review of literature based solely on teachers in the K-12 level suggested that any model that is solely behavioral is conceptually incomplete, not accounting for the predictable variations in teacher’s behavior arising from differences in their thoughts, judgments, and decisions. Shavelson and Stern also suggest that empirical research linking teacher’s intentions to their behavior can provide a sound basis for educating teachers and implementing educational innovations.

Given the importance of understanding engineering educators’ teaching-related decision making, we hope that by beginning to characterize the factors these educators considered, others will gain a greater awareness of decision making by recognizing factors and solutions to overcome barriers. Thus, the following research question guided this portion of the research study:

- What do engineering educators take into consideration when making teaching-related decisions?

As part of our research, we have chosen to use a qualitative interview approach to understand engineering educators’ teaching-related decision making. We focus our first analysis on half of the dataset (10 interviews), in order to identify hypotheses and themes that can be tested against the rest of the dataset. This focused analysis of the collected interview data revealed that engineering educators in our sample utilized a range of factors that may impact their teaching-related decisions making. For the purpose of this paper, we have carefully chosen one specific factor that is common across all 10 participants – the time factor. The pervasiveness of references to time clearly makes this factor a central and critical issue among all levels of faculty members.

In the next section, we will describe our research methodology. Then, we will provide examples of shared experiences of time among faculty members. Next, we will illustrate the various creative ways that faculty members used to overcome the time barrier. Finally, we will provide a list of suggestions for new engineering educators to overcome their time issues.

Methods

This current study uses the Critical Decision Method⁴ (CDM) approach to elicit the specific information regarding processes and factors that engineering faculty use when making teaching-related decisions. The CDM builds on critical incident techniques⁵ by using a set of cognitive probes to determine the basis for situation assessment and decision making during critical incidents. This approach is especially apt because it can be used to study people at different

levels of expertise in a naturalistic setting by relying on interviews to examine recent cases of interest; in our case, it would be teaching-related activities.

During the interviews we first ask the interviewees their *background and demographics*. For example, we ask them what their faculty status is and how long they have been teaching. This might be potentially influential as to how they view teaching (e.g., pre-tenured engineering faculty might spend more time and energy on teaching decisions when they teach a course for the first time). Second, we then ask them to talk about their *definition* of teaching decisions and their *reactions* to framing teaching as decision making. Through these initial questions, we gain an understanding of how engineering faculty define decisions in their own terms and we also gauge their reactions to teaching as a decision-making activity (e.g., to what extent do engineering faculty already think of teaching in terms of decision making). Third, we ask them to talk about a *pre-active teaching decision*, which we define as decisions that they have made while planning a course. Fourth, we ask them to talk about an *interactive teaching decision* that they have made spontaneously while teaching a class. During the two teaching decision questions, we ask participants to describe the context for these decisions, their process for making these decisions, the factors that they considered, their level of satisfaction with the outcome of each decision, and whether they would make a different decision if faced with the same situation again. Finally, we close the interview by having participants describe their usual processes of decision making and reiterate the factors they considered.

We purposefully selected ten interviews from this data set in order to identify the factors that engineering educators considered in teaching-related decision making. We have chosen to analyze ten interviews in order to identify significant themes that can be compared to the rest of the dataset. Researchers used thematic analysis⁶ to identify a range of factors that were discussed during the interviews. For the purpose of this paper, we focus on reporting one key issue -- the pervasiveness of the references to the time factor among the 10 participants.

Findings

Participation in this study was voluntary and all participants indicated a strong interest in teaching and learning issues within engineering education. All participants currently hold faculty level positions within the College of Engineering and are currently teaching or have recently taught courses in engineering. Our participants include both genders and their faculty status ranged from senior lecturer to full professor. The distribution of their disciplines is represented across all ten departments within the College of Engineering. Their teaching experiences ranged from a couple of years to almost 30 years of college teaching.

In this section, we will provide a snapshot of our findings regarding the time factor as it emerged from the data. First, we will present findings related to how faculty perceive time as a constraint in their teaching and how they report managing this constraint. We will then present three creative approaches that faculty shared regarding overcoming the time barrier: faculty centered approaches, student centered approaches, and content-centered approaches.

