Understanding what influences engineering faculty course decisions using activity systems analysis

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ABSTRACT

Engineering faculty members often publish about their courses, but what is lacking from these articles is an understanding of why they make the decisions they make during the course design activity. Using cultural historical activity theory as a theoretical framework, this dissertation looks at how seven award-winning engineering faculty members approach their syllabus and their course. The course syllabus acted as a tool for faculty to both share about their course and course design process, and to communicate their beliefs to their students and to others within their disciplinary communities. However, the course syllabus was not always used in the way that participant faculty intended, and was often under-utilized by many of the students. As a result, participant faculty relied on their beliefs about teaching and learning, and the stakeholder position they held in their departments, as tools as they wrote their course syllabuses and taught their courses.

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Chapter 1: Introduction

College and university courses are "academic plans purposefully constructed to facilitate student learning" (Stark, 2000, 127). While large-scale academic plans like program curriculum, are constructed by departments, individual courses, on the other hand, are usually created by the faculty member who will teach the course (Stark, 2000). In professional fields like engineering, nursing, or education, course design is often influenced by external forces like accrediting bodies or professional societies, in addition to the educational demands of the profession itself. This is because professional programs like education or engineering focus on the careers that their students will have after graduation (Lattuca and Stark, 2009).

While faculty may hold different beliefs about what the purpose of education is, research shows that nearly all faculty start their course planning by discerning what discipline-specific content they will be teaching (Hora, 2016; Lattuca and Stark, 2009). Planning is less of a specific activity and more informal tweaking and adjusting the course where needed. Planning is usually done individually, with limited help from colleagues and almost no influence from the published literature on teaching and learning. When theory is put into practice, its usually highly recognizable and widely circulated pedagogy like Bloom's Taxonomy (Lattuca and Stark, 2009; Stark, 2000). Because faculty tend to believe students differ little year-to-year, curriculum itself tends to remain static unless there are major reasons to change (Hora, 2016; Stark et al, 1988). This means that often the course syllabus is reused year after year unless major revisions are needed.

Recently, there has been a call for colleges of engineering to revitalize their curriculum and instruction. Much of the call for change is top-down, from funding entities like the National Science Foundation (NSF) or from professional organizations like the American Society for

Engineering Education (ASEE). However, when engineering faculty members share about their courses, they do so in the form of practitioner-focused articles related to changes and adjustments that they have made in their own classes (Borrego, 2007). The changes engineering faculty members make range from adding classroom response system quizzes to their lectures, transitioning their courses from face-to-face to online, creating remote or virtual laboratories, or flipping classrooms.

Practitioner-focused articles in engineering education are heavy on discipline-related jargon and light on theory. Changes that are discussed are due to department-level decisions about curriculum, a push to add online classes, or even issues like student grades. What is lacking, however, is an in-depth understanding of why faculty members make the decisions they do with regards to planning and implementation of instruction, because many teaching techniques are not simple to implement.

One area where this research does not elaborate is why faculty members make the *specific* choices that they do when they are planning and teaching their courses. While it would be easy to argue that this change is solely driven by calls for change from funding agencies like NSF, the way that change occurs may speak to differences in implementation. For example, flipping a classroom requires faculty members to plan and create content meant to be read or viewed ahead of time so that class time can be spent working through application problems (Li and Daher, 2016). Because these changes require a time commitment and dedicated effort, education researchers may ask why engineering faculty members make the decisions they do in terms of pedagogy for their courses.

One possible tool that may aid in understanding course decisions is the course syllabus. A course syllabus is an integral part of any college course. A good syllabus, Slattery and Carlson

(2005) argue, "creates an effective structure for both faculty and students, allowing all parties to recognize where they need to go and what they need to do to get there" (p. 160). The intended purpose of a course syllabus is to communicate the goals and objectives of the course to students, other faculty members, and even other professionals in the discipline (Afros and Schryer, 2009; Thompson, 2007). According to Hora and Ferrere (2013), the syllabus can be considered the written expression of faculty goals, objectives, and desires for the course.

> Viewing the syllabus as a device underscores the fact that it functions in ways similar to other more commonly studied artifacts such as instructional technology or departmental governance systems, in that it presents to the individual a constrained set of possibilities in regard to future practice (i.e., affordances). The implications of this view are twofold: first, that syllabuses are artifacts created with specific intentions and goals in mind for users, and, second, that syllabuses will act as important mediators between faculty members' intentions and their ultimate classroom practice (p.245).

I agree with Hora and Ferrare (2013) that a course syllabus may be a tool that aids faculty in their course design and can be seen as an indication of classroom practice. But, Lattuca and Stark (2009) have found that syllabuses vary by discipline, with those created in fields like physics or engineering offering sparse details about the class beyond the schedule and textbook, whereas syllabuses created by faculty members in fields like education or nursing contain more detail. Considering that engineering syllabuses are known to be sparser and may reveal less of the faculty member's beliefs, the syllabus may not be a tool that reveals the inner workings of a faculty member's intentions, but rather an artifact that provide an opening for faculty members to discuss course design decisions and beliefs related to teaching and learning.

In this dissertation I will explore what influences engineering faculty members as they make specific decisions related to planning and teaching their courses. I will use the syllabus as a tool to help me, a non-engineer, try to understand the decisions they make. I will analyze syllabuses and related course documents in addition to interviews of engineering faculty who have won awards within the college of engineering. Cultural historical activity theory (CHAT) will provide the theoretical framework for my qualitative data analysis.

Positionality and background of the study

I will begin this chapter, and my dissertation, by presenting my position as a researcher, and identifying how it relates to this study, both in terms of why I have chosen the topic, and what has already been said in the literature that led me to this topic. As an educational researcher, I believe that reflexivity is an essential component of my process, because reflexivity "demands that we interrogate each of our selves regarding the ways in which research efforts are shaped and staged around the binaries, contradictions, and paradoxes that form our own lives" (Guba and Lincoln, 2008, p.279). I am both a researcher and an educator, and my lived experiences as both profoundly affect this dissertation as much – or as little – as my lack of engineering degree.

Though I focus my research on engineering faculty members, I am not an engineer; I am an educator who works with engineers. I do not have a background in science, engineering, or mathematics, and, as such, do not have the depth or breadth of knowledge that is required to teach engineering. Likewise, I do not have the lived experience of being an engineer, let alone an engineering faculty member. What I do have, and kick-started this study, is a spouse who is both an engineer and an engineering faculty member at a university.

The research direction and research questions were inspired by conversations between myself and my spouse over the course of my doctoral degree, and probably before that, when I was a K-12 classroom educator. I taught middle school social studies for several years before returning for my doctorate. I returned because I wanted to dig deeper into ideas about teachers, teaching, and learning. This was serendipitous, because I spent the first four years of my graduate study as the instructor of an educational psychology class that focused on teaching pre-service teachers about learning theories.

In my doctoral coursework and classroom instruction, I found that I had ideas about teaching and learning that differed from that of my spouse and our friends who were also scientists and engineers. My beliefs are strongly rooted in constructivism and situated cognition. As a learning theory, constructivism emphasizes the role of the learner actively constructing knowledge as they make sense of their experiences, giving learners an active role in the process (Driscoll, 2005). In situated cognition, learners participate in communities, and newcomers enter into the community from the periphery, but, as they interact with experts (like teachers) and gradually became more involved, they acquire knowledge through this interaction (Lave & Wenger, 1991). Both constructivism and situated learning share an overall theory of knowledge construction through meaning-making, with emphasis on learning by doing. This often takes the form of problem-based learning, internships or apprenticeships, flipped classrooms, or experimentation learning situations.

The ideas that make up constructivism, I found, were too ill-defined for most engineers, especially when some areas – for example, calculating load capacity for a power grid – have problems that need to be solved with minimal risk. However, being infinitely stubborn where my spouse is concerned, I did not want to believe that the ideas that were talked about in

education were not present in engineering, and I set out to understand what was being discussed in engineering education. I found what appeared to be two different areas of engineering education research, at least to me as an outsider: the articles written by engineering education researchers, and articles written by engineering faculty members.

Two different types of engineering scholars

Engineering education researchers engage in scholarship on teaching and learning related to educating engineers, usually at the university level. The majority of engineering education researchers have received technical training and, at one point, were engineering faculty who have since shifted their focus to education research (Borrego, 2007). Very few have an education background, though I believe that credentials may have changed with the introduction of engineering education departments within schools of engineering over the last several decades.

Reading the research on engineering education, I found a larger discussion occurring about engineering education in the United States. This discussion, which I will elaborate more on in my historical overview of engineering education in the review of the literature, involved scholars, engineers, and the federal government. In brief, interested parties have worried for many years about the preparation of engineers. Engineering education scholars cite reports by entities like the Boyer Commission, the National Academies, the American Society for Engineering Education (ASEE), or the Accreditation Board for Engineering and Technology (ABET) that present engineering education at American universities as static, unchanging, uninventive, and in need of reform so that US engineers will be able to keep up with their international peers. This is not a new fear, but rather the extension of what became obvious after

World War II: compared to emigrating scientists, those trained in the US lacked theoretical knowledge in basic science concepts and were at a significant disadvantage (Seely, 2005).

There are many ideas for how to improve engineering education. Suggested reforms are aimed at encouraging faculty to adopt newer teaching practices like group work or problem-based learning (Kolmos and de Graaff, 2014: McKenna and Yalvac, 2007). Others argue for the complete overhaul of university curriculum, resulting in less separation between theory and practice. To them, this requires more integration of labs and design classes in undergraduate engineering curriculum (Lord and Chen, 2014; Sheppard et al., 2009). A related critique is that the desired changes could occur if engineering faculty members moved away from using lecture instead of group work, or if they incorporated more opportunities for practical experience such as design courses (Borrego, Froyd, and Hall, 2010; Huang, Yellin, and Turns, 2005; Matusovich, Paretti, McNair, and Hixson, 2014; Sheppard et al, 2014).

In summation, engineering education researchers and the entities they are affiliated with believe that engineering faculty need to change how they teach and embrace pedagogy found in K-12 education and colleges of education. The articles these researchers publish discuss potential ideas for reform, all of which are ideas already popular in education, like problem-based learning. It was at this point, after reading publication after publication about what could be done, what should be done, and what needed to be done, such as *Educating the Engineer of 2020* (National Academy Press, 2005), *Moving Forward to Improve Engineering Education* (National Science Board, 2007), *The Cambridge Handbook of Engineering Education* (ed. Johri and Olds, 2014) and others (i.e. Haghighi, 2005; Heywood, 2005; Johri, 2010; Shulman, 2005), that I wondered exactly what *was* being done. This made me question what engineering faculty members were putting into practice on the ground.

Engineering faculty members publish practical and short articles about courses that incorporate little educational theory and plenty of helpful ideas. For example, Rowland (2009) shared about a circuits course that was disliked by faculty for many reasons including lacking laboratory sessions and the instructors (PhD students) were underprepared for the task at hand. When they made a significant effort to realign the course with ABET criteria and added in a laboratory component, students did better and faculty expressed increased satisfaction. Another article by Albano (2006) focuses on redesigning an undergraduate steel course. The redesign was spurred on by the faculty realizing that students were not learning what they needed to learn the way the course, and the syllabus, were structured. When they shifted the class to a more assignment-centered course and rewrote the course syllabus to clearly explicate what needed to be done to complete the course, student grades went up and course evaluations demonstrated higher student satisfaction.

These two articles are just examples of what exists in the literature. They contain instructions, rationale, justifications, and most importantly information. They also demonstrate that change can lead to positive results. Albano (2006) shows that by reframing the course and rewriting the syllabus to be clear and concise, student grades improved, and students were happier as a result.

Articles by engineering faculty are written in a way that is easy for others to replicate, so they are sharing their knowledge and their experience with their peers, but they are also very short. Most of these articles are less than 10 pages, and do not contained detailed information. For example, the articles summarize the thought process that leads to changes, but does not share what faculty believe about teaching, pedagogy, revising their course, and so on like education articles might. Additionally, as I have learned from casual conversation over six years, faculty

do not place as much time or value on education articles compared to research articles. The articles are meant to add paper counts to their CV as they approach tenure, or to help raise their publication numbers.

But from personal experience, when engineering acquaintances find out I am an educator, they want to talk about their teaching. They have pride in what they're doing, and an interest in new ways of doing it that is not obvious in the straight-forward articles or in anything written by engineering education researchers. That is what I find interesting and what I want to know more about.

My position

As an educator and a researcher, I found myself frustrated by what felt like a lack of conversation between two halves of the whole picture of engineering education. Were engineering education researchers ignoring what was being done in favor of what could be done? What about engineering faculty members? Why did engineering faculty members seem to ignore suggestions that were linked to funding agencies? Was it that it was too much work to adopt newer instructional strategies, or did they not find any value-added to it?

My research methodology comes from cultural historical activity theory, which is meant to "explicate how human action is related to cultural, institutional, and historical context" (Wertsch, 2000, p. 511). Overlooking the actions of engineering faculty members meant overlooking what they contribute to the discussion on teaching and learning within engineering at the university level. Even if a paper is not technical, there is a cost-benefit analysis of the time and energy spent on a paper and not spent on research. Further, it seemed that the articles being published were not for engineering education researchers as much as they

are publishing for their fellow engineering faculty. As an education researcher, I wanted to know what engineering faculty members are doing that was not being told, either because the narrative is being dominated by engineering education researchers, or because the role they are taking is less obvious.

Additionally, I have some experience as an instructional designer, and years spent planning and teaching my own courses, including writing a course syllabus. I personally found that planning was a meditative process that was also challenging, but allowed me to have a good mental grasp of what I was teaching, when I was teaching, and what my objectives were. In my research, I wanted to know more about the courses that engineering faculty members were sharing. I wanted to know more about their motivations, and their reasoning, and how they made the choices they did, because I always found making course decisions to be difficult, challenging, and also rewarding. To me, course decisions seemed like the ground from which to build up what I was looking at. I wanted to know *why*.

Purpose of study

The purpose of this study is to understand what factors influence engineering faculty as they make decisions in the activity of planning and teaching their course. My research questions are:

1. How do engineering faculty approach planning and teaching their course?
2. How do engineering faculty use their course syllabuses and related documents in the course design activity?

The way that engineering faculty members use instructional strategies in the classroom does not always agree with suggestions from engineering education researchers to change how they teach, though they do seem to be incorporating some education ideas (see Albano, 2006 and Rowland, 2009, referenced earlier). Engineering education research show faculty members attempt new ways of teaching but then backslide into their old ways of teaching due to uncertainty and discomfort with implementing newer forms (Henderson and Dancy, 2007; Moore et al, 2014; Turns et al, 2008). For example, Moore et al. (2014) share how faculty members eagerly learn new instructional strategies but fall back on older ones when their confidence falters. However, these articles focus on teaching, not on course planning or the beliefs that drive the structuring of a course which then drives the content (Hora and Ferrare, 2013).

Context

Engineering faculty members are individuals who are not trained in pedagogy during their doctoral study yet who are tasked with teaching in addition to research and service (Moore et al., 2015). Despite increased research on STEM education and professional development, many STEM faculty members often struggle with their teaching because they are not consistently trained in pedagogy while in graduate school (Borrego, Froyd, and Hall, 2010); DeChenne, Enochs, and Needham, 2012; Mills, 2011; Prieto & Meyers, 1999). Some departments may have rigorous training in teaching (Burton, Bamberry, & Harris-Boundy, 2005). Others are much more ad hoc with the overall consensus that graduate students are there to learn research skills, something that is very evident in the hard sciences and engineering (Parker, 2014)

Additionally, faculty have numerous responsibilities including: research, teaching, preparing courses, completing accreditation documentation, advising students, publishing their research, and fulfilling service obligations to the university community. Some scholars argue that the increased pressure to produce more research and secure grant funding over the last several decades has resulted in universities de-valuing teaching, especially in STEM fields including engineering (Lattuca and Stark, 2009; Menges and Austin, 2001; Seldin, 1995; Wells and Gordon, 2013). Because most engineering departments are housed in large research universities, some researchers have argued that research productivity has been emphasized at the expense of teaching (Seely, 2005; Matusovich et al., 2014). Because of this, faculty may under-emphasize the teaching portion of their workload because it is near-impossible to be simultaneously productive in both teaching and research (Fairweather, 2002).