Time Factor

“I am definitely going to take a course on time management... just as soon as I can work it into my schedule.” ~ Louis E. Boone

Time is an important factor in academic life. Time is one of many factors (or constraints as some participants described) that these participants considered while making teaching-related decisions. Time is intrinsically tied to all aspects of teaching-related decision making, whether it is explicitly said or implicitly implied.

It is commonly acknowledged throughout higher education that time management is one key skill that a successful faculty member should master^{7, 8, and 9}. We anticipated that faculty would mention time as a factor, limitation, constraint or scarce resource for their teaching decisions, and all of the 10 engineering faculty in fact did talk about time in those terms. SD107, a full professor with 19 years of teaching experience, described time as a constraint for teaching decisions explicitly, stating “deciding about time -- both the students' time management and my own time management is simply a constraint of the modern world.”

Faculty characterized specific time intervals as constraints that they factored into their teaching decisions. Examples of these time intervals included the total number of hours in a term-long course, the minutes allocated to specific activities during a class session, the amount of time needed to grade or assess student work, and how much time faculty expected students to spend on specific activities.

They often described these time intervals as boundary conditions. In the following example, the time interval of an individual class session became a local boundary condition for making sure that specific content was covered; the teaching decisions about the pace for delivering this content during an individual class session also had to satisfy the time constraint imposed by the global boundary condition of the total number of hours that the course met over the entire term. Both of these time intervals were considered when deciding how many group learning activities to include during the entire course, “I mean 50 minutes, one thing, you're done. And so you can't do that every week, you just can't.” SD106, an assistant professor who was beginning his third year of teaching at the university level, also used the time interval of a term both to evaluate the value of a new course that he was developing, “something that you can teach in 10 weeks that's worthwhile”, and as a specific design constraint for discretizing and sequencing the topics he chose to include, “I kind of formulated the course and got the little topics stretched out and figured out I had enough weeks.”

Faculty also characterized time as a scarce resource when they were deciding how much time to allocate to their teaching with respect to the time allocated to other professional and personal responsibilities. SD117, a full professor who carried a heavy administrative load in addition to research, teaching, and family responsibilities described a strategy for minimizing teaching preparation time, stating “I'm sort of proud of myself. In 16 years I've only taught 3 different courses, which I think is a model of teaching efficiency in terms of prep time.” SD105, an associate professor with 8 years of teaching experience echoed this strategy, describing the preparation time needed for a course he had taught several times as having “reached a steady state... that asymptotic area where my lectures are more or less under control. I can ... show up

an hour before lecture, organize my overheads.... read my notes once and show up and I'm ready to give a good lecture.”

New faculty members in our study confirmed how some experienced faculty seemed to minimize the time they allocated to teaching preparation. SD106, an assistant professor with 2 years of university teaching experience, discussed the amount of time he spent preparing for his classes compared with the amount of time that he thought more experienced colleagues spent preparing, stating “I probably do more preparation for classes than a lot of instructors, at least the instructors I know, who are -- some of them are experienced ones. Once you teach a class like 27 times, it's really easy to wing it.” However, these observations from SD105, SD106, and SD117 were not echoed by all of the more experienced faculty. SD109, a full professor with more than 10 years of teaching experience, reported spending a significant amount of time on preparation, saying “you need to spend five hours at least to prepare for one good hour of teaching.”

In some cases, time can also be framed as a context for not considering the use of crucial information such as student diversity, student prior knowledge and misconceptions, and the variety of available pedagogies. For example, when asked whether the participants had considered taking student diversity (in terms of backgrounds and personalities) into consideration when teaching, the following were mentioned:

“It would be best to take that into consideration, but it's very difficult due to limited time on faculty members. Actually after class, the contact is very limited, yeah, very limited.” (SD109, Full professor)

“I think about the fact that people have different learning styles, and I don't believe in a single learning style... It would be great if you could teach every idea with every learning approach...But that's too time consuming.” (SD107, Full professor)