My interest is not in why they are not adopting these new pedagogies, but rather what they are doing instead, how they make the choices they are making, and what influences those choices. When it comes to teaching and courses, research (i.e. Gess-Newsome, Southerland, Johnson, and Woodbury, 2003) demonstrates that course design decisions may be influenced by factors like reform literature, the university, the individual's beliefs, and student data among other information. This is not a new argument, as other researchers (Lattuca, Terenzeni, Harper, and Yin, 2010) have stressed the role that institutions, their values, and the values of the discipline have on faculty adoption of reforms and innovations. This is also an argument that aligns with my theoretical framework of course design, that it can be considered a complex activity. I believe that the best way to understand these questions is by using CHAT as a theoretical framework for the study. Research using CHAT aims to "explicate how human action is related to cultural, institutional, and historical context(s)" (Wertsch, 2000, p.511). In

CHAT, learning comes *from* activity, not *before* it (Jonassen & Rohrer-Murphy, 1999, emphasis mine).

Theoretical framework

The ideas and principles that make up CHAT explain the theory as a complex, object-oriented way of understanding human development (Stetsensko, 2005). At its heart, CHAT and the other sociocultural theories that are interwoven with and connect to it (e.g. distributed cognition, situated learning, human-computer interaction) present a way to understand human cognition that is not strictly behaviorist, cognitivist, or reductionist. Instead, human cognition is a social and collaborative activity, and cognition reaches beyond the individual mind into social communities, cultural artifacts, and activities (Arievitch, 2008).

Lev S. Vygotsky is often seen as the genesis for what we understand as CHAT. Vygotsky made the distinction between lower and higher order psychological functions, arguing that higher order functions, like those tied to human consciousness, were culturally-mediated (Miettenen, 2005). According to Yamagata-Lynch (2010), Vygotsky "used Marx's political theory regarding collective exchanges and material production to examine the organism and the environment as a single unit of analysis" (p.15), focusing on how interaction with the environment and shared meaning-making helped construct knowledge with respect to individuals as agents within a cultural-historical framework. Marx believed that activity was the process of forming the subject (Blunden, 2014). CHAT also adopts "Marx's dialectic materialist view of activity and consciousness as dynamically interrelated, which provides an alternative perspective to the mentalist and idealist views of human knowledge that claim learning must precede activity" (Jonassen & Rohrer-Murphy, 1999, p.62). For Marx, activity was the purpose of human beings,

and that all of it was possible only through using artifacts (like words, images, or tools) that communicate social constructs to individuals.

How this can be understood when looking at engineering education course decisions is through the use of tools in an object-oriented mediated activity. Mediated activity occurs when the individual, or subject, directs their activity towards a goal, or object. This is also called object-oriented activity. Mediation itself is a process that considers the ways that cultural tools are used, as well as the ways that they can shape action (Wertsch, Del Rio, and Alvarez, 1995). In order to engage in an activity, the individual must have a need to engage in it. A need can be defined as "an emerging dilemma, a contradiction, or a possibility of an artifact-mediated activity" (Miettenin, 2005). In the process of pursuing their goal, the individual uses an artifact, or tool to aid their actions.

Significance of study

I believe much can be learned through understanding the choices that engineering faculty make as they prepare for and teach their courses, specifically in terms of implementing decisions. I believe that implementing small-scale, discipline-appropriate changes to their curriculum demonstrates that faculty are open to change and open to trying new things and being innovative on their own terms. Using CHAT as the theoretical framework for this study may lead to fuller understanding of how engineering faculty use – or choose not to use – their syllabus as a tool to help with decisions they make as they plan and teach their courses.

By focusing on faculty members who have won teaching awards within their college, I am hoping to better understand the argument that award-winning faculty have defined beliefs about teaching and learning (Dunkin and Precians, 1992; Roth, 1997) as well as relatively stable

efficacy as it related to their teaching (Morris and Usher, 2011). As Wright (2005) has found, in departments without a strong teaching culture there are only one or two educators who are referred to as expert teachers by their colleagues. In departments lacking a strong teaching culture, faculty focus more on research productivity than teaching, and teaching observations are not considered a critical part of the tenure process. By comparison, Wright (2005) found that departments with strong congruence in teaching beliefs foster increased discussion about teaching and learning, have multiple instructors who are considered effective educators, and incorporate observations as important components of tenure and of professional development.

Most importantly, I believe that this research will give insight into teaching and may help facilitate a middle ground between the newer innovations that engineering education researchers encourage and the way that they already teach. This is not an epistemological study, as that is outside the scope of this dissertation. However, beliefs about teaching and learning factor into decisions in the classroom, and helping faculty understanding choices faculty make and why, how they have identified problems and solved them, and how they have navigated institutional norms and personal beliefs might be beneficial to other faculty who are struggling with their own courses. I believe this research can provide some context for engineering courses, identify the tensions that faculty must negotiate, and possibly help faculty as they come to understand their own course design and the role their syllabus may play.

Organization of dissertation

This dissertation will be organized into five chapters. The first chapter, the introduction [that you have just read,] has established the background for the study. I have stated and contextualized the problem as well as provided the significance of the study. Subsequent

chapters will delve deeper into the literature that helps position this study within the academic literature, as well as my methods, findings, and conclusions.

Just like I have positioned this study in the context of greater socio-political and socio-historical strands in this chapter, I will take time in chapter 2 to contextualize this study in light of current academic research on course design and syllabuses. This chapter will examine the current discussion on course design in higher education, including syllabus design, and on engineering education course design. I will also delve more into cultural historical activity theory, which is my theoretical framework for this study.

Chapter 3 will focus on my methodology, which is guided by CHAT. I will discuss my use of qualitative data collection and analysis methods. Because this study is a combination of document analysis and interviews, I will expand on these methods of analysis as well. Chapter 4 communicates my findings and interpretations and Chapter 5 discusses the implications for future research that I have drawn from these findings.

Chapter 2: Review of the Literature

This review of the literature will take a three-part approach where I will synthesize significant literature on three specific areas. I will begin this chapter with beliefs about teaching in higher education, because engineering education scholars often draw on that well-established literature. Next, I will share the historical trajectory of engineering education as it has led to the nascent field of engineering education, as well as the literature on teaching in engineering. Finally, I will return to cultural historical activity theory. I will build on the overview from the previous chapter with regards to the use of CHAT and activity systems analysis to understand college courses and college teaching.

Gathering sources

Boote and Beilie (2005) state that a literature review must accomplish several objectives, including setting the parameters for what literature included and excluded, positioning the literature within a broader scholarly context, and critically examining the literature for what is missing and what can be built upon its foundation. I have endeavored to follow these criteria, and I will start by explaining what is and is not included in this literature review.

This literature review draws from the existing literature on higher education teaching, with specific emphasis on STEM and engineering education. I focused mostly on what the literature could tell me about choices related to planning or teaching. I know there is a body of literature on planning as well as literature on teaching but ultimately that literature only took me further away from the nature of my inquiry.

When looking at the literature on engineering education, I tried to focus on when decision-making was discussed i.e. the decision to adopt a new way of teaching or the decision to

modify course content. While I find epistemology important, there is limited information available in engineering education literature and it was outside the scope of this dissertation to delve much into that topic. And finally, with regards to the literature on activity theory, I tried to focus my efforts on studies focusing on higher education. Activity theory is used in many different contexts from design firms to hospitals and while the literature is broad, I found narrowing my focus for this study made the literature more relevant.

I had two primary methods of gathering sources for this literature review. First, I used books and articles that I was already familiar with through past research, and our university's OneSearch library function. With the sources that I was already familiar with, I followed citations to interesting articles or books, and then kept diving deeper and deeper down trails to track down articles and their related links. I became a reverent reader of bibliographies and footnotes, and chased down as many sources as I could this way. Using the library's search options on the website allowed me to search through journals like the *Journal of Engineering Education* (JEE) or *Mind, Culture, and Activity* to find articles specific to my needs.

One thing I did early on was get an overall idea of what existed in the engineering education literature. I searched for works by engineering education researchers that answered questions about teaching and learning beliefs, epistemic beliefs, innovative practices, the theory-research gap, and so on. Because the field is small, it was easy to identify the major contributors and search through their research. The primary journal that I searched was the *Journal of Engineering Education* (JEE). JEE is published by the American Society for Engineering Education (ASEE), the major professional organization in engineering education in the United States. In the early 2000s, JEE reframed its mission statement to focus more on establishing rigor in engineering education research (Haghighi, 2005; Jesick, Newswander, and Borrego,

2009). No other journal features as much engineering education research as JEE, and so when I conducted my search using key terms, I primarily focused there.

As of 2017, I found that most of the articles in JEE focused on undergraduate teaching and learning (909) with a particular emphasis on curriculum (990), design classes (1111) or retention (392). There was also a significant number of articles related to underrepresented populations like women (379) or minorities (323). There was also a strong focus on accreditation and assessment (393). In comparison, articles about epistemology (62) or instructional design (41) were less seldom found and usually were written by the same authors, some of whom will be cited multiple times in this dissertation alone. To me, this implied that there is a limited discussion on what faculty believe compared to discussion on more institutional and systemic barriers. When I searched journals other than JEE that were related to individual engineering disciplines like mechanical engineering or electrical engineering, I found substantially fewer articles related to pedagogy or epistemology and more articles related to teaching practices.

Higher education faculty

Academic institutions, including departments, are a significant influence on faculty members' course planning and their use of instructional strategies. As previously mentioned, faculty have many demands on their time that, coupled with their institution's beliefs about the role of faculty, directly impact course design, planning, and teaching (Lattuca and Stark, 2009). For example, Hora (2012) found that faculty in a research-intensive (R1) university based their planning and instructional decisions on institutional factors like personnel policies related to tenure, promotion and research productivity, and whether their department valued teaching by granting faculty autonomy in their course design.

Factors like those listed above directly influenced the choices that faculty made with regards to their courses, but they were not the only influences. Individual beliefs also influenced how faculty made teaching decisions. Their decisions were usually not based on pedagogical concepts, however, but on their own beliefs related to teaching and learning (Kane, Sandretto, and Heath, 2002; Lindblom-Ylänne, Trigwell, Nevgi, and Ashwin, 2006; Oleson and Hora, 2013). Faculty's perceptions of teaching are often the result of contextual factors like prior success or failures (Fives and Looney, 2009; Kembler, 1997; Prosser et al., 2003). In their research on planning, McAlpine et al (2006) were surprised to find that instructors drew on "complex repertoires" that included prior experience of teaching the course, prior students, other courses they taught, and other students within other courses, to make up their understanding of planning and teaching (p. 143).

One example of this is in Franklin's dissertation (2013), where she is an active participant in the planning process of an award-winning psychology faculty member who is also a phenomenologist. As a theoretical orientation, phenomenology is deeply rooted in an individual's experiences, and it was this instructor's theoretical background that significantly affected how he planned and taught his phenomenology course. The faculty member intended to have his students be phenomenologists, which meant that the class sessions often contained experiential exercises that encouraged deep learning through doing, with the faculty member not over-directing the experience. The take-away for Franklin (2013) was that using a "phenomenological attitude" while planning for the course allowed the faculty member to best teach his students about phenomenology (p.168).

Academic disciplines and internal institutional policies are only the first step in understanding how faculty members teach their courses and what strategies they use, but

personal beliefs cannot be exorcised from this discussion. The literature on beliefs related to teaching and learning tends to focus on teacher-centered versus student-centered, experience, efficacy, or discipline-specific methods of teaching. The idea of discipline-specific methods of teaching influencing beliefs was seen in the reference to Franklin (2013)'s phenomenologist and will be continued in the next section on literature related to science faculty.

Science faculty

In this section, I will pivot way from higher education faculty in general to discuss science instructors specifically before I continue into engineering education. This is because there is a healthy body of literature on areas like physics instruction, and also because these disciplines are often considered the parent disciplines for engineering fields (e.g. chemistry as the foundation for chemical engineering) (Lattuca and Stark, 2009). Researchers of science and mathematics education at the university-level often look at what is being done, and what is not being done and why. For the purpose of this literature review, I will focus in on discussions in the literature about when faculty members make or fail to make changes.

Some scholars look at why science faculty members are resistant to reform. This ties into the concept of reform that, in the context of science education, refers to research-based pedagogical strategies that are often advocating very different ideas than what is currently being practiced. For example, Henderson and Dancy (2007) found that physics faculty are often very resistant to implementing new instructional strategies, even if they would normally accept suggestions (e.g. senior faculty who were known to be reflective practitioners). Though these instructors were aware of the fact that they could improve their classes by using research-based suggestions, they refused to do that for a variety of reasons ranging from discomfort with

educational researchers invading their space to questioning educational research as a whole (Henderson and Dancy, 2007).

The idea that science faculty are told what to do instead of having their agency respected is also found in the literature. Bouwma-Gearhart (2012) found that most professional development for science faculty favors a top-down approach, and that there was very little insight into the needs of faculty. The idea of science faculty members being uncomfortable with education researchers invading their domain raises a salient point about the relationship between science faculty and education researchers. If science faculty do not trust education research to be rigorous, then adopting new ideas suggested by those researchers is not an option. Further, if science faculty feel like they are being attacked or they are being told what to do, then that is another impediment to change.

Encouraging faculty members to adopt new strategies can often rely on different approaches to understanding how they make decisions. Dancy and Henderson (2010) found that most physics faculty are interested in new ideas but report a lack of time. Gess-Newsome et al (2003) found that pedagogical dissatisfaction, or the dissatisfaction in how one is currently teaching coupled with the belief that there were better ways to teach, led to faculty members trying new teaching methods. There is an element of self-efficacy to be considered where this topic is concerned: as Southerland and colleagues (2003, 2011) argue in their pedagogical dissatisfaction instrument, only those faculty members who believe that they are proficient educators will attempt change. In this case, self-efficacy in teaching is created through past success and failures, meaning that if faculty members succeeded in the past in their teaching, they believe they will succeed again, which gives them the willingness to take a risk with a new form of teaching.

One scholar who I have found to be particularly useful in understanding this topic has been Hora (2016), who approaches the course design and teaching of science and mathematics faculty from a cognitive science perspective. Much of Hora's work discusses mental or cognitive models and mapping the decisions that faculty make in STEM domains. For example, Hora (2016) examines the curricular artifacts that faculty members use for planning their courses. He concludes that course maintenance, or maintaining the course at the status quo, is the result of whatever affordances faculty perceive to have for the course, including viewing students as being the same year after year. If they see students the same way, they will do little work (Stark, 2000), whereas McAlpine et al (2006) referenced earlier states that instructors draw from past experiences. Hora (2016) points out that instead of working on their courses, faculty will then redistribute effort towards looking for funding, writing and researching.

Hora (2016) ends his research with a call for a culturally-informed study of the role of curricular artifacts in course planning and instructional practice. Indeed, there are few culturally-informed articles that discuss the role of an artifact or tool – the syllabus, tests, questions, homework and other curricular materials – in the process of how faculty members make course decisions. Additionally, studies often draw from older literature (e.g. Trigwell et al, 1994) that do not reflect STEM disciplines as well as more recent, discipline-specific work. From another angle, Franklin (2013) found in her study of a phenomenologist that doing phenomenology was the basis of his course planning and teaching. It stands to reason that being an engineer may factor heavily into the planning, teaching, and design of engineering courses.

Engineering education

I believe that it is important to understand the historical origins of a phenomenon under study. In this case, I will introduce how engineering education first started, how it came to be formalized, and how it has evolved into what it is today. When discussing engineering education at universities, I will also discuss what has been shared in the literature about how curriculum is planned, how courses are designed, and what limited information there is about the factors that influence faculty members and their decision-making.

The undergraduate education of engineers has evolved over the course of American history from military-trained engineers to engineering as a middle-class profession. Until the early nineteenth century, the only formally-educated engineers were those trained at American military institutions like West Point and the Virginia Military Institute (VMI). This was due to the long-standing tradition of using engineers in the military to handle situations like siegecraft or building bridges and roads (National Academy of Engineering, 2009). During the rapid industrialization of the eighteenth and nineteenth centuries, engineers were informally trained through apprenticeships (National Academy of Engineering, 2009). There would be a shift in the years after the Civil War, when the booming post-1865 economy provided a host of new careers, new social ranks and new opportunities.

In the last decades of the nineteenth century, the formation of a new middle class in America lead to the rise of professional fields like medicine, law, and engineering, which also shifted how engineering was taught. Having a college degree conferred social status on members of this new professional class, and engineering education itself became more formalized and standardized as a result (Froyd and Lohmann, 2014; Seely, 2005). The change affected how universities educated their students, focusing on practice-oriented coursework

taught by individuals with engineering experience (Fink, Ambrose, and Wheeler, 2005). Engineering classes focused on the background information of engineering domains but, as technical requirements for engineering changed, technology began to feature into the curriculum more (Seely, 2005).

Engineering education changed after World War II. With the emigration of well-trained scientists from Europe during the 1930s and 1940s, and their assistance on wartime projects like the Manhattan Project, it became increasingly obvious that American scientists and engineers were deficient in theoretical understanding of science and engineering concepts (Seely, 2005). The rapid scientific and technological advancements that happened both during and after the war, including the push for space exploration, led government and military officials to emphasize math and science in K-12 education in a push to become globally competitive (Froyd, Wankat, and Smith, 2012). Following the overall trend of encouraging researchers to have a strong theoretical understanding of math and science, university administrators in engineering departments began post World War II to hire faculty members who, for the first time, had a strong research background in engineering but lacked experience in industry (Froyd, Wankat, and Smith, 2012; Seely, 2005).

The restructuring of engineering higher education after World War II was intended to create technologically-literate and globally-competitive American engineers (National Academy of Engineering, 2005, 2009). This focus, and the rhetoric used to describe policies and procedures related to the post-World War II shift in priorities, has changed little since the 1950s. Policy makers, scholars, and educators still emphasize training students to become scientists, engineers, mathematicians, and technologically-savvy individuals in K-12 so that the United States can remain globally competitive (National Academies Press, 2009).

The idea of producing engineers who can work with and in diverse populations is an emphasis of nearly all the engineering education publications, policy statements, and articles produced by the National Academies, the National Science Foundation (NSF), and engineering education researchers since the early 2000s. It manifests in many ways, from *Educating the Engineer of 2020* which lays the blueprint for how universities should educate engineers, to the Accrediting Board for Engineering and Technology (ABET), whose accreditation standards now play a significant role in the planning and paperwork of engineering departments.

A major area of emphasis as part of the recent push for restructuring engineering curriculum has been retention and attrition. Despite the push to produce more engineers, engineering colleges still have difficulties with recruiting, retaining, and graduating engineers – especially those from underrepresented populations. For many minority populations, engineering presents a significant challenge for several reasons, like the cost of the extra year of school sometimes required of an engineering degree, or the difficulty of the curriculum, which builds on math, physics, and sometimes computing knowledge they may not have in high school (National Science Board, 2005). Engineering curriculum itself may be a barrier to entry for some students, so a closer look at curriculum sequencing is also important.

Engineering curriculum design

According to the literature on engineering education in American universities, there appears to be a common course trajectory that most engineering departments follow (Lord and Chen, 2014; Sheppard et al., 2009). The first year of study generally focuses on engineering fundamentals and an introduction to the field. The second year is packed with courses meant to help students accumulate theoretical understanding of their discipline. Years two and three also

include engineering laboratories, where students can put engineering theory into practice. All of this culminates in senior design projects, which are meant to replicate actual engineering activities. Lord and Chen (2014) have criticized that design classes, while growing for freshmen and seniors, are lacking in the middle years of an engineering student's progress. The middle years of an engineering degree often demonstrate little connection to the first and final years of study. Sheppard et al. (2009) also argue that there is too much emphasis being placed on theoretical knowledge and not enough on practical skills that apply theoretical knowledge to situations engineers will face in their jobs. By this, Sheppard and colleagues would like to see more focus on laboratory work, design classes, and training in ethical engineering practice, which is an important criterion of ABET accreditation.

Planning and teaching

When planning instruction, engineering faculty often focus on transmitting the major concepts of their field to students (Oleson and Hora, 2014; Stark, 2000). Teaching often takes the form of lecture or direct instruction for several reasons: the instructor's expert knowledge in the field compared to their students; the instructor's lack of prior pedagogical training which encourages falling back on time-honored teaching techniques; the effectiveness of direct instruction in conveying all the material needed; and the lack of time to try new things while fulfilling other professional duties (Allendoerfer, Williams, Kim, and Burpee, 2014; Huang et al, 2005; McKenna and Yalvac, 2007; Moore et al., 2015; Walchoak, 2015). Additionally, as stated earlier, educational innovation is just one minor part of the tenure package, and tenure-track faculty members may find that there are more important components of the tenure process than teaching (Matusovich et al, 2014).

Several studies exist on factors that influence what engineering faculty teach. Turns et al (2008) found that the concerns of engineering faculty echo what has already been mentioned about the multiple roles that faculty hold, the difficulty in being both a researcher and a teacher , lack of pedagogical training, and a lack of culture dedicated to teaching and learning within their departments. It is implied that these concerns create difficulties where planning is concerned, especially when considering the push to adopt innovative pedagogies; in fact, Turns and her collaborators found that over half of the teaching concerns faculty shared were related to adopting the very instructional strategies that engineering education researchers promote. This concern echoes what Dancy and Henderson (2010), and Hora (2016) have found in regard to having the time and energy to be able to implement changes in classroom teaching practice.

Moore et al (2015) demonstrates how specific implementation of a new teaching practice – in this case, model-eliciting activities (MEAs) - could alter the instructional strategies of engineering faculty members. While their research demonstrated that change could occur as faculty shifted from a less teacher-centered to a more student-centered way of teaching (i.e. flipped classrooms), there was also backsliding to teacher-centered ways of instruction (i.e. direct instruction, lecture). Some of this backsliding may have been due to faculty members questioning their abilities of adopting the new teaching methods in class and lack of familiarity with the methods.

Perceived difficulty with implementing new strategies may not be unique to engineering education but it was a concern for many engineering faculty members. Moore et al. (2015) who found that even though their faculty members favored more learner-centered strategies, struggling with implemented often shifted them back towards teacher-centered (and less interactive) pedagogies. Finelli, Daly, and Richardson (2014) found that faculty face tremendous

obstacles like colleagues, institutional barriers, personal disposition, and motivation among others. Matusovich et al (2014) found that faculty want to be innovative but often worry about the beliefs of others, stating:

> That is, participants may want to engage in the research–practice cycle but believe doing so could go against collective values. These collective values, which participants typically share, include recognizing funding and support from administrators and peers as the measureable markers toward tenure. (p.323)

Choice and decision

There is very little information on why engineering faculty make the decisions that they do regarding course design. One exception is Warcholak's 2015 dissertation, which examines how faculty in engineering make instructional planning choices using pedagogical content knowledge as his dissertation framework. Pedagogical content knowledge (PCK) specifically relates to the knowledge that teachers or instructors have about how to teach a subject, as opposed to general content knowledge which is usually just overall knowledge of a topic (Shulman, 1986). In the practice of engineering education, this relates to knowing how to build a reinforced concrete beam (general content knowledge) versus knowing how to teach students how to build a reinforced concrete beam. Through a series of interviews, Warcholak connects beliefs faculty have related to teaching and learning to their PCK. Of special interest related to his conclusions is that those engineering faculty he interviewed wanted to transmit the knowledge of their discipline to their students, hence their choices when teaching their content, such as accessing prior knowledge and caring about student perspectives.

The literature on engineering faculty's instructional practice is growing, which supports the claim that there is still more room for it to expand as a discipline. While it is frustrating for studies to conclude that implementing new strategies is difficult because faculty members are backsliding into old teaching methods, that is also more than one significant insight into understanding engineering faculty and their teaching. There are other questions that can be asked, like whether the old teaching methods have been sufficient, or if faculty are using some, not all, new ideas. Warcholak's exploration of PCK is a step in the right direction of drilling down more into what is being done in regard to pedagogy, but more can be done switching away from absolutes – e.g. implementation or not – and trying to understand the area in between, and what is currently being done. Looking at engineering education from an activity theory perspective may help present a more holistic view of teaching, learning, planning, and thinking as a complex human activity.

Activity theory

Though tracing its immediate heritage to the work of Vygotsky and Soviet psychologists, many activity theorists believe that activity theory embraces Hegel's dialectic, the ideas of Marx, and the work of American pragmatists like Peirce and Dewey as it has evolved to become a multidisciplinary theory (Engeström, 1999). Often seen as an alternative approach to the Cartesian dualism which permeates much of social science research, CHAT draws from the Hegalian dialectic that rejects dichotomies and emphasizes the process of parts emerging and giving meaning to the whole (Gillespie & Zittoun, 2010). The work of pragmatists like Dewey and Peirce are also threaded throughout CHAT, specifically in Peirce's belief that we cannot separate ideas from experience or thought from action, and in Dewey's belief that knowing is an

activity, and inquiry "a dialectical relationship between inquirers and their objects of inquiry, a relationship that is dynamic, flexible, and reciprocal" (Thayer-Bacon, 1998, p.58).

While CHAT is a multi-faceted theoretical framework that draws from many different influences, the work of Soviet psychologist Lev S. Vygotsky is considered to be the foundations. As a psychologist in the early part of the twentieth century, Vygotsky was working to understand consciousness within the confines of communism. A major area of interest for Vygotsky was the "crisis" in psychology, the methodological and conceptual focus on observed behaviors exclusively (Vygotsky, 1978). Vygotsky's solution to the crisis built on work about human consciousness and higher psychological processes and incorporated Marxist approach towards the role of socio-historical time and place (Hyman, 2012).

Object-oriented activity

As mentioned in Chapter 1, mediated activity or the relationship between subject, tool, and object, is the heart of human activity in CHAT. Focusing on the subject-tool-object relationship can give great insight into learning environments, especially because learning itself "arises from participation in communities, using and observing the use of tools in a joint, goal-directed activity" (Turpen & Finkelstein, 2013). Leontiev further developed Vygotsky's theories after his death, focusing on object-oriented, or goal-directed, activity as a way to understand the social actions of the individual, which forms the basis of activity theory (Yamagata-Lynch, 2010).

Leontiev proposed the concepts of activity, action, and operations. Activities are collective, contextual endeavors like jobs that are driven by an individual's pursuit of basic human needs. Activities are developed within a specific socio-historical culture (Wells & Edwards, 2013). In the case of CHAT, activity is larger and more collective, such as *redesigning*

instruction or *managing* schools (Roth & Lee, 2007, p.201, emphasis theirs). Activity is the performing of conscious actions, which are concrete, situated in a specific time, and directed towards situational goals, such as completing a homework assignment or grading a test. The same action can play a part in different activities, develop into activity systems, and become internalized (Wells & Edwards, 2013). Within this relationship are operations that are unconscious applications of tools that start off as conscious actions. They utilize the resources and participants needed in response to the goal-driven action (Jonassen & Rohrer-Murphy, 1999; Roth & Lee, 2007; Wells & Edwards, 2013).

Leontiev (1981) developed the idea of object-oriented activity, where the object of the activity is both what we (the subject) project onto the objective world as well as the world as we understand it (Kapetlilin, 2005). To Leontiev (1981), activities are collective, contextual endeavors that are driven by an individual's pursuit of basic human needs and developed within a specific socio-historical culture (Wells & Edwards, 2013). As a result, goal-directed, artifact-mediated activity should be the primary unit of psychological analysis used to the study of the social interactions of the individual (Kapetlinin, 2005). Artifact-mediated activity is the same as tool-mediated activity, referring back to the subject-tool-object relationship.

The object of the activity is the ultimate reason (Kapetlin, 2005) that motivates an individual's behavior. Object-oriented activity is influenced by consciousness (Stetsenko, 2005). The nature of what motivates an individual to engage in the activity can be complex; a need can direct actions only when there is an ultimate reason (Miettenin, 2005).

Kapetlinin (2005) argues that CHAT scholars need to differentiate between "object of the activity" and "motive". To him, objects of an activity are constructed in light of affordances and constraints like the subject(s) themselves, their needs, the activity that is meant to be completed,

related activities, other individuals, and so on. Any change in a single component of this activity will change other components and start a construction and reconstruction process similar to a design process (Kaptelin, 2005).

If we consider object-oriented activity as being a consciously chosen, goal-directed activity that links psychological processes with our perception of the greater world (and the influence of those perceptions on us) (Kaptelin, 2005), it is possible to gain new insight into how higher education courses are constructed to aid in knowledge construction. Additionally, if we acknowledge that in the process of the subject-object activity, the artifacts and tools used (like a syllabus, computer, or maybe another person) help change the subject and object themselves (Bodker, 1997; Kapetlinin and Nardi, 2012). In Leontiev's activity, tools were not just mediators but also a way to connect through the activity to others in the social world (Miettenin, 2005).

Tools are found in academia in many forms. Each use is unique. Using the tool transforms the tool and is the only way to understand a tool as a cultural product (Brown, Collins, and Duguid, 1989; Wertsch, 2000). Tools can be individuals, like group members in a group project or peers in class. Barab et al. (2002) demonstrate how a student can come to a deeper understanding of astronomy by having their peer help mediate what they have learned in class. Within this example, the student is the subject and their object is to fully understand a topic from the class. Their peer helps them do this by explaining the concept and their understanding of it. This example can be applied to other higher education instructional settings as students' understanding of the material (which is their goal) will be mediated by either their peers or the instructor. This means that instructors can serve as tools to help students construct understanding of the subject matter.

Bell & Hunter (2013) studied underrepresented populations in science participating in a course that had intensive lab activities taught by experienced researchers. They found that having to work through an undetermined problem using scientific equipment gave students a better idea of what they were doing and taught them to use scientific argumentation. By manipulating the tools, the interns (subjects) were better able to articulate their understanding of what they were doing and developed more agency related to their learning in the process (Bell & Hunter, 2013). In these examples, it is clear that using a tool like a peer or a tangible manipulative while engaging in a goal-directed activity allows for subjects to gain greater understanding.

Tools can also be digital, including the software required to complete a course assignment. Human-computer interaction is a well-established field that draws from and informs CHAT. It is relevant in the context of this dissertation due to the fact that faculty members in engineering rely heavily on computers in their research like running simulations or coding, and due to the fact that course materials, communication, and course planning are all carried out on computers.

As a tool, Kapetlinin (1996) points out that humans use computers less because they want to interact with the computer, but more because it helps them communicate and interact with others. Computers have different functions, but the functions of the tool can help carry out the subject's internal plan, or object-oriented activity. In an example of an undergraduate physics class, Turpen & Finkelstein (2013) show how an instructor (subject) using innovative teaching strategies like online tutorials (tool) can enable students to become effective practitioners of science (object). They found that when faculty actively plan instruction around the use of innovative teaching tools as opposed to using the tutorials and tools ad hoc, students

comprehension increases and faculty's perceptions of teaching and learning change through participation in the activity (Turpen & Finkelstein, 2013).

Leontiev (1978) focused more on individual activity, which was still carried out socially if not collectively. To him, the object was the motivation or the need for the activity to commence. Later activity theorists like Engeström , however, have focused on collective activities that fall within large-scale systems (Kaptelin, 2005).

Engeström and activity systems

Continuing in the vein of Vygotsky (first generation) and following Leontiev (second generation) Engeström's third generation of activity introduced activity systems as an extension of Leontiev's work. In Figure 1 below, Engeström's idea of nesting activity triangles is displayed.

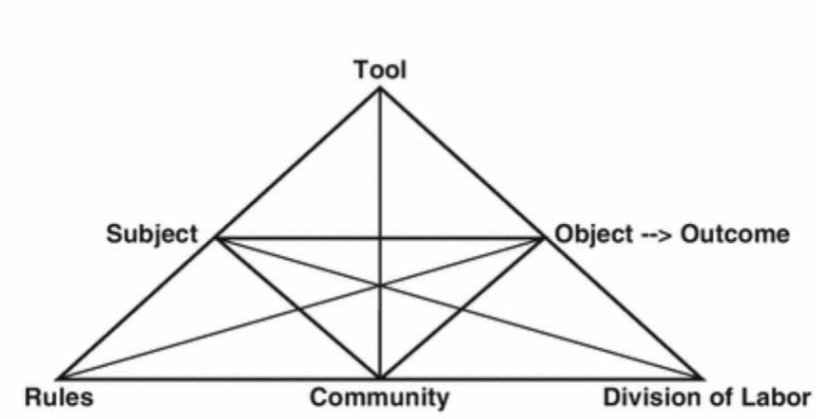


Figure 1. Engeström's activity systems analysis from Yamagata-Lynch (2010)

Engeström visually demonstrated how individual activity influenced and was influenced by the community (Wells & Edwards, 2013). Within this nested activity, a subject still acts on

an object through the use of an artifact or tool, but there are additional influences to be examined such as the community that surrounds the activity, the rules that bind the activity, and the division of labor within the activity. Human activity thus becomes, as Engeström (2015) states, a "complex systemic formation" of the mind and body within society (p.xxx).

Rules bind all activities and often create tension within an activity system. Within higher education settings, rules that affect the instructional practices of faculty can include external accreditation standards (i.e. ABET) as well as formal or informal departmental rules about class times, semester course offerings, and criteria for programs of study. There are also the rules that bind a class itself such as the syllabus, the procedures for submitting assignments, the rubrics and grading scales, and with more specifically rules for laboratory or practicum courses. In Turpen & Finkelstein's (2013) study of undergraduate physics teaching, the rules that bound the activity were the instructions for the homework assignments. Because they studied a variety of implementation strategies for new instructional tools, the directions for each assignment ranged from working independently and taking responsibility to focusing on concepts related to the content. In the examples, the rules emphasized the goal of the activity, as well as who was responsible for the work.