In both cases, the issue of time becomes a constraint to take student diversity into considerations. Faculty members tend not to optimize because they are under time pressure or constraints. This corroborates with Herbert Simon's ideology of *satisficing* in which people tend to accept a choice or a course of action that will satisfy the minimum requirements necessary to achieve a particular goal when under constraints or limitations¹⁰. *Satisficing* is a combination of the word “satisfy” and “suffice”. Herbert Simon coined the terminology back in 1955, because he believed that under certain circumstances, people will not choose to optimize, because optimization requires processes that are more complex than those needed to merely *satisfice*. In the examples illustrated above, both faculty acknowledged the importance of taking student background and personalities into account when teaching. However, because of time constraints, they chose to *satisfice*.

The limitation of time seems to be a constant frustration for some faculty members, even after tenured. One full professor explicitly acknowledged that it is like a race to catch up with time in terms of planning class content to be delivered.

“How do you catch up with time? That’s a constant problem. Never teach after the bell. Nothing has ever been successfully taught when the bell rings, right? When the bell rings, you’re done.” (SD108, Full professor)

The time issue was prevalent across all levels of faculty and was acknowledged by all participants in our study. So far, we have revealed excerpts of a common understanding of time as a constraint in terms of planning for teaching and the actual instruction. In the next section, we will discuss three creative ways that time was reflected in the decision-making interviews.

Creative approaches to overcome time barrier

“We must use time as a tool, not as a crutch.” ~ John F. Kennedy

There are certain things and ideas participants suggested that made the time issues seem more pervasive. Although participants generally acknowledged time as constraints or limitations, some participants also revealed their beliefs that time issues can sometimes be beyond being a constraint. Their responses suggested creative solutions to overcome time as a limitation.

In the paragraphs below, we have categorized these creative approaches along these three dimensions:

- (1) Faculty centered approaches
- (2) Student centered approaches
- (3) Content centered approaches

Faculty centered approaches - Creating more faculty time

As mentioned above, time is limited. Faculty members need to balance their time in terms of the three main responsibilities: research, teaching and service. In some faculty members cases, complicating the time issue can result in creative ways to carve out more time for themselves.

Creating time for oneself is important as faculty members need to juggle between multiple roles and responsibilities within their positions. Most of our participants commented about the three components of a faculty career – research, teaching, and service – have arbitrary and complicated boundaries. In the examples below, three participants claimed that it was hard for them to make the distinction between their research, teaching and service time allocations.

“It’s really hard to separate it out. If I’m reading a journal article, I don’t know whether I’m reading it necessarily for research or reading it for teaching. It’s a big ... confused mess.” (SD108, Full professor)

“Which I think are arbitrary definitions. I mean things cross all three, but I would say it depends (on the quarter)”. (SD106, Assistant professor)

“Probably the teaching is about half the time. The research is a little more than a quarter of the time, maybe, and then the service is the remaining. Maybe it’s 50/25/25, something like that. But the – again, the boundaries are kind of fuzzy.” (SD104, Full professor)

In order to deal with this limited resource, some faculty members talked about blurring the boundaries between their teaching assignments and their research interests. Some talked about assigning students readings that would match their current research interest, thus, hitting two birds with one stone. A couple of participants talked about including classroom and teaching-related issues into their research agenda (i.e., incorporating educational technology, new classroom assessment techniques). Others talked about teaching classes that only relate to their research interests so they can optimize the time spent on both areas. In one specific example, this participant talked about choosing to teach classes that relate to his research interest and background so that he can optimize both his teaching and research interests.

“...the courses I tend to choose to teach are courses that are related to my background, related to my interest, either laboratory or hands-on. The senior-level course is a new course that I had developed, the one I teach in spring, and that was based on my interests -- started out as just materials, and gradually evolved toward the role of materials in construction and constructability, and so the senior course I teach is on reinforced concrete construction, and we talk about constructability issues, not just how materials affect it, but also understanding the whole process. But that I guess would be a decision. I decided to offer -- to develop that course and offer it because it was kind of a continuation of my evolving interests.” (SD113, Associate professor)

Another participant talked about using alternative teaching approach such as active learning activity to create time for herself during class periods. She then used the extra time to prepare and plan for the rest of the class sessions and thinking of ways to steer students to the topic of the day.

“Oh, it’s a little bit funny, this active learning, because you -- you give out the little assignments, and then you all of a sudden have nothing to do, you’re waiting for them to think about it, and you want to kind of stay out of their way. And so I kind of step back, and sometimes I’ll tidy up the classroom or I’ll look, you know, and see what’s coming up and how I can organize the rest of the class, because sometimes -- like on this topic, it’s so condensed, I have a content issue with this particular topic, and so picking out some of the things that I think are most important. So I guess in decision making concept I’m taking the time of active learning to actually then kind of formulate decisions for the remainder of the class.” (SD111, Assistant professor)

Another professor talked about having his graduate students and colleagues teach classes while he is on travel during the term in order to cover the curriculum materials. Instead of canceling class and compressing time during the rest of the term, he utilized his graduate students and colleagues to cover the class meetings that he had to miss.

“So I had two guest lecturers. I had a conference; I had to miss two classes, which is a lot of missing in my book. But I had two guest lecturers, and the students didn’t miss anything.” (SD108, Full professor)

Another professor who balances a busy family life and with career talked about “having fun” and “planning ahead” in the classroom in order to lower the pressure as a teacher. Specifically, SD117 makes sure the course syllabus is well planned and also tries to anticipate other instructional issues before the term starts.

“Efficiency, time management, lower -- reducing the pressure on myself, reducing the time pressure on myself during the quarter, that's key, being cognizant about the community and the classroom, the teaching ratings, trying to have fun.” (SD117, Full professor)

“... It’s just so nice to go in there and know that it’s not – you’re not going to have these great big things hanging over you, so now I like having it all done up ahead of time” (SD117, Full professor)

Our participants also discussed a wide variety of resources that they utilized in order to “plan ahead” and be “time efficient.” Such resources include consulting previous instructors (who have taught the same class), borrowing ideas from previous syllabi used by colleagues, incorporating course evaluation feedback from previous years, seeking advice from faculty developers (to brainstorm about additional activities) and researching ideas from available assortment of literature (i.e., textbooks and journal articles).

As our examples show, there are a variety of ways to create more time in the classroom and in your faculty career. In the next section, we will discuss the numerous ways to consider the needs of students from these participants’ perspectives.

Student centered approaches - Considering the needs of students

Faculty reported that they often considered the needs of their students with respect to time. The majority of the responses related to scheduling issues such as “changing term paper deadlines and midterm dates, depending on the needs of the audience,” as SD105, an associate professor said when describing his core philosophy of flexibility for “certain things.” Faculty also considered time in their teaching decisions as it related to the maturity of the students, both in terms of developing the maturity of students in preparing them for their professional responsibilities as engineers, and in considering the maturity of students as faculty made design decisions about their courses.

In the first example SD105, an associate professor, discussed how three of his core philosophies influenced his decision to postpone the due date on an assignment so as to not ruin family time for students over the Thanksgiving holiday. Although the students told him that they were willing to work on their term papers over Thanksgiving break, SD105 felt that it was not fair to require students to work on assignments rather than spending time with their families during a holiday that is traditionally family oriented because he was unable to get them timely feedback.

In this example, he decided to postpone the due date to two days after Thanksgiving break based on three of his core philosophies: flexibility, the need to maintain a healthy balance between professional and personal responsibilities, and giving students feedback in a timely manner. These core philosophies influenced both how he managed his own time and how he expected students to manage their time. He elicited feedback from the students before making his decision, but decided to postpone the due date despite his students' stated willingness to "sabotage Thanksgiving" with an earlier due date because he felt that this was the right thing to do.