Accredited colleges of engineering are bound to standards as well. The Accreditation Board for Engineering and Technology (ABET), which accredits engineering programs that apply and complete the rigorous process, argues that accreditation improves graduates' job prospects, signaling to prospective employers as the student has learned specific skills (ABET, 2015). Part of this process is ensuring that what students are taught aligns with the ABET standards. ABET's student outcomes are often used to evaluate teaching and learning, though how they inform the course design process is unclear.

Within higher education instructional settings, the labor can be divided between multiple parties or it can be restricted to the faculty members themselves. In some courses, the instructor has graduate assistants who assume a portion of responsibility for teaching or for grading. In Turpen & Finkelstein's (2013) physics class example, the role of the instructor and students varied depending on the instructional strategy being used. If the instructor was teaching without planning to use digital tools then the instructor provided more direct lecture instruction and students were responsible for their own learning. If the instructor was fully committed to teaching conceptual understanding by using online tutorials as tools, then their role was more of a facilitator and the students were expected to be more actively engaged in problem solving (Turpen & Finkelstein, 2013). Understanding the role of students within an instructional setting is important in understanding how they learn and what can be done to help them learn.

The division of labor can also help establish partnerships with the community. Classrooms do not exist within a vacuum. The instructor and students must exist cooperatively in higher education instructional settings. There is also the department, which the students may or may not be a part of, and any graduate assistants that serve roles within the class. Large classes create different communities compared to smaller classes, which also skews the division of labor and the rules (Turpen & Finkelstein, 2013). There is also the larger discipline community. Ellis (2013) writes about the role of teacher education programs creating connections between schools, universities, and the community at large. These connections are important for professional programs, as graduates will work in the community and so instruction must be designed with this goal in mind, and often with the input of the community stakeholders. Community, the final component of activity systems, is also critical to understanding the complexities of higher education instruction.

Additionally, Engeström (1993, 2001) notes that there are internal contradictions within an activity, created by structural tensions with and between other activities. He gives the example of adding something to an activity, thereby upsetting the existing balance and creating secondary contradictions. Secondary contradictions create conflict and tension but also create room for innovation.

Extension of activity theory: Communities of practice

Arievitch (2008) argues that CHAT is the study of human cognition that is not restricted to an individual's cognitive processes but rather stretches into the realm of the social, becoming a collaborative, cultural activity. Learning is social participation, and everyone belongs to informal communities of practice in a variety of forms ranging from office environments to social organizations to schools. As a result, learning comes from engaging in and contributing to the practice of communities (Wenger, 1998). The study of learning as an activity situated in social life is often called situated learning (Driscoll, 2005; Lave & Wenger, 1991). From situated learning comes the idea of communities of practice. The root of a community of practice is four main premises: that humans are social beings who need to learn in social situations; knowledge is seen in competence displayed when engaged in valued exercises; knowing is understood by pursing valued exercises; and learning produces meaning (Wenger, 1998).

In terms of education, a community of practice can be seen in throughout university classes. It can be found in the relationship of an expert – an instructor at the university level – sharing their knowledge with novice members on the periphery. It can be found in the efforts made by the instructor to bring students into the community of practice by helping them learn the vocabulary and jargon of the community, by bringing them into the authentic activities of the

community through active engagement and participation. In engineering, lab classes put theory into practice, and have the potential to move students into the community from the periphery, if they are engaged and learning.

Because professional practice is an important part of engineering education, educators and researchers in that field have attempted to create communities of practice. These are usually top-down implementations created by individuals for a specific purpose as opposed to evolving out of the interplay between experts and novices. Most studies on communities of practice in engineering tend to use the term as a buzzword (Donath et al, 2005), or try to artificially create them (Newswander and Borrego, 2009); as such, the communities do not last very long and without any of the nuance of the original theory. For example, Hurwitz et al (2013) share about a community of practice formed during a meeting, where ideas about active learning where disseminated to participants with the hope they would bring them to their practice. A similar idea can be found in an engineering-adjacent field, computer science, where Fincher and Tenenberg (2006) write about creating a professional development community of practice. This idea has some merit in engineering education, but not in the current form the research takes.

Conclusion

CHAT offers a comprehensive view of learning and teaching as a complex human activity influenced by multiple factors and multiple tensions negotiated by the individual(s) engaged in the activity. Because CHAT takes into account multiple factors like the goal of the individual, their actions towards a goal, and the larger institutional pressures that can constrain these actions, it can be considered a useful framework for exploring university faculty's course decisions.

Because tools help mediate the construction of knowledge in an object-oriented activity, (Vygotsky, 1978), using an activity theory perspective could be especially fruitful in understanding what choices a faculty member makes as they write their syllabus, and what happens if they choose to revise it. Wertsch (2000) points out that actions are constrained by cultural tools like a syllabus, and within this context a course syllabus and related documents like a course schedule or assignments may be useful in helping a faculty member make choices related to content and instruction. These choices, then, can provide insight into what engineering faculty believe about teaching and learning, which is important when considering the tremendous energy has gone into reforming engineering education at the university level.

Chapter 3: Methodology

There is a limited literature on how engineering faculty members plan and teach their courses, or what influences their decisions about their courses. Engineering faculty members do publish on their courses, but what they publish is often straightforward articulations of how they implemented a new activity or how they realigned their course. Most of these articles are very brief, and lack elaboration on the pedagogical choices made and what may impact those choices. This contrasts with some of the research in higher education teaching and STEM, which goes into more depth. Further, little engineering education research has been conducted using socio-cultural methods like activity theory which would provide a holistic view of how engineering faculty members write their syllabus, and how that syllabus can be considered a tool in the course design and decision-making process.

In this chapter, I will elaborate on the research methodologies that I used to collect and analyze data for this dissertation. I will first describe my participants and how I recruited them. Because the participants I recruited were selected with specific criteria, I will elaborate on the literature about faculty members related to award winning faculty. Next, I will describe my data collection process. For this dissertation, I had two sources of data: syllabuses and related course documents, and interviews from the faculty members who provided the syllabuses. In this section, I will discuss why I chose the data sources that I did, and how I collected my data. The next section will be an explanation of my data analysis in which I will explain my coding schemes, how I proceeded through first and second cycles of coding, and how I conducted an activity systems analysis of the data.

Participant recruitment

Before I started recruiting participants, I was given approval to conduct research by the Institutional Review Board (IRB) at the University of Tennessee. Following IRB procedures, participants signed two separate informed consent documents that explained the voluntary nature of the study as well as the potential risks and benefits. The first informed consent was done electronically when I asked for participants to share syllabuses, and the second was done during the interview. For this study, there was a slight risk of identification due to the small sample size of the participant pool. Participants were assigned pseudonyms and any personal or identifying information was altered or removed completely while writing the results of this study, including course names and numbers, and departments. Participants were told that they could terminate their participation at any time. For the full informed consent document, please see Appendix B.

Participants

Participants for this study were recruited from 37 retired and full-time instructors at the University of Tennessee who received recognition for exemplary teaching at the College of Engineering annual awards. Specifically, participants were recruited from the publically-available awards lists for the years 2009-2017. The awards lists were obtained from the UT College of Engineering website.

Kristensen and Ravn (2015) emphasize that when researchers determine the criteria for selecting their participants they do so with intentionality, so they can interview those individuals who are best suited to their study. I chose these recipients because of the availability of their information as well as the fact that previous studies on faculty in higher education have demonstrated that award-winning faculty have well-established beliefs about teaching and

learning (Dunkin, 2002; Dunkin and Precians, 1992; Pollio and Humphreys, 1996). Their beliefs about their own teaching efficacy is confirmed through the feedback from their students and their peers in the form of awards (Morris and Usher, 2011). Additionally, because individuals who believe that they are "relevant contributors to illuminating certain topics" (Kristensen and Ravn, 2015) are easier to recruit, I hoped that award-winning faculty would feel like they could talk about the subject easily. The recipients of the awards range from non-tenured lecturers to full professors and professor emeritus, though most award winners are clustered at the associate or full professor rank.

Recruitment

To recruit my participants, I used Qualtrics survey management software to create a browser-based survey that I distributed via anonymous link (see Appendix A for recruitment email). I created a form that included the informed consent to participate in the document collection, several targeted questions to collect demographic data about the faculty members' rank and department affiliation, an upload link for uploading a course syllabus, and the ability to opt-in to the interview process (see Appendix B for the informed consent). This recruitment email was sent to thirty faculty members in February 2017. Another email was sent to twenty-five faculty members in May 2017 that included some faculty from the first recruitment who had not responded earlier and after the 2017 award winners were announced. Sixteen individuals received the email in both recruitment drives.

The initial recruitment email focused on award winners from 2009-2016. It attracted the attention of four faculty members: three who won awards after 2013, and one who won multiple awards including during the 2009-2016 timespan. Because most of my participants won awards after 2013, I thought maybe individuals who won awards recently would be more eager to share

their experiences. As a result, I sent out a second recruitment email excluding my participants to those who won from 2014-2017. This meant that I re-sent the email to 16 individuals. In the second wave of recruitment, four additional faculty members expressed interest in participating: two were tenured full professors, and two were non-tenured lecturers. In the end, I interviewed the two tenured professors and one lecturer, who was not tenured or tenure-track.

Interestingly, many of my participants emailed me after they received the recruitment email to express their interest. Three of my participants from the first recruitment drive and one from the second contacted me directly after they received the email. Two contacted me after they consented to be interviewed to give me more information about their course syllabus. Of these two, one mentioned that they couldn't upload a syllabus because they used a course website. The other mentioned that they might not be an ideal participant since they tended to adjust their syllabus and schedule as the course went on. Another participant contacted me after receiving the recruitment email to clarify that all they needed to do was to follow the survey link. This participant ended up combining course syllabuses together into a PDF so that they could share multiple syllabuses via the Qualtrics upload link. Finally, another participant who contacted me was inquiring if they could keep the interview to 30 minutes instead of an hour.

Limitation of using Qualtrics

Qualtrics made it possible to send a survey link and collect data using a third-party app, and it was easy to use and customize. I chose this method because I did not know how my participants would feel about being asked to upload a file to a personal cloud storage account like OneDrive or GoogleDrive. While in the end this may not have been an obstacle, Qualtrics did provide a painless way of collecting syllabuses and aggregating response rates.

However, there were some limitations to using the program. One limitation was that faculty members could not submit multiple syllabuses if they wanted because document uploads were limited to one document per person. Like mentioned earlier, one faculty member ended up combining their syllabuses into a PDF document so that they could attach more than one. Additionally, some participants found the design of Qualtrics to be less than intuitive, which may no longer be an issue now that Qualtrics has a new user interface.

Another limitation, but not necessarily because of Qualtrics, was that I did not include an option to link to a course website. This came up when one participant directly emailed me to note that they did not use a traditional syllabus but rather a course website. In the end, three participants used some variation of a course website or a course management system that they created and maintained separate from the university system. While I am sure that this would have been entirely possible to document through Qualtrics, it is more the limitations of my own thought process related to how to collect the syllabuses rather than the tool I used. In the future, I would make sure to include text boxes and other options for links and additional information.

Participant demographics

In total, 11 individuals started the survey and eight consented to be interviewed. I interviewed seven instructors and gathered course syllabuses for eight courses. One participant shared approximately five course syllabuses with me, and another shared three. Two instructors who had websites encouraged me to compare the syllabus they first discussed with those of their other courses. Of these six participants, one was an associate professor, four were full professors, and one was a recently-retired professor emeritus. The following two tables show the participant name, rank, years teaching, and awards one won (Table 1) and gives a brief biographic sketch of the participant (Table 2).

Table 1. Participant awards

Participant	**Rank**	**Years teaching**	**College teaching awards 2009-2017**	**Department Awards**
Bob	Professor	27	2	1
Hank	Professor Emeritus	58	4	2
Jerry	Associate Professor	8*	2	3
Morty	Professor	25	1	1
Rusty	Professor	34	3	4
Rick	Professor	25	1	10
Dean	Lecturer	3*	1	0

Table 2. Participant descriptions

Participant Pseudonym	**Bio**
Bob	Bob has taught at UT for over 25 years. He, along with Morty and Rick have been colleagues since their department was in the College of Arts and Sciences, and the three of them team-teach a series of courses. Bob, Morty, and Rick do not have doctorates in engineering, but much of what engineers do and know requires them to take the courses that the three teach. Bob sees teaching as a recipe that students need to follow to learn.
Hank	Hank has been teaching for over 50 years, and is now retired. As an emeritus professor, he still teaches some courses because he loves teaching. Much like Rusty, Hank has seen the trajectory of engineering change over his career. When he initially taught at UTK, he had a master's degree and he was able to make tenure. At that time, his department had few PhDs. Hank left to earn his PhD and then returned to UTK, where he received tenure for the second time.
Jerry	Jerry is relatively new to academia. Now a tenured associate professor, Jerry had been a staff scientist at a national lab before coming to UTK. His reason for joining academia was because he wanted more opportunities to work with students. Jerry has been at UTK for over eight years.
Morty	Like Bob and Rick, Morty is a full professor who has been teaching at UTK for over 25 years. He has a teaching rotation with the two others but unlike his peers, he spends more time engrossed in educational research. He has flipped his freshman level course and attempted to flip a junior-level course. Morty actively seeks help with his course design.
Rusty	Rusty is in the same department as Hank, but he also works as part of a team of lecturers to ensure that students have basic engineering knowledge.
Rick	Rick works with Bob and Morty, and considers himself to be more like Morty than Bob in his teaching style. The three members of the teaching rotation share similar beliefs about teaching and learning. Additionally, Hank sees teaching as his legacy, and having greater impact on his field than papers or publications.
Dean	Dean is the only non-tenured participant. Like Jerry, he was also a staff scientist at a national lab before he returned to academia. Dean does not have a PhD (yet). He teaches three lab courses for his department. With little prior teaching experience, he draws on his experience as a coach.

Of the seven participant faculty that I interviewed**,** the majority (N=6) who responded to my recruitment email were tenured faculty. Of the tenured faculty who responded, five were full professors and one tenured faculty member was at the associate professor rank. All my participants were Caucasian males. Only one of my participants was born outside of the United States.

There are two things to consider where my participants are concerned: first, that more tenured faculty win teaching awards (Lough, 1997), and second, that tenured faculty have more experience teaching which mean that their years spent teaching hone their craft and make them more ideal candidates for teaching awards than junior faculty. In his study of faculty members who won the Carnegie award for teaching, Lough (1997) found that most award winners were in the later part of their teaching career, usually at the rank of full professor or an endowed chair. He argued that this should have been the point where their enthusiasm for teaching waned due to being in the later-half of their career, but instead, they were being rewarded for their passion and innovation

Limitations of recruited population

Unfortunately, I did not recruit a diverse population for this study. I had hoped to recruit tenure-track faculty and non-tenured instructors, as well as faculty from underrepresented populations like minority men and women. My reason for wanting a more diverse population was so that I could hear different perspectives; this is not to say that I do not believe the lived experiences of my male participants were universally the same, but from my position as a white female in academia, I know that women have different experiences.

I believe there are different reasons for why I was able to recruit mostly male, white, tenured faculty. The first reason is that nearly all my tenured faculty had been teaching for 25 or

more years, so it can be assumed that their research program has been established since they are still here and have tenure. If their research program and funding sources had not been established, they would probably not be at UT any longer. This is because in engineering, it is essential for faculty to publish papers, which they need a research program to do, and which they need money to fund, all of which directly contribute to tenure (Fink, Ambrose, and Wheeler, 2005). Because tenure-track faculty must secure funding to build their research program while teaching and writing papers, they may not have been able to spare an hour of their time for my interview. Also, asking for an hour of time may have been prohibitive based on the demands of faculty. It is also possible that junior faculty and adjunct faculty did not feel that their experiences were meaningful or could contribute to the larger narrative on course design (Kristensen and Ravn, 2015).

My assumption for why I was unable to recruit any female faculty members is like the previous tenure-track assumption – the need to build a research program – with the additional burden of juggling multiple tasks. Research indicates that female engineering faculty find their job responsibilities are often disproportionate to their salaries. By this, they usually mean they are expected to serve on committees, take meeting notes, in addition to other tasks that their male colleagues may not be expected to do (Phipps, 2007; Xu, 2007). While none of the female faculty members I sent recruitment emails to told me as much, this may be a reasonable guess as to why they did not participate.

Still, it was important that I interviewed tenured faculty because experience often influences beliefs about teaching and learning - and, as I found out, many of my tenured faculty felt free to speak their mind. Dunkin (2002) found that experienced teachers who had received teaching awards had more fluid conceptions of teaching compared to their junior peers. Prosser

et al. (2003) found that senior faculty used approaches that favored deeper knowledge acquisition, and as a result, students reported higher quality learning experience. This may also be because tenured faculty have had more experience as instructors as well as teaching specific content, which may suggest they may have different beliefs about teaching than novice faculty.

Data Collection

I relied primarily on two sources of data: interviews with the award-winning faculty members and course syllabuses and related documents such as course schedules and assignments. In this section, I will describe why I chose my data sources, as well as my data collection methods. I chose these two sources to use, interviews and documents, because, as a researcher, I agree with Fontana and Frey (2000) that "the spoken or written word has always a residue of ambiguity", no matter how carefully we word the questions or how carefully we report or code the answers. Using both sources, I believe, allowed me to better understand the participants' lived experiences as related to their syllabuses.

Interviews

I believe that interviews are an important source of data because, as Kvale and Brinkman (2009) point out, interviews are meant to help researchers understand the world from their participant's point of view. An interview should be more than just a passive, one-way conversation where the interviewer asks questions and only records answers. Interviews are interactions between the researcher and participant, and in this interaction, knowledge is constructed and co-constructed (Kvale and Brinkman, 2009; Ralston, deMarrais, and Lewis, 2003). Within an interview, the interviewee is not just responding to questions but to process

and reflect on their lived experiences while talking with the interviewer (Kristensen and Ravn, 2015).

Potter and Hepburn (2005) discuss the issue of stake and interest. They note that, in dissertation studies, the interviewer and researcher are one in the same, and therefore the stake they have in the interview, and the interests that shape their questioning, should be considered. After all, participants are not chosen because they have broad, neutral knowledge about something, but because they also have specific understanding of the topic, as well as their own stake and interests (Potter and Hepburn, 2005). The interest of the researcher/interviewer, and the stake they have in the interview, can vary across the interview, with certain lines of questioning being more obviously related to the researcher's background than others. Aware of this, I made sure to be open with my participants during the interviews about who I was, what I was studying and why, and how I came to this topic.

Before each interview, I introduced myself and talked about the driving reasons for why I was researching this topic, including my intention of trying to fill a gap in the literature about what engineering faculty members are doing successfully in their teaching practice. I was upfront about the fact that I was not an engineer, but that I was married to one who was also tenure-track engineering faculty. I also talked about my experiences in education as a K-12 teacher and as a college instructor. I did this because I believed positioning myself and sharing my background was important, since I was coming into this research more as an observer than as a participant (Yamagata-Lynch, Cowan, and Luetkehans, 2015); I may have been constructing meaning with the participants through the interview process, but I was not involved or participating in their class or planning. Also, I felt the need to establish a connection with my participants to avoid making them feel that I was coming from the outside to tell them what to do – a salient critique

in research on why science and engineering faculty fail to adopt new instructional practices (Henderson and Dancy, 2008).

Acknowledging my own engineering connection seemed to put my participants at ease, and they would often refer to my husband's trajectory towards tenure in our interviews. One participant would use it to compare to his own tenure process years before to demonstrate how times had changed. It also gave me a frame of reference to share what I knew about engineering content, which allowed for deeper questioning. Overall, I think acknowledging my connection was a good decision, because it allowed me to connect with my participants in a way that I may not have been able to since I do not have my own lived experience as an engineer.

Prior to the interview, I had my participants sign an informed consent document. I conducted seven interviews total with six tenured faculty members and one non-tenure track lecturer. The interviews ranged in time from twenty minutes to eighty minutes, though the average length of an interview was around forty minutes. All interviews took place either in the participant's office or, for one interview, in a department conference room.

The interviews were semi-structured in that I had a list of questions that were already generated (see Appendix C) but I tried to remain flexible and allowed my participants to set the tone of the interview, so I asked questions that were not on my list. As a result, each interview progressed in a different way, but I started all interviews by asking about the participant's background. While the focus of the interview was on course design, it was impossible to not discuss the participant's beliefs about teaching and learning.

All interviews were transcribed and sent to the participants for member-checking prior to any data analysis. Only two of the seven participants did not respond to the emails requesting them to edit their transcripts. Of the remainder, two made corrections prior to returning the

transcripts; one corrected for grammar and understanding, the other redacted information. One participant did ask questions related about the use of transcripts and pseudonyms, which they were reassured about anonymity.

Documents analysis

According to Coffey (2014), documents like syllabuses "provide a mechanism and vehicle for understanding and making sense of social and organizational practices" (p.367). This is because documents are intentionally created for a purpose by individuals who have a specific audience in mind (Hodden, 2000; Krippendorf, 2013). Course documents, such as a course syllabus, are examples of documents created for a specific purpose such as organizing the sequence of the course, explaining the content, establishing course expectations, or acting as a contract between the student and the instructor (Hora and Ferrare, 2013). Yamagata-Lynch (2010) points out that documents or artifacts are usually created before the study, as found in the case of syllabuses and course websites, but they still can help explain the rules and division of labor that occur in the participant's daily life.

Documents like syllabuses and course websites are great examples of what are participants lived experiences in that they outline what the schedule, policies, and procedures are for specific periods of time. Syllabuses contain schedules of lectures, assignments, and exams. They set up the rules and procedures for turning in homework and for being absent from class. They provide insight into what a faculty member will do for the period of the class, how they will distribute their work (i.e. giving GTAs assignments to grade or labs to teach). Though they cannot give the complete picture of the activity, they can provide enough information to

supplement the interview, and provide a look at the rules, division of labor, and even community of the activity.

During my participant recruitment, I asked for participants to upload their course syllabuses, which were then downloaded from Qualtrics and stored on my password-protected computer. In addition, I used Evernote's Web Clipper tool to capture course websites as well as information (CVs, etc) from their departmental websites. I pulled that information with the Web Clipped tool and imported it into ATLAS.ti. I will discuss my use of ATLAS.ti in more depth in the data analysis section of this chapter.

Saturation

My sample size consisted of seven participants, though eight individuals responded to the recruitment email. The reason I did not continue to pursue the final participant, despite their ticking one of the boxes in demographics that I needed more of (lecturer) was that I felt I had reached saturation. Qualitative researchers like Bowen (2008) and Guest and colleagues (2006) state that saturation is a difficult concept to measure because there are many ways to conduct qualitative research, and some have more prescriptive ways of collecting and analyzing data than others (Walker, 2012). One way that many researchers define saturation is when no new information is given, and redundancy occurs (Fusch and Ness, 2012).

In the case of my study, I had realized that I had reached saturation by my sixth participant; at that point, I was not getting any new information, and that interview lasted only 20 minutes. That participant's course website was the richest of the websites I analyzed but was similar to another's course website because they taught the same course and even stated in the interview that they had a similar philosophy of teaching. As I looked at the different syllabuses

and documents, I realized that I was not finding anything new. I conducted one more interview with a non-tenure track lecturer, but I struggled to ask new and interesting questions, because I could already predict what my participants would say. As a result, I knew I had reached saturation and could stop my recruitment efforts.

Data analysis

Data analysis proceeded in several stages. To start, I analyzed the four interview transcripts, syllabuses and related documents from my first phase of recruitment using open coding. I reduced my codes using constant comparative analysis before coding the syllabuses and interview transcripts collected during the second phase of recruitment. I used axial coding to help determine themes for both the syllabus data and the interview data, then I wrote thick descriptions of the themes. Finally, I used activity systems analysis to identify the activity as well as tensions within the activity. Figure 2 describes each stage of my analysis.

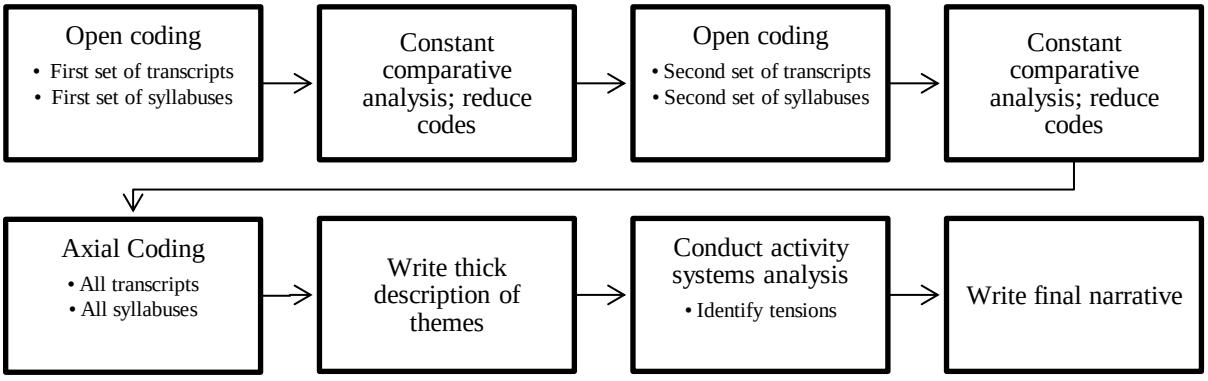


Figure 2. Data analysis flowchart

I chose to use a computer-assisted qualitative data analysis software (CAQDAS) to code my interview transcripts and documents. I find CAQDAS useful because, as Konopasek (2008) states, the software allows for assistance and support so that the researcher can organize and categorize more clearly. I used ATLAS.ti, a CAQDAS software that I have found beneficial for document analysis in that it is possible to engage in coding cycles and to assign colors to code families and write memos about codes easily. In the newest version of Altas.ti, notes about codes are kept when codes are merged, so I was able to trace my thought process beyond writing memos to see the evolution of my observations.

Transparency in data analysis

In order to make sure that I was transparent, I coded the first interview transcript using ATLAS.ti. Then, I made a list of codes I used for the first ten pages of my first interview transcript, as well as the first ten pages themselves, and sent these to a member of my research group. I gave my colleague my codes and also met with her to discuss what she found and we reached a consensus on what we saw. My colleague and I did not reach immediate consensus with my original coding. Part of this may be because I did not tell her all of the biographical or demographic data about the first participant. Any discrepancies also revealed my biases, and what I perceived to be hers; namely, I worried I was being too accommodating to the idiosyncrasies of engineers, and worried that perhaps she was being too harsh. We were able to talk about her beliefs and her positionality, which comes from a background in phenomenology, and that helped me go back and re-read the transcript again. I tried to be aware of my biases a little more than I had been previously, and I also followed the path of some of her observations to begin coding for affective statements, and any emotion that I may have overlooked.

Coding the data

In this section, I will elaborate on how I analyzed the data using first and second-cycle coding methods to reduce and reorganize my data, making it easier to find themes. As an overview, I started by coding the first four interview transcripts, syllabuses, and related documents using open coding (Saldaña, 2016). I repeated this coding with my second round of interviews and documents. Then, I progressed to second-cycle coding to reorganize the data and identify emergent themes, relying primarily on axial coding to reduce and categorize my data to help make meaning. In total, I collected and analyzed 7 interview transcripts and 31 documents comprised of course syllabuses, course websites, and other related documents. Some of these documents include individual pages of websites (i.e. Homework, Attendance Policy, etc).

First cycle coding.

Saldaña (2016) divides qualitative coding into two cycles: the first cycle of coding is organizing and reorganizing the information to get an overall idea of what themes are emerging from the data, and second cycle coding focuses more on analysis, synthesis, reorganizations, and categorization to create a more cohesive picture. During my first cycle of coding, I primarily relied on open coding. Boeije (2010) states that open coding encourages researchers to think thematically as they take apart the text, comparing and then assigning the data to categories. During open coding, I read through the transcripts looking to break apart the data into multiple broad categories (Strauss and Corbin, 1998). For example, I would read through a transcript and code what I found interesting, alternating between grabbing participant quotes for in vivo coding, and trying to write descriptive identifiers for the codes.

Once I finished coding a transcript, I used the ATLAS.ti code manager to add definitions to my codes and categorize them. After I coded a document, I went through and made sure to write definitions for the new codes I created. I used this definition-writing process in a way that Saldaña (2016) describes as both a personal debriefing and a code and category-generation method (p. 118).

One element of open coding that factors into the process is the idea of looking for conceptual ideas in the data that could begin to bring together ideas (Saldaña, 2016). To understand the larger conceptual implications of the data, I would define my codes and create categories with parent-child codes within the Code Manager of ATLAS.ti ,nesting codes together for more nuanced understanding (Saldaña, 2016). For example, participants often talked about their teaching, so I had a *teachin*g category followed by more specifics, like *team teaching* or *beliefs about teaching* (for a list of all codes, see Appendix D).

I would continue to re-read and re-code the transcript, being more focused and looking more intently at ideas like affective beliefs or emotions, contradictions, etc. I consider all of this to be the first cycle of coding since this was often before I reduced codes, which is more of a second cycle process. During the first cycle, if I reduced or combined codes it was because codes were similar or repeated, or as the coding went on I had to rename my code. The version of ATLAS.ti that I used, which is ATLAS.ti version 1.5.3 for Mac, now keeps all the definitions of codes if codes are merged together, which allowed me to have another running record of what my thinking was as I combined codes.

In my coding process, I also used what Saldaña (2016) considers to be simultaneous codes, which is when two or more codes applied to the same passage or sequential passages. I did this because participants' responses often contained information that applied to more than

one code. For example, a response discussing how the participant moved classes around on the schedule to accommodate external influences could be coded both affectively if the faculty expressed frustration about the lack of control they had to cover the material, as well course planning if the faculty member adjusted their course schedule.

Second cycle coding.

Saldaña (2016) considers second cycle coding to be developing categorical, theoretical, or conceptual organization from the codes (p. 234). Second cycle coding requires more analytical thought before action, as well as openness to identifying redundancies and ideas which are no longer as important. In this second cycle of coding, I relied on axial coding, which also has deep roots in grounded theory. Axial coding is meant to move from the codes to the data and, in the process, to "determine which [codes] in the research are the dominant ones and which are less important" (Boeije, 2010, p. 109).

After I completed my first cycle of coding, my focus was on reducing the codes. At the end of my first cycle of coding I had over 100 codes that gave me some insight into my research questions but did not provide any definite answers. I used axial coding to take my data and reassemble it (Saldaña, 2016) to find the dominant themes, as well as linking categories and sub-categories into a larger, cohesive description.

One way that I did this was by combining codes. Because I had already developed parent-child codes in my open coding, I combined sub-categories to reduce the number of codes I had. For example, I had several distinct codes related to what faculty members said in their interviews about working with their peers, about team-teaching, creating courses together, or planning curriculum sequences together. In my very first interview, one of my participants

(Bob) made a comment about how the faculty he worked with in his department owned their courses to the point where if a course was bad, they would work to change it. That was originally a code identifying faculty members as stakeholders in the curriculum. But, as I reread my data and reduced my codes, I realized that when my participants mentioned these working relationships they always spoke about individuals whose beliefs about teaching and learning aligned with theirs, including the emphasis on teaching or rewriting curriculum. As a result, many of those codes related to working with others, team-teaching or collaborating, were reduced into a single code defined as the affordance of having faculty as stakeholders.

During my axial coding, I tried not to make my categories too abstract, but often ended up with more concrete categories due to the data. It was easier to narrow the focus of the documents than the interviews, because as I looked at the codes for documents, two clear themes stood out which is when I knew I had reached saturation. The interviews were more complicated, and took a great deal of consideration, some memo-writing, some more reading, and deeper thinking.

Memos

As mentioned in my statement about subjectivity, it is important for me to understand my potential biases as I analyzed the data. Saldaña (2016) states that writing memos "helps you work *toward* a solution, *away from* a problem, or both" (p.44, emphasis his). Further, he points out that writing about what is problematic, ambiguous, or complex does not mean that clarity will emerge, but rather that it can "serve as a heuristic that may lead to deeper awareness of the multifaceted social word, and as an initiating tactic to refocus the blurry" (p.54). Because my

qualitative data collection and the subsequent analysis were an iterative process of thinking and reflecting on the data (Creswell, 2013), I wrote memos during my data analysis.

I wrote most of my memos during the coding process, but I wrote some immediately after I had analyzed the first set of interviews and while I was transcribing the second set. In this case, memos were a way for me to document an idea from the data and go back and explore it later on. When I defined a new code or revised the definition of an existing one, I explained why and I wrote out my lines of thinking as memos. I used memos more for categorical exploration than coding, which is why I did not code my memos in the end. I kept them both in ATLAS.ti and on paper close to my computer to refer back to. Writing out my thoughts helped me finalize the themes that emerged from the data prior to writing my thick description.

Thick description

Once the codes were determined, I wrote a thick description of what themes emerged from the data. Writing a thick description is an important part of data analysis in that it helps researchers make sense of their research and creates a commitment to their beliefs, which they will then share with others in their publications (Yamagata-Lynch, Skutnik, Garty, and Do, 2016). In many ways, writing a thick description helps make abstract ideas into a concrete tool used to help in aiding understanding (Sfard, 1998).