"...You know, I'm consistently flexible on certain things, like changing term paper deadlines and midterm dates, depending upon the needs of the audience. We had a decision today. I said, okay, I'm supposed to get my term papers, because I do two term papers for graduate students in my 400 level class, so, okay, I promised you I'd have it back by a certain date, and I'm not done, so -- and I also promised you that I wouldn't make a second due date less than a week from the time when you got the first one back, because you want to like learn from the first one. So we got a problem here, we have to reschedule, you know, but if we don't reschedule, if we think about this, you could end up working on this assignment over Thanksgiving break, and I don't want to sabotage Thanksgiving, you know. And they're all like sabotage Thanksgiving, that's fine. Everybody is like sabotage Thanksgiving. I said, well, I don't really want to do that, so we'll make it due Tuesday night after Thanksgiving so that you can put some time during Thanksgiving break on it but you still have two days when you get back to kind of polish it off..." (SD105, Associate professor)

Our next example illustrates one way in which an instructor considered time as it relates to student maturity. SD107, a full professor teaching an undergraduate course in embedded systems, discussed a decision he made about the level of detail he provided in the design specifications for a project in terms of developing their maturity as practicing engineers. In this case, SD107 uses time as it relates to the maturity of the student as a dependent variable; a surrogate for engineering experience. Although he spent a significant amount of time in framing the design problem for his students, he felt that a certain amount of ambiguity in the design specifications helped contribute to students developing skills that they need in the workplace, where project specifications are routinely more ambiguous than they are in lower level undergraduate classes.

"...And it's also very important to help their sort of general maturity as a software engineer, because when you give a typical undergrad a programming assignment, you specify it in extreme detail and they get it right or wrong. But the real world there's often a very -- a detailed set of requirements, but it's never enough, and the engineer has to use their judgment and understanding of the end goal to fill in details. Because otherwise writing the requirements and specs would take too long. So that part is missing unless you put the framework around it. So if we make this sort of a convincing little iPod, then what I'm hoping they'll do is if there's an ambiguity in the requirements either that I've put it in intentionally or unintentionally, and both are in there, they'll figure out what would be the answer that makes the better end product, and they'll shape the requirements according to some understanding of the end goal..." (SD107, Full professor)

The third example shows how an instructor based decisions about delivering content on his perceptions of the level of maturity of his students. SD106, an assistant professor with extensive military experience, discussed maturity and experience as a surrogate for time in explaining the differences between undergraduates, graduate students, practicing engineers in a certificate program, and senior officers taking courses that he taught during his military service who had more experience than he did. SD106 also described how the power differential he experienced between students and instructors in the military was quite different than that of academia, because “you're teaching crews about tactics, so not only are you teaching folks who might be your peers or folks who might be junior to you, but you're also teaching folks who are captains of ships who know a lot more than you and can tell you to do things, so it's a very different atmosphere.”

In the military, students in SD106's classes routinely were senior officers with more experience than him who outranked him and had no hesitation in challenging him on course content or ordering him to provide them with additional course materials. These time related differences in maturity and experience level between instructor and student led to a power differential within the classroom that faculty in academia rarely experience:

“...And so, you know, some folks are receptive, some folks have had -- in some of their jobs have had just a load of experience in this and know way more than you do, and others don't. And when you're done at the end of the day, they say, you know, that thing you mentioned earlier on, I'd like to get a copy of that, and could you have that on my desk by 6:00 p.m., and you say, ‘Yes, sir’, and you go get it. And they will call you. They will call your bluffs, no problem. So I learned a lot teaching those kinds of courses...” (SD106, Assistant professor)

By contrast, in academia he found that the power differential was in his favor, even with more mature students. Undergraduate students rarely challenged statements that he made during lectures. Although graduate students in the certificate program who had extensive experience as practicing engineers were more skeptical than the undergraduates, they did not have the power to have him fired, unlike the senior officers who were his students in the tactics classes he taught in the military:

“...You know, you're teaching graduate students and undergraduates. And by and large undergraduates will believe you whatever you say. So, you know, power is -- can be dangerous. You know, so there's certainly -- situations aren't like that anymore. I mean, you know, they'll call you on it. I mean if you say something stupid, they'll ask you questions, but they can't -- they can't get you fired like some of these guys are...” (SD106, Assistant professor)

In our final example SD105, an associate professor, describes negotiating the date for a midterm in his junior-level class with an older colleague who wished to schedule his midterm in a different class on the same day. SD105 ended up applying his core philosophy of flexibility when deciding to change his midterm date so that their students would be able to manage their time to study and perform well on both midterms. In this example, SD105 expresses frustration with his older colleague, who based his decision to schedule his midterm on the same day as