In writing the thick description of the data, I took the themes from the analysis of syllabuses and the themes from the interview analysis, found common threads, and wrote about what emerged. Writing this thick description allowed me to make sense of all the data within a larger context, since it is one thing to focus on the specific codes or code categories, but another thing to try to pull everything together into a coherent narrative that reflects the participants. While I did this, I included as much raw data as I found relevant, specifically focusing on quotes

from the participant interviews and their course websites. I relied on my prior research training as a historian to thread the data and quotations together to tell a story – a story that was not fiction, but rather carefully-constructed from multiple data sources and careful analysis (Yamagata-Lynch, 2010).

After I finished writing the thick description of my codes, I brought the thick description and the codes to my research group. There, I asked them to share their perspectives and discussed my findings with them. It was a useful experience to get outside of my own head, but also to get an external perspective on data that I had been focused on, alone. I repeated this sharing process again in my dissertation writing, when I had revised my findings more.

Activity systems analysis

Writing a thick description of my data allows me, as Yamagata-Lynch (2010) states, to put participants' stories into words by organizing the data in a way that constructs and shares meaning. It also forms the foundation for the activity systems analysis of my data in that I have already written a narrative that describes the experiences of my participants and, then, the next step is to deconstruct it from the perspective of a complex human activity. Activity systems analysis is Yamagata-Lynch's methodology that codifies analysis of Engeström 's activity systems.

After writing the thick description, I drafted out my activity systems based on my research question and the thick descriptions. I did this by hand at first, and then made them electronically using draw.io, a free web tool that can be added on to Google Documents. I started with an overall, overarching activity system based on my question and then looked deeper

to look at sub-activities and other actions taken by the engineering faculty members that I studied.

Engeström (2000) states that a collective activity is "driven by a deeply communal motive" which is 'embedded in the object of the activity" (p.964). All faculty members are engaged in the same activity of course preparation and teaching, regardless of the instructional methods they use to teach the course. All engineering faculty members are constrained by the graduation guidelines of the college of engineering, and by the accreditation standards of ABET which influence what is taught in their course, and how they report back their course data. These similar processes make their course preparation process a collective activity, even if they may not work together.

Acknowledging the collective activity of engineering faculty members allowed me to draft activities based on what I found. After I drafted the activities, I re-read my emergent themes and the thick descriptions that I had written, and modified activities as I saw necessarily. Finally, I identified the tensions that existed within the activity. Tensions, or what Engeström (2001) refers to as contradictions, are not problems or conflicts, but sources of change within the activity (p. 137). He uses the example of technology adoption, where new technologies brought into the activity system can create a contradiction with an existing element, like older technology, which can lead to innovation and changes in the activity (Engeström, 2001). Within the activity systems I analyzed, contradictions were often in the form of rules or interpersonal actions that meant that the subjected needed to shift or evolve (which will be discussed more in Chapters 4 and 5).

Trustworthiness

I relied on Tracy's (2010) criteria of trustworthiness, which include: worthy topic; rich rigor; sincerity; credibility; resonance; significant contribution; ethical; meaningful coherence. Some criteria, like ethical research behavior, are reflected in receiving IRB approval and how I interacted with my subjects and my data. Others, like worthy topics and significant contributions, may matter more to the discourse communicates I seek to join; after all, I may believe that these topics are timely and that my research is conceptually significant, but that will not be able to be determined until later. What I focused on, and what I sometimes struggled with, were the criteria of rich rigor, sincerity, credibility, and meaningful coherence.

While completing my data collection and analysis, I maintained rigor by gathering as much data as I could prior to analysis, and before making claims. If I made a claim in my findings, I made sure to back it up with data include quotations and other textual data. I also spent sufficient time with my data to understand it thoroughly, and was familiar enough with it to realize when I had reached saturation, or when new ideas were emerging and shifting the focus of this dissertation (Tracy, 2010). I maintained similar analysis procedures for both cycles of data collection and coding, and constantly and consistently referred back to the data in my writing.

Tracy (2010) states that qualitative credibility is achieved "through practices involving thick descriptions, triangulation or crystallization, and multivocality and partiality" (p. 843). As I have mentioned before, I shared my data analysis with my colleagues in my research group on three separate occasions. I did this as a way to confirm my own findings, but also to confirm my own understanding of the content. Likewise, sharing and discussing my findings also helped me

establish meaningful coherence, as my advisor and my research group kept me on target to understand the phenomena I was studying.

This ties into my sincerity as a researcher. Like Potter and Hepburn (2005) state, those who are doing dissertation research have to acknowledge that their role is both as interviewer and a researcher, and that they have a stake in the outcomes and the data. Being aware of this, I tried to position myself as both an outsider, in that I am not an engineer, but also an insider since I am married to one and I now work in engineering education. This unique position means that I have acquired what Tracy (2010) identifies as tacit knowledge, or what is taken for granted by others but recognized by those in the intimate position to recognize it. One example early on in my research came when I had shared my initial codes with a member of my research team. As we compared our codes I realized that, by virtue of my daily acquaintance with engineering faculty members, I had a tacit understanding of the participant's words and demeanor that were lost on my colleague who was just reading the text, and who came from a different position. This made me aware of what I knew, and how I could approach it in my coding and data analysis.

Conclusion

For this dissertation, I recruited participants from a pool of engineering faculty members who had won teaching awards from 2011-2017. I interviewed seven faculty members, and received syllabuses and course documents for five individuals for a total of 31 course documents, including website data I retrieved myself. After collecting the data, I used ATLAS.ti to code and analyze, discerning emergent themes. Once my themes were determined, I wrote a thick

description of them and then conducted an activity systems analysis of the themes and thick description. Chapter Four will contain my findings.

Chapter 4: Findings

In the following sections, I will provide a narrative description of the findings. First, I will start by addressing the themes that emerged from the syllabuses and course websites. Because both the course documents and the interviews shared a common theme, I will weave the themes from the documents and interviews together to explain my findings. After this, I will share the narrative of the activity, which is based on the emergent themes. Using the narrative, I conducted an activity systems analysis based on Yamagata-Lynch's (2010) methodology. I identified two activities based on the research questions related to engineering faculty, syllabus use, and courses. After I share this activity system, I will share my own interpretation of the data.

As mentioned in Chapter 3, after coding was complete, I determined what themes emerged from the data. Boejie (2014) suggests that this is not necessarily a passive process, but that the researcher has to be active for the themes to emerge. By this, it is meant that the researcher thinks about the data, categorize the data, read the data and reflect on the data. For this step of the process, I had already reduced my codes to the point where I had 5 parent code categories with 37 child codes for my interviews, and 6 parent code categories with 36 child codes for my documents (See Appendix D). I printed out all of my codes and their categories and then spent several days reading over the codes, writing notes, and determining what themes emerged.

I found that that there were three themes: one theme for the syllabuses and documents alone, and two themes shared between interviews and syllabuses. I will start by discussing the syllabuses and related documents, where the theme of ***common syllabus elements*** emerged. Next, I will build on themes that emerged in both the syllabuses and the interviews, starting with

the theme of ***lived experiences as faculty.*** Finally, I will connect the theme that emerged from the interviews, which was related to ***faculty as stakeholders.***

Theme 1: Common syllabus elements

The first theme found in the syllabuses and course documents is the idea of ***common syllabus elements***, or components found in all of the syllabuses collected for this study. Most syllabuses analyzed in this study were not very long unless the participant faculty had chosen to use a course website. Syllabuses were usually very streamlined, averaging 1-2 pages in length and featuring contact information for the instructor and the TAs, including office hours and office location. The grading policy and grading scale was often outlined and, if it was an undergraduate course cross-listed with a graduate course, the grading scale for graduate students was also included. Textbooks, both required and recommended, were mentioned in the syllabus as well. Some participant faculty, specifically those who taught freshman and sophomore-level undergraduate courses, stated the technology needed for the course, such as calculators. Participant faculty also mentioned that students needed access to their course website and/or course management system.

Participant faculty varied in whether or not they included their course schedule with their course syllabus or had it as a separate document. All faculty except Rick included their schedule or at least a basic outline of what the course would cover. Rick just listed three main course goals, and linked to a Google calendar which was embedded in his course website. Some, like Morty, listed the number of days it would take to complete the topic instead of giving specific dates.

Most of the syllabuses included detailed course schedules of what would be covered when, but there was usually a caveat either in the syllabus or the schedule that it was tentative. Jerry stated that the schedule may change during the semester depending on how long the class spent on a chapter – or, if the chapter in question took less time. If material took less time to cover, as Hank pointed out in his interview, it was because the students understood the material already or picked it up quickly.

Contact information and availability

Every syllabus and website listed the instructor's contact information. All faculty members gave their office location, and 4 of the 5 faculty members listed their office hours. Of the 5 course syllabuses analyzed, only one did not have the instructor's email address listed as the way to be contacted. Instead, the participant faculty had their phone number listed. This instructor also did not have office hours listed. This may be in part because they were recently retired, and thus on campus less than before.

Office hours were usually posted in the syllabus or, if not, it was made clear that they were flexible. Because office hours are times set aside by faculty members to allow their students to consult with them about the class, they were found on all syllabuses or, if they were not listed, participant faculty told students that they could make an appointment. Some faculty, like Bob, made it clear that students could just drop in if they needed to, though having an appointment or following the procedures of office times was preferred.

The names of graduate (and in some cases undergraduate) teaching assistants and their office hours was often clearly posted in a syllabus or website. This was because many of the

courses analyzed were undergraduate courses that had many students and thus needed to have multiple individuals handling the bulk of the class work.

It should be noted, though, that as students progressed from freshman level undergraduate classes to graduate classes, the number of individuals assisting the class changed. Bob shared several syllabuses for his classes that ranged from a large 100-level lecture class meant for freshman to 600-level doctoral classes. The personnel involved in the course changed with each course. For example, in Bob's freshman 100-level classes, he had several GTAs, but with each progressive year (sophomore, junior, senior-level courses), he had less help. In the case of senior-level undergraduate classes or 500-level graduate classes, he had one GTA. He taught his doctoral students without any additional personnel or help. In Jerry's case, the individuals involved changed from GTAs to highly qualified professionals in the field who worked at the nearby national laboratory. Their contact information was shared with the class, since he considered them to be co-instructors along with him.

University statements

The Campus Syllabus of UT contains six statements, ranging from disability access to civility to academic integrity, that are meant to be common for every course across the university (UT Knoxville Campus Syllabus 2017-2018). Because these elements are merely suggested, they were not consistently included in the documents. Some participant faculty explained their attitude about cheating and academic integrity in a more casual, personal tone. For example, Bob's syllabuses all state: "You must work alone (?) unless told otherwise. Cheating (including but not limited to copying other students' work and plagiarism in general) will result in an F and the incident will be reported to student conduct. Don't do it!!!"

Rick, who teaches on a team with Morty and Bob, had a different way of cautioning against cheating on his website:

> I shouldn't have to put this down as a pet peeve, since it's so obvious, but after watching my children go through college and hearing the tales of cheating that they relay, I will address it. If you cheat, you deserve to be kicked out of school. Does that statement make my views on cheating clear enough? It absolutely disgusts me.

Hank is the only faculty member who used the university-supplied disability and honor statements, whereas Rusty was the only one who also included the civility statement that the university suggests be included in the syllabus.

Attendance

Attendance policies varied widely across all of the course syllabuses. Some participant faculty stated that attendance was mandatory, while others did not. Lower-level courses for freshman and sophomores were more likely to have a mandatory attendance policy while courses for upperclassmen and graduate students did not. Participant faculty like Jerry did caution that not everything could be obtained from the PowerPoints posted on the course LMS, and that students would have to make sure they got notes from friends or spoke with him. The idea of personal responsibility for what was missed showed up in Bob's syllabuses as well.

Morty's attendance policy was different than the other faculty members. He did not require attendance at the beginning of the semester, but he did require it in the back-half, when they switched programming languages. His rationale, which was clearly stated on his website, was that from experience he saw that students struggled more learning one language over another, and so he believed it necessary for them to be present during that section of the course. Bob, who taught courses in the same sequence as Morty, required mandatory attendance in his

undergraduate classes. As students progressed from 100-level freshman courses to upper-level undergraduate courses and graduate courses, this policy changed and attendance was no longer mandatory but suggested.

Grades

All faculty had grading scales available in their syllabuses or on their course websites. Some were straightforward, but others, like Bob's, stated that higher grades would be given to students who "show significant progress" in the class over the course of the semester. Bob goes on to qualify that this sort of progress is judged by active participation in class and labs as they master the material. Jerry stated that his grading scale was adjustable, and that if the class average was lower, then the grading scale would adjust accordingly. Morty states explicitly that he will throw out the three lowest quiz grades.

Textbook

Not all participant faculty required a textbook. Some instructors, like Hank, required that students purchase manuals for class that would be used in their professional career. Others, like instructors of programming courses, tended to suggest textbooks but stressed class notes or videos over actual textbooks. Further, some had suggested books to learn programming, but did not have a mandatory class textbook. On his course website, which for Rick was his syllabus, he stated that he found textbook prices too high and so he chose to write detailed notes for the students as well as give them a list of books that could be supplemental. In one of his graduate-level special topics classes, Jerry posted links to US Department of Energy reports in lieu of a textbook.

Assignments

Most instructors had instructions for their in-class and homework assignments, as well as the exams. All classes had multiple exams, including a middle and a final exam. Participant faculty who had course websites usually had prior exams available for students to study from. They also posted the exams and answers on their course websites.

In-class assignments were different for every faculty member. Faculty who had in-class assignments or unexpected quizzes that counted for grades warned about the possibility in their course syllabus. Jerry stated that in-class assignments "will be turned in at the end of the lecture. You may work in groups on those assignments. If the in-class assignment is a pop-quiz, you must work alone. Morty took a different tone in his online syllabus when it related to in-class work:

> On those days when I have you working on homework assignments, you will be required to work on the assigned homework during that time and you will receive a 0 for that day if I catch you working on an assignment for another course. This may sound harsh but the past few times I've taught the course I've discovered that students have started to flounder on some of the later topics in the course, such as Python, concurrent programming, and functional languages and the primary reason seems to be that students are skipping class in order to catch up on assignments in other classes. By mandating attendance later in the semester and requiring you to work on the homework assignments, I can at least guarantee that you spend some time working on the homework assignments and getting some practice with the programming concepts they involve.

Instructions for homework varied in length and detail for each faculty syllabus and each class, but were almost always included in the syllabus or found on a related document. For

example, Hank and Jerry's explanations were very sparse compared to Rick and Morty's. Jerry's instructions stated that homework would be due the next class date that followed a lecture. Hank's statements were short, reminding students that they must state what information was given and what is required on each assignment. In his syllabus, Bob requested that partnering was not allowed. Jerry warned students that because the class was so large and because GTAs in that department worked only ten hours a week, not all problems were graded but those that would be graded would be selected randomly.

Other faculty members, like Rick and Morty, were very specific about how homework was going to be graded and how it should be turned in. Morty included a detailed point breakdown for the code that his students were expected to submit, as well as explanations for how to submit the code. Computer programming codes were difficult for students to submit in a learning management system so Rick and Morty had to be clever with their methods, which included email and other ways to commit their code. They detailed this in their course websites.

Explanation of late policies and how to turn in homework dominated most of the syllabuses and websites. Morty stated that if homework was submitted in advance of the deadline, students would receive 5 extra credit points. Conversely, he also stated that turning homework up to two days late would mean ten points off for each day it was late. Some faculty members, like Hank, told students that problems should be handed in by a certain period, but that he would accept them as late as the second period after the due date.

Rick and Morty, who had course websites, went into more detail with their expectations for homework. Rick explained his nomenclature of calling homework 'labs' which he understood could get confusing. He required students to upload their homework in a very specific way, which also required some explaining as it was a multi-step process that required

some verification and the potential to believe something had been submitted when it had not, in fact, been submitted. Also, his website stated when homework would be graded, and when they would be due, with the following: "In general, labs will be due at midnight on Sunday night. I won't let you work all night on Sunday, because then you either sleep through lab on Monday, or you skip it."

The syllabus characteristics found during the document analysis are somewhat in alignment with what has already been acknowledged in the literature. It has been stated that faculty members in some departments write course syllabuses that are more streamlined and less expository than others (Lattuca and Stark, 2009). As seen in my research, participant engineering faculty fall into this category. The syllabuses and course documents shared also communicated course goals and vital information (Afros and Schryer, 2009), but the sparsity of some syllabuses made it difficult to fully discern the intentions of faculty members. Course websites, like those created by Rick and Morty, elaborated on the ideas of their creators, but others were a little less hard to decipher without speaking to the participant faculty during interviews.

As I analyzed the interviews, I found themes that had some connection with the course syllabuses. These themes were ***lived experiences*** and ***participant faculty as stakeholders***. The themes emerged from the data because, during the interviews, faculty members supplied information not readily available in the course syllabuses, such as frustration or happiness. They elaborated on their course schedules and their decision-making process, and as a result, it was possible to start to piece together how they approached the activity of course planning, administration, and instruction.

In the next two sections, I will focus on the two themes that spanned the course syllabuses, related documents, and interviews. First, I will focus on how faculty used their lived experiences to inform their course planning. Then, I will delve into the theme of faculty members as stakeholders.

Theme 2: Lived experiences of faculty members

A theme that emerged in the data, both in the interviews and in the syllabuses and documents was the idea of faculty members using their lived experiences to inform their classroom practice, from their course planning to how they approached their students. The theme lived experiences as faculty is not a code that emerged *in vivo,* but rather was inspired by quotes from participant faculty, like Hank who spoke about "war stories" he told his students based on his more than fifty years as engineering faculty. While war stories would have been an acceptable code, I thought that the connotation of war stories would imply an event that took place during conflict of some kind, while the individual was under pressure. Instead, ***lived experiences*** implies continuously, and gradually, building experience after experience, which participant faculty appeared to do. All of these experiences helped them make decisions as they planned and taught their courses.

Accommodating students

All participant faculty paid attention to their students' needs, learning their traits and their dispositions and making decisions to help their learning. In all interviews, participant faculty made comments about certain traits of their students that they had observed over the years, and most recently in the newer generation of students. Examples of student-specific traits included their students' not referring back to the syllabus throughout the semester, or perhaps even

reading it thoroughly at all, and students' focus on grades. Additionally, participant faculty made attempts to adjust for these idiosyncrasies through their syllabus.

A reoccurring concept in all of the interviews was shifting the due dates on the syllabus to accommodate student learning. As a participant, Jerry, explained, "(the) schedule may change during the semester if a particular chapter takes longer or shorter than expected." Jerry also stated that if students have team events, conferences, or professional-related events, to let him know ahead of time so that he could help them make up assignments that they missed.

Every faculty member stated that they would push back deadlines if they felt that students did not completely grasp the content. This often meant dropping content, which participant faculty could find frustrating. Rick stated that he did not like thinking he had to remove content, but that it was important to cover what they could. In fact, most faculty seemed to approach the schedule with the understanding that they may have to drop material and that they would try to do their best to convert the content that they thought was necessary for the nature of their class. As Hank said:

> it bothers me a little bit because I think I'm not going to get to cover everything here if I'm not careful. But I'll do it anyway because I want to be sure that we understand, we learned everything through here, and if something gets lopped off in the end, in the great scheme of things it's probably not going to matter much. But I had rather learn what we're learning along the way and actually understand it.

Each faculty member had their own way of making their course schedules student-focused. Bob stated that he had a list of every class day and the content so that he would know what material could be dropped from the course outline if he had to make do with fewer days. Other participants, like Morty, listed the number of days it would take to cover the material on

the schedule, with the understanding that sometimes that number would change based on outside circumstances. Jerry wrote in his syllabus that days would be adjusted depending on their progress.

Another component of flexibility included attendance. In Rick's course website, he stated that he did not care what section students attended when it came to lab, just so long as they attended a section. Morty mentioned that he would prefer students come to class sessions later in the semester when the content was newer and they were less likely to know it.

Many participant faculty also seemed to be flexible with their exam dates. They shifted exam dates when students came to them with concerns about too many exams at once. Dean shared that, as teaching faculty, he tried to be more flexible with his deadlines than tenure-track or tenure faculty members. He knew that students would prioritize other work over his since his class was only worth one-credit compared to most other classes, which were three-credit. While being mindful about this issue, he would often check with others faculty when their deadlines were set and tried to plan his classes around other instructor's topics.

Hank pointed out that, over the years of working with other faculty members, he knew who was much stricter about exams than he was, and he would gladly move his own exams around to accommodate them:

> And I stick to (the course outline) except the dates. And I tell them at the very beginning that those dates are, uh, what would I say? They're variable. If we're gonna cover this amount of material, and then we're gonna have a test over it. That stays put. That's right. But exactly when can vary and who knows what could happen. We might get stuck on one topic, take an extra day. Or I'll say, 'all right, problem 12 is due on Friday so we'll have it back to you on Monday, test on Wednesday,' and then people start

> screaming ‘Ah [professor’s name] has a [subject] test on Wednesday’ and he’s one of these guys that’s got every day, every test date planned and shown on the syllabus – so it’s easier, rather than arguing with [professor’s name], just say ‘okay, we’ll have ours on Friday.’ So to me that works fine.

Participant faculty expressed preference for being able to adjust the schedules on their own terms. While all the participant faculty interviewed agreed that pushing deadlines back to help students master the material was something they were at least marginally comfortable with, all of them stated they did not like when it felt like it was outside of their control. Internal factors, like needing to review materials, was one thing. Illness, delayed openings or school closures due to inclement weather during spring semester were often accounted for in flexible schedules. But when the university itself made a unilateral decision to close for a football game, participant faculty were less than thrilled.

During the 2016-2017 semester school year when these interviews took place, the university decided to cancel class for the first football game of the year, which was on a Thursday. Tuesday-Thursdays are busy days on campus for classes, so closing the university on a Thursday in early September upset the entire teaching and exam schedule, shifting everything backwards. The way faculty members felt can best be summed up with Jerry’s statement about what an outside influence versus an inside influence makes them feel about adjusting classes:

> Okay, an outside influence like a Thursday night football game? Not happy with but it’s something you have to deal with. When I make the changes myself, I think I’m doing it for the betterment of the students so I have a positive feeling about it. Students may not, but I do.

Technology use

The use of technology itself was another way that engineering participant faculty both demonstrated awareness of their students' preferences and their own lessons learned over years of teaching. Several instructors (Bob, Rick, Morty, and Rusty) used asynchronous discussion boards in their courses so that students could ask, and in some cases answer, questions. The discussion boards they used were not Canvas or Blackboard, which were the preferred LMSes at the time. Instead, they used third-party sites like Piazza, which were not connected with the university (Bob), or hosted on the instructor's own learning management system (Rusty). Asynchronous discussion boards were a place where students posted question about the homework or the content of the class. As Bob states: "I tell them upfront 'don't email me individual questions – put them up there because if you have a question, chances are other people have a question and everyone can learn from this.'" Discussion boards like Piazza were usually semi-anonymous in that the participant faculty entered the names and knew who the students were, but the other students did not. Participant faculty monitored discussion boards not just to answer questions, but to ensure that inappropriate behavior did not happen.

Rusty's discussion board, which was part of his learning management system that was independent of the university, was more complex. When students posted on the discussion board, they could list the problem number of their homework and Rusty could look up the actual homework problem in the LMS's database to understand what the answer was. Students could even post pictures of the work they did on their problem. Because of the scale of Rusty's class sections, having the database of questions even allowed to track the question back a semester to see if this was a common issue. Rusty thought this system of using a discussion board worked well:

> It makes sense – a student wants an answer and I think it's best for them to get the answer right when they're working on the problem, so if they ask the question although we look at the discussion board a lot, evenings, and weekends and stuff, it's going to be a couple hours most likely, you now. So they post it at one Saturday afternoon and at 4:00 I look at it as well they're long since moved on to something else so if they can get their answer right then it's the best. I think answering three hours later is better than waiting until Monday.

Bob, and the others, added that there were occasions when another student had answered the question before the participant faculty member saw it. Some participant faculty viewed this as a good learning experience for both the student with the question and the one answering it. Others like Morty believed that students were more likely to just ask a question on the discussion board than look in the textbook for it. Participant faculty also noted that sometimes questions were deleted by students once the students spent more time with the problem, which was another learning experience.

Another element of technology use that demonstrated experience of the faculty was use of a flipped classroom. A flipped classroom is different from a typical lecture or expository class in that students are expected to read the material or watch videos on the material prior to coming to class. Class meetings are meant to be spent advancing understanding of concepts by activities, like group discussions or working examples (Li and Daher, 2016). Only one participant, Morty, had a flipped classroom for his freshmen-level undergraduate lab, though others like Rusty were considering it for their larger freshmen classes. Morty recorded video lectures for students to watch prior to coming to the class meeting. In class, they worked through problems that were low-stakes and easy to be corrected by the instructor. He attempted to do the same with his

junior and senior level classes, but found that it did not work in the same way due to the fact that students in these classes were working on harder material that needed more explanation, and the small class size of upper-level classes did not yield as great a benefit.

Frustration

Participant faculty also expressed frustration with different parts of their course planning, teaching, and experiences. All participant faculty interviewed pointed out that, in their experience, students do not read the course syllabus. Dean went so far as to claim that he thought students expected him to remind them about everything, adding that he was sure that if he sent them a text instead of an email, that they would read it. What students did notice, some participants pointed out, was the grading policy. Dean had added, "I wish that the students understood more of the timeframes and I wish they understood where their grade was coming from based on the syllabus." Bob was also frustrated by students not reading the syllabus, stating that "there's no excuse for it but there will be people who ask questions and you'll be like "Yeah, it's on there, you got it on day one." Meanwhile Rick pointed out that he never read the syllabus when he was a student.

One area of frustration that Jerry had was about students focusing on grades. Grading scales featured in syllabuses, and everything students did – asking questions about homework, having exams moved – focused on their ability to get a good grade. Jerry was frustrated that this seemed to supersede the desire to learn the content:

> And they're all worried about their grade point average and I tell them 'your grade point average only counts for your first job, your first step out here. After that, nobody cares about your grade point average.' I've never been asked about my grade point average

> after I graduate and I don't even think it mattered for my postdoc position, to be honest with you. So it matters for going into graduate school. I try to tell them 'Ease back, if you get a B' - we have a lot of high-achieving students and they all want to get As - I say 'if you get a B+ or a B, don't worry about it, if I see that you worked hard I'd be willing to give you a good letter of recommendation if you deserve it' that sort of thing. Those are the things that really help you in your career - it's what you learn and it's not your grade point average because if it was grade point average they'd all be a bunch of medical students, right? That (students) are memorizing things for the exam and forget about it afterwards, right?

Frustration for participant faculty seemed to be centered in having beliefs about teaching – that grades were of lesser importance than content, that students did not read the syllabus they spent time writing, that students asked questions on the discussion board that could be easily answered if they took time to re-work the problem – that did not always align with the students they taught. More than one participant faculty mentioned a generation shift between students in the years that they had been teaching. Hank, who had been teaching for over 50 years, stated that students changed in what they expected from faculty. Bob talked about students using YouTube videos to help them master concepts. Dean used LMS announcements to constantly remind students of their deadlines. Morty cited research showing how mobile phones decreased attention spans. All participant faculty were aware that the students they were teaching had changed considerably from their own days as students. But despite these frustrations, faculty still found personal fulfillment in their job.

The joy of teaching

All participant faculty expressed satisfaction and fulfillment in connecting with students through teaching. When asked about teaching, each participant faculty directly referenced the connection with their students, like Hank:

> And I like that. And I like to get to know the students. And I like to teach the students. Sometimes, I know there have been a couple of times that I would think, starting a new quarter or new semester, that I have taught this stuff how many times? Ten times, twelve times? And it's simple stuff - its Newton's laws basically - and then a little bit of friction whatever whatever. And then I will start teaching and halfway through the first class I'll look around out there and say "These people don't know this." And it's - I'm teaching old material but they're new people.

Rusty expressed similar beliefs about teaching the same content to new people, and how rewarding that could be. Other participant faculty, like Bob, saw their students success at gaining understanding of a concept as important and fulfilling:

> to see the lightbulb go off is rewarding and it's fun and it doesn't really matter whether it's a freshman, junior, or PhD student for that matter. It's just a current - you know, what it takes to make that lightbulb go off and the type of lightbulb is different but it's the same principle really.

Some participant faculty, like Jerry and Dean, had jobs as staff scientists for national labs before teaching. Jerry mentioned wanting to work with students as the reason for his decision to switch careers. Dean mentioned his past history as a swim coach as informing his own teaching decisions, and why he accepted the instructor position he did.

Participant faculty enjoyed helping students learn. Rick was particularly honest when it came to describing why he liked teaching:

> I love all the good parts of teaching. I like having the kids learn. I'm teaching the kids in - when they hit 300, I'm teaching them non-obvious things. So, this is the first time you're really teaching them stuff that that a smart kid might not be able to figure out on his own. I mean I couldn't when I was when I was learning it, this is material that I would learn, I'd be like "wow that's really cool." So, I get to teach that so that's really fun yeah to do and I also like having them come back when they get their jobs and everything and come back and tell me how much they value what I taught them. That's a good thing. I get a lot of that because I'm a tough teacher but you know, I get kids all the time - I got a lot of kids who come back and say, "you know, I just thought you were mean, you know, or you were too hard on us and now that I've got a job I realized that you're not, and that this is what we should be doing," so you know that's good.

Rick also saw this role as his legacy compared to publications or research:

> [A fellow academic] said the average life of the journal paper in terms of impact is like three years. So if you think about the impact that we make in our profession, the impact we make teaching is so much bigger than that our research impact and it's a fair point. Certainly I'm impacting, you know, 150 kids every year or 200 kids every year that's a lot more - if I have a paper that had 200 citations- I've got four that have over 200 citations so you're not getting that much impact.

The personal connection to teaching, and to their students, meant that some participant faculty – specifically those who maintained personal course websites outside of Canvas or Blackboard - often shared personal stories about their teaching on their website. Morty used his

course site to clearly communicate his views about the class with the students. For example, his attendance policy is flexible in that attendance during the first part of the semester was not mandatory, but it would become mandatory as the semester progress. This is because:

> This may sound harsh but the past few times I've taught the course I've discovered that students have started to flounder on some of the later topics in the course, such as Python, concurrent programming, and functional languages and the primary reason seems to be that students are skipping class in order to catch up on assignments in other classes.

On his course website, Morty was also open about the expectations of his flipped classroom, which was not commonly done in engineering. Rusty was the only other faculty who mentioned a flipped classroom. However, Rusty's decision to move to a flipped classroom was more about handling issues with class size first before the flipped classroom benefits. Morty's decision was based on data about student performance. As Morty told his students:

> If you have watched the video lectures and come to class then you should find the quizzes relatively easy to complete. If you simply read the class notes, there is a good chance you will be able to complete the quizzes, but the video lectures will add additional details, so you may not be able to answer every question by simply reading the notes. Additionally, you will probably find it problematic to answer the problems if you do not watch the videos.

Throughout his course website, Morty provided as much detail as possible to communicate clearly to students the course expectations, and how to complete the required course content. Another participant with a course website, Rick, struck a different tone. While he also explained his decisions in more detail than his colleague, he often used humor to connect to students. For example, he told the students that he thought of them as his children:

> I take a parental view of class. I am your father, and you are my children. My wife says that this can be construed as being demeaning when I say it, so I want to let you know that it is not. I take class and teaching very personally -- I really want you all to work hard and succeed with this material. Sometimes that requires tough love, but let it be known that I do care and want you to do well.
>
> You are all brothers and sisters in this class. While I am not the biggest fan of interpersonal interaction and conversation, even I will admit that you learn many unexpected and valuable things through interaction. This is when you are both soliciting help and providing it. I encourage you to try to help each other. Piazza is a great vehicle for this.

Rick used humor and honesty when he discussed the obligations of himself and the TAs: "I shouldn't have to write this, but history requires me to. While I love you, and the TA's love you, this class is not our only responsibility during the semester." And finally, he solicited students for feedback, noting that it was important to him to hear how to improve the class:

> When the semester is over, go over this list (of course goals) and see how well these goals were met. If you feel like it, send me email with comments – it's more useful after the semester than in the middle of it, I think.

Rick's request for feedback was not the norm among his two peers and other participants of this study. No other participant faculty members asked for informal feedback on their syllabus or website. Historically, end of course evaluations are the only formalized opportunity for faculty to receive feedback, however, no faculty member referenced them in their syllabus. Rick's open statement about feedback was different than his peers, but also highlighted another

theme that emerged from the data: that of participant faculty stating that they had a vested interested in their course design and teaching.

Theme 3: Faculty as stakeholders

One major theme that emerged from the interviews was the idea of faculty members as stakeholders. It should be noted that ***stakeholder*** was not a code that emerged in vivo from the data, but rather was a term I used to simplify what participant faculty described. The concept of stakeholders first emerged with Bob, who stated that "…we own pretty much all our (courses), all the way from 100 level. So if it's good, it's because we're good, if it's bad we own it and we fix it." As I continued to analyze the data, I found that all faculty members referenced being invested in their department's curriculum and accreditation process as well as their own course design and teaching. Thus, the term ***stakeholder*** – which defines someone who has a vested interest in some entity, like a business and in this case, like their department – seems more than adequate for this emergent theme.