SD105's on his own experiences as a graduate student 40 years ago, rather than considering the learning needs of current undergraduate students. Time enters into this decision in multiple ways: negotiating midterm dates with colleagues; helping students manage their study time; helping students demonstrate their learning optimally; flexibility in scheduling based on beliefs about student needs; and dealing with a generation gap that revealed extreme differences in teaching philosophies between colleagues. Ultimately, SD105 decided to change his midterm date after his colleague refused to reschedule because he felt that this was in the best interests of the students. In their evaluations at the end of the term, students commented positively upon SD105's willingness to negotiate with his colleagues on their behalf and work with them.

"...During the junior year all of the students are taking the same sequence of classes, so there are 80 students in the same five classes, and I always tell them, I said, you know, I'm going to work with all the team that are teaching this quarter so that we don't all give you the midterm on the same day. You know, because that's like -- that's a problem. And they're like, okay, cool. And so I send an e-mail to all the professors saying, okay, I'm going to give my midterm on the Wednesday of the fifth week or the fourth week or whatever.

And some of them respond, some don't. And so I had a case where like the professor announces two days before he was going to do his midterm on that same day, after I had already asked him, you know, to try to work with me on this. And so I communicated with him, and I said, you know, I contacted you with the e-mail, I tried to sort this problem out, and then you end up assigning it on the same day. And he says, well, when I was a graduate student -- of course, the guy is like 70 years old. When I was a graduate student, we had to do all our tests on the same day. There's no reason why they can't do it, blah, blah, blah, blah, blah, blah, blah. I'm like this is bullshit, because you know that if they do two midterms on the same day that they're going to be less prepared for one than the other, so, I mean why put them through that. We want them to do as best as they can in each class. It doesn't make any sense.

It's just like kind of punish them, like a hazing ritual or something like that. And so -- well, that's what it really is, you know. And so I went back to the students, and I said, okay, he changed his date to my date. I talked to him about it, he's inflexible, so I'm changing my date, at last second. So then I turned mine from Wednesday to Friday. And then I said, don't tell him I did that, because he'll change his to Friday, you know. I was just pulling their leg, but, you know, the students appreciated the fact that I was willing to work with them, you know. I mean this guy was going to be a horse's ass. I wasn't going to...." (SD105, Associate professor)

Our examples show that faculty members considered students' needs with respect to time in their teaching-related decision making, both in terms of scheduling decisions and in using time as a surrogate for student maturity and professional experience. In the next section, we will discuss different ways to approach content and curriculum with respect to the time issue.

Content centered approach – Be selective

Because our study was situated in a Research Extensive university with a quarter system – meaning faculty have only 10 weeks to teach a course to students, thus, choosing and

selecting the most crucial content to deliver in class became time-dependent. Faculty members in our study talked about being “selective” and “meeting industry and application requirements.” While they felt it was important that students have an understanding of theory and fundamentals, they also wanted to make sure students were aware of the forefront of research and industry work in order to prepare them for the engineering work force and/or graduate school.

“Yeah, you should stay in front of research area and know and you have to lead students in correct directions. So many materials, usually -- usually in every course there is whole part in application area and cannot give up whole part, that must be covered, in application area, the senior classes, even old textbook, they must know a lot of application area to apply this core theory to this area, right? That area, we need to carefully select, okay we in college cannot teach all of it because time is limited right?” (SD109, Full professor)

Some participants also discussed their efforts to continuously update their teaching materials because of the way technology works within their fields. They talked about it in terms of cutting out old materials from the class curriculum and updating it with the more current technology that is current with the industry needs.

“And some old things -- so using just another -- so too old topics, okay, old application areas should be deleted from textbook, deleted from teaching.” (SD109, Full professor)

“...well the course doesn't change, but the content changes all the time, and that's true of all the course that I teach, so it's not that I'm doing the same thing. Believe me I'm not doing the same thing year after year...” (SD108, Full professor)

One participant spoke about trimming content materials in order to cover new curriculum materials in his class because of the ever changing technology in his particular research expertise.

“Ultimately, there's a finite amount of content. I would say I'll have to trim some other things or speed through them or do them in less depth or find some clever way of hitting, you know, two birds with one stone. There is that problem.” (SD108, Full professor)

In addition, participants have to negotiate the course content materials with the time factor in order to plan teaching strategies that would allow efficient conveying of critical and crucial content knowledge to students.

“I think that the courses we develop, we try and develop things that are very relevant to what's going on now and are not the kind of traditional course that you would find in just about every university course catalog. So those are early on decisions. And then, you know, later on you have to figure out how to present material and how

much time you need to give students to absorb it, and, you know, those kinds of things, which I think are more traditional.” (SD106, Assistant professor)

One participant raved about scheduling field trips to substitute for one of the three lecture classes every week. This participant strongly believed that this decision provided a more enlightening way to convey curriculum content to students via an experiential learning experience.

“So I think it’s a much more powerful experience for them, and it’s about the same time commitment for me to prepare a lecture and give it as it is for me to organize a tour and take them down there. A little bit more, actually, because I tend to have to baby-sit the tour then, but it’s well worth it in my mind.” (SD111, Assistant professor)

Although the field trip approach may work for one individual in terms of delivery of efficient core content, not everyone is as successful.

“...we tried to do a field trip last year, but I think it’s awfully rough to do it during the week, and on the weekend they scream, plus nobody does construction on the weekend unless they’re behind...And if they’re behind, they don’t want to talk to you.” (SD106, Assistant professor)

This finding showcased how our faculty members thought about time as it relates to the curriculum content. Through these excerpts, we see approaches that faculty members adopt in order to cover the most crucial curriculum content and convey the right balance of information to students.

Summary and Suggestions

In this paper, we have discussed the issue of time as it relates to the teaching decision making that engineering educators make. Drawing on data from a study of teacher decision making, we discussed examples of an exceptionally common formulation of time in terms of teaching–limited faculty time as a constraint on what can be done in terms of planning and execution. We then discussed three additional ways that time was reflected in the teaching decisions we have been hearing about in our study – creating more faculty time, thinking about student time, and thinking about time as it relates to the content being taught. In each case, we illustrated the way time was invoked through a specific example from our research and then provided other examples of similar conceptualizations.

In terms of the ongoing research, these results illustrate that time can be a valuable lens for showing the complexity of engineering educator decisions. We also believe that these ideas and findings support the following tips for new engineering educators:

1. Talk with other colleagues about how they make tradeoffs given time limitations – how to allocate class time, etc. Ask them about decisions and considerations.
2. Be cognizant of how scheduling can function as a surrogate for other significant judgments about materials. Let scheduling function as a surrogate for other significant

judgments about materials. Think of scheduling decisions in terms of how they reflect other significant judgments about materials. For example, when scheduling materials – you can cover a) most significant items first, b) harder items first, c) prioritize items with longer time constants.

3. Look for ways to make time by blurring boundaries between research and teaching. In extreme cases, educators/researchers have formulated their research to include teaching issues (focus on educational technology, focus on how to teach x). However, such extreme cases are not the only ways to do this. Other strategies include having students read papers relevant to your research, having students do projects relevant to your research, using your research as examples in your teaching.
4. Use time as a lens for asking questions about students, and thus becoming more student centered. For example, ask questions or gather information on what students are doing with their time this term. Consider asking questions about what cognitively students are doing with their time. Perhaps read *My Freshman Year: What a Professor Learned by Becoming a Student*¹¹ to learn more about students and their time considerations.
5. Play with notions of time as it relates to content. For example, consider the time constant or half life of some of the ideas you are teaching. Since good instruction is also content-centered, this becomes a way to think about content that is also student-centered.
6. Utilize resources on college and university campuses to help faculty members to manage their time (i.e., senior colleagues, faculty developers, faculty development workshops).

Future work

In this paper, we provided a snapshot of our emerging findings. We will continue to analyze the interview data from this on-going study about how engineering faculty make teaching decisions.

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