Department stakeholders

Being a stakeholder meant being invested in the department, and for many faculty this was the result of going through the tenure process. Tenure has evolved, as Hank pointed out, to have significantly more requirements. As someone who received tenure twice at the University of Tennessee – once before he had received his PhD, and once again afterwards – Hank was well-positioned to see the shift in emphasis to theory and practice as described in Chapter 2. While the shift away from application towards research has been beneficial, Hank also worried that teaching was underemphasized, saying "you could be the best teacher in the whole wide

world and if you don't have the research and publications, then you don't have enough beans to count, then you don't get promoted."

Tenure requires specific benchmarks to be met, as Hank and Rusty pointed out, "And we joke around that when you go up for tenure and promotion you're evaluated on four things: your refereed publications, the research dollars, number of PhD students, and everything else." Everything else, in this case, referred to teaching, which participant faculty like Rusty and Morty pointed out was not rewarded. Both Rusty and Morty, who had each been teaching for over twenty-five years, also stated that they had been asked by junior (i..e tenure-track) faculty in their department about advice for teaching. Both told the junior faculty members to not worry about their teaching, and to focus on the other metrics that mattered like publications, funding, and graduated students.

Because all participant faculty had expressed being committed to their role within their department, those that spoke about tenure and promotion as it related to teaching were not always positive about it. At the beginning of his interview, Morty was honest about the lack of incentives for teaching:

> the way incentives are provided in most engineering colleges which is that the incentives are for you to publish and do research and get funding from various sources and that's what you're rewarded for both in terms of pay increases, in terms of promotions, in terms of your job security. And in general, in an engineering college, if you're a good researcher you'll probably get promoted and get pay increases just as long as you fulfill the basic obligations of teaching but if you're an outstanding teacher and a poor researcher you'll probably lose your job.

Later in his interview, when discussing his flipped class, Morty stated that it was suggested from those in positions above him to focus less on teaching and more on research. His status as a tenured full professor did mitigate repercussions, however; Morty emphasized that this might not have been the case with a junior or un-tenured faculty member.

Despite the complications of tenure and lack of incentives for teaching, all participant faculty members clearly cared about their teaching and put effort into planning and teaching their courses. When it came to course design, many participant faculty worked with other instructors in their department. In some cases, like that of Jerry, more experienced faculty members worked with junior faculty members to design courses. In other cases, like that of Bob, Rick, and Morty, they took turns teaching a sequence of required classes. Participant faculty members also mentioned the role they played in designing graduate and undergraduate curriculum.

Jerry mentioned that he created or revised courses and then handed the courses off to newer faculty members, which was a result of his department doubling in size over the eight years he had been there. One example that was referenced was a junior faculty member in the same sub-field as Jerry, which made it possible for Jerry to collaborate, share notes, plan the courses, and substitute for each other when one had to go on travel. Unlike Jerry, Rusty's colleagues are non-tenured lecturers. Because the department is small, Rusty and his colleagues do everything as a team: they teach each course in teams of two, they have semester retreats where they evaluate what went well and what could be improved, and they are constant sounding boards for each other in generating new ideas. As Rusty said,

> It's really nice to have colleagues that you're talking through things about, you know? And I miss that with my graduate class. It's just me but it's nice to be able to go to my

> colleagues and say 'well I had this idea, what do you think?'…they come to me with ideas too, it's a starting point. Then we work through it.

Participant faculty also commented that they had a role in the curriculum design process at the department level. It is important to note that the engineering departments of participant faculty do not have one track towards an engineering degree but rather break them up into sub-specialties: for example, an electrical engineering department can have a basic electrical engineering track and specific tracks like power systems and energy or power electronics. In Rick's case, he mentioned that there was a specific group of faculty members in their department who cared about the courses they taught in their area of expertise. It was this group of faculty members who worked together to set the curriculum. Bob stated that he frequently discussed course planning and pacing with the other faculty members who taught the same courses he did, which included Morty and Rick.

Hank talked about divvying up the course assignments with his colleagues, but also about establishing a major part of his own department's curriculum.

> And then we have our design course that everybody has to take, steel and concrete. And we're the only one, only group in the department that actually has that. Most of them have an analysis course as their required course in environmental or transportation or whatever. But this was my insistence that every student will at least know what a reinforced concrete beam is and what a structural steel beam is. They may forget how to design it but at least they'll know what it is….and they will have designed one.

Faculty members have many roles within their departments. In addition to teaching, they are expected to serve on departmental, college, and university committees (Turns et al, 2008). A large department-level obligation of engineering faculty members is to help prepare

documentation related to accreditation. This was not something that was fun for participant faculty, and nearly all faculty members involved with the accreditation process had reservations about it.

As mentioned in Chapters 1 and 2, nearly every engineering or engineering technology department within the United States is accredited by the Accreditation Board for Engineering and Technology (ABET), which has specific standards that accredited schools must meet in order to maintain accreditation. Accreditation matters because graduating from an accredited school means that the degree has been conferred under specific standards and that the engineering program has obtained a specific standard of quality.

ABET was mentioned by nearly all participants as part of their responsibility as faculty, instructors, and stakeholders. Participant faculty were involved in the accreditation process in their department in one way or another, mostly in terms of keeping records, rubrics, and other metrics. Engineering departments establish their own curriculum, with input from faculty members like those who participated in this research, but according to Hank, "ABET has us enunciate, I guess, or write out or identify the objectives that we want to meet and they give us some flexibility in what courses we use to meet those."

Most faculty members focused on the paperwork accreditation required. Bob and Morty spoke the most about it since they were the most involved participant faculty members due to respective roles within their department and college. They both commented on ABET being process-oriented, with faculty members having to provide documentation on how they achieved their goals and what their plans would be if students failed to meet certain thresholds (which, Morty pointed out, are usually set by the colleges themselves). As Morty explained, "we have accreditation and accreditation requires that we cover certain topics. It is so general - they

appear to be so afraid of being prescriptive that for you not to meet those requirements in your curriculum would simply be malfeasance. It would take extreme negligence."

Paperwork and vagueness were just two things that bothered faculty where accreditation was concerned. Bob disliked the process-oriented nature, and Jerry did not think it was the best system for evaluating and making changes in higher education, but it seemed to be the most expedient considering the scale of accreditation. Morty, however, took Jerry's critique of its evaluation process further. He commented that:

> we all know without having these different students what students are good at and what they're not good at. We don't need these specific things like teams, ethics, blah blah blah. We know what they're good and bad at, we are always - even the people who are research oriented - try to change their courses so that where they're weak, that they spend more time or change the way they lecture so students improve.

For Morty, ABET did not really evaluate student preparedness:

> what accreditation should be is that it should ensure that when a student finishes a program, that they have achieved a certain threshold of expertise in that major. For example, if you graduate as a civil engineer, you should be able to design a bridge so that it doesn't go down in a windstorm.

ABET appeared to enforce a different way of evaluating students that was counter to how participant faculty evaluated them based on their years of personal experience as instructors and researchers in their field. This did not seem to sit well with faculty, who seemed to value their autonomy and their own roles with their courses and with their department.

Instructional stakeholders

In their individual courses, faculty members created course objectives, adjusted course deadlines, moved content around, and made modifications to the course schedule as needed. Their individual courses were also impacted by their beliefs about teaching and learning. For example, Morty used grades and other data to measure what worked and what did not, so he could adjust his teaching. Morty flipped an introductory class that he taught, and within three years grades went up across the class by two-thirds of a letter grade. He asserted that the nature of the flipped classroom made students more engaged in the material, and even went so far as to tell students how they should view the videos he made: by speeding up the playback speed which, according to research, helps students process better.

Morty was the only faculty member who flipped his classes, but for others, teaching meant putting ideas into practice. Examples included demonstrating how to solve problems, program, run an experiment, or write a technical report. For participant faculty, actively being involved in the instructional process was critical for student learning.

Every faculty member interviewed mentioned that working through problems – either on a whiteboard, on a computer projected onto a screen, or integrated part of a laboratory class meeting – was a major component of their teaching methodology and an important part of learning in their course. Participant faculty emphasized that they felt like students needed to see them solving the problem to learn how to do it correctly. Rick's explanation for this was as follows:

> So I like to do a lot of live programming in class so you might explain a concept or an algorithm but usually until the students actually do something they don't learn it, so in class I'll often take a problem, either one that I've made up or one from Top Coder or some external source, and then I'll go from the top and from start to finish programming

> it live in class with the student…**when you make mistakes, they get to see how you fix mistakes**. (emphasis mine)

All participants also agreed that having students work through problems was a critical component of their course, though what this meant in practice varied between participant faculty. Some faculty members, like Morty and Dean, mentioned that making mistakes was a way for students to learn. This idea echoed Rick's belief that students needed to see him make mistakes to learn. Morty, who flipped his introductory class, thought that students benefited from making mistakes themselves. He said that:

> And not only that but when they attempt the problem, even if they fail I think they're much more dialed in when you then go over the solution. They're invested in it. Where if you simply go over the problem and they've never attempted it, they are not invested in it and they may not even understand - at least if they attempted it, they understand what the problem was trying to teach them.

In Dean's laboratory class, he did what he could to ensure that there was room for testing hypotheses and becoming comfortable with the idea of failure.

> I also realized that, you know, the experiences in my life which were the most educational were those where I was able to make mistakes, where people put me in a situation or where I got to try something myself and I got to look back and say did it work or did it not work or did I get the anticipated results? Fundamentally that's where all of my teaching style comes from is giving them a chance to make mistakes.

For Dean, learning was an active process that required him to let his students fail, and for him to help them learn from their mistakes. A major component of Dean's course was writing lab reports, which were a necessary standard for ABET. After students turned in their first

laboratory report, Dean sat down with each student and graded their lab reports with them. Part of this was to help them with their writing, part of this was to help them with their efficacy, but he also did this to help them because, in his words, they were all in this process together:

> since I get to teach them over a three course sequence I don't have to fix it all in one semester and that's why I think our students are becoming much better writers is because that's where I think the continuity of my position has really made a big difference in the department.

Other faculty members felt that it was necessary for students to follow them step by step because it forced them to be alert and engaged. For Hank, working through a problem was less about mistakes and more about students being awake and alert: "If I put (the problem) on the blackboard, they gotta be awake, they gotta keep up, they gotta work. And I develop it right there, we go along together – what's the next step, and together we work through the problem." Rusty also stated that most of the class he teaches is working through examples that are projected on the board and then assessed using clickers, or devices that allow students to interact and stay alert through polling or problem-solving during in-class quizzes. Jerry also talked about trying to maintain engagement through switching between modalities:

> Students zone out with PowerPoint so I go more towards – now I write on the blackboard…whiteboard, and in some rooms they have the overhead projector display so I find there's a lot more engagement with the students if I'm writing something and they follow along and write it as well, instead of me just droning 'well you go from Step A to Step B' and you're going through the PowerPoint slide and it's so easy for students to drift off with that.

Emergent themes summary

The three major themes that emerged from the interview transcripts, syllabuses, and course documents present a picture of engaged faculty members who value their position as stakeholders, who want to communicate with students, and who use their syllabuses to communicate course information. In the next section, I will share my narrative of the activity that emerged from the themes before completing an activity systems analysis.

Activity narrative

In this section, I will present a narrative of how the emergent themes – common syllabus elements, connecting with students, and faculty as stakeholders – portray a complex human activity. In the following section, I will then use activity systems analysis to dig further into the activity of participant faculty using the syllabus and other tools, like their position a stakeholder, to the course design activity.

When participant faculty wrote their syllabuses, they were often straightforward and included pertinent information relevant to students as they completed the course. Syllabuses contained contact information for the participant faculty and any TAs or co-instructors, as well as class meeting locations and office hours. The grading policy and grading scale was outlined, and textbooks or other materials listed or linked. Some syllabuses contained an outline of the course or a tentative schedule, or the schedule was given to students in a separate document. Participant faculty also created additional documents with more information about homework assignments or projects. Overall, participant faculty members did not use their syllabuses for more than sharing relevant course information.

When participant faculty maintained a course website, they often shared more information than what they provide in the syllabuses. Rick and Morty, who had course websites, used their website as a way to elaborate on their syllabus. Some of what they included were tips for succeeding in the course (i.e. watching the course videos and coming to lecture), but there were also personal anecdotes and stories related to their professional experiences and beliefs. For example, Rick included a personal statement about how he felt about cheating: "If you cheat, you deserve to be kicked out of school. Does that statement make my views on cheating clear enough? It absolutely disgusts me."

Course websites also allowed participant faculty to elaborate on topics that may have been overlooked in a printed syllabus. Rick and Morty also included elaborations on their policies about turning work in, attending class meetings or lab sections, or other relevant observations from their years of teaching. This include the following statement from Morty about course attendance:

> This may sound harsh but the past few times I've taught the course I've discovered that students have started to flounder on some of the later topics in the course, such as Python, concurrent programming, and functional languages and the primary reason seems to be that students are skipping class in order to catch up on assignments in other classes.

Course websites allowed participant faculty more space to expand on their beliefs and their ideas related to teaching outside of the confines of the syllabus. Statements or anecdotes on course website were usually honest, sometimes humorous, and always demonstrated that participant faculty like Rick and Morty cared about their students' success.

Participant faculty used their lived experiences as faculty members to influence their decision-making process. Often these lived experiences were grounded in years of teaching or

being an engineer. Drawing on their lived experiences allowed participant faculty to focus on making their course meaningful for their students.

All participant faculty members expressed satisfaction in teaching, and in their role as an educator. Bob referred to the "lightbulb" moment when a student finally understood a concept. Rick talked about students coming back to see him after they graduated, sharing how well prepared they were after they left his class. And Hank shared that, even after years of teaching, the newness of each group of students was part of the fun:

> Sometimes, I know there have been a couple of times that I would think, starting a new quarter or new semester, that I have taught this stuff how many times? Ten times, twelve times? And it's simple stuff - its Newton's laws basically - and then a little bit of friction whatever whatever. And then I will start teaching and halfway through the first class I'll look around out there and say "These people don't know this." And it's - I'm teaching old material but they're new people.

Participant faculty also wanted to connect with students in their classes. Participant faculty demonstrated that they put effort into understanding their students' needs and trying to connect with them as they taught. Many faculty demonstrated concern for student learning in light of issues that could arise during the semester and effect the course schedule by adjusting the course schedule as needed, giving more time to certain topics or reducing the number of days if a class understood the material quicker. Some participant faculty knew the number of days it would take to cover the content, and others adjusted based on seeing how students did with the material. They would move exams if needed as well. As Jerry said, "When I make the changes myself, I think I'm doing it for the betterment of the students so I have a positive feeling about it."

As part of caring about students, participant faculty also expressed frustration with their students at times. A common cause for frustration was not reading the syllabus or emails from faculty. Another cause was not spending time trying to find answers to their questions and instead immediately asking for help. A common solution to the problem of wanting instant answers was in having discussion boards for students to ask and answer each other's questions. Like Rusty stated,

> It makes sense – a student wants an answer and I think it's best for them to get the answer right when they're working on the problem, so if they ask the question although we look at the discussion board a lot, evenings, and weekends and stuff, it's going to be a couple hours most likely, you now. So they post it at one Saturday afternoon and at 4:00 I look at it as well they're long since moved on to something else so if they can get their answer right then it's the best. I think answering three hours later is better than waiting until Monday.

Participant faculty also could be frustrated by the focus of the students on their grades or the potential embarrassment of making a mistake. Rick and Dean wanted students to learn from mistakes, and so they made their class a place where that was possible. Jerry saw the bigger picture beyond grades, and wanted students to worry less about the letter on their transcript and more on the knowledge gained in college.

Participant faculty found that their teaching practice was important to them both in their role as a stakeholder in the department, and in their teaching role as they helped prepare future professionals. Participant faculty members put their best effort into teaching despite the fact that teaching can be perceived as being less important than publishing or graduating students. Rusty, Hank, and Morty all mentioned that teaching was not incentivized, and that faculty who were

fantastic teachers could fail to earn tenure if they did not put enough energy into research or publications. However, six of the seven participant faculty in this study were already tenured or were teaching faculty, which did not carry the constraints of tenure; as a result, the tenure and promotion expectations seemed to not influence their feelings or actions regarding teaching. That was of less important than their role as stakeholders within their departments.

Participant faculty emphasized their role as a stakeholder, which was apparent in how they talked about their course. Like Bob said, "…we own pretty much all our (courses), all the way from 100 level. So if it's good, it's because we're good, if it's bad we own it and we fix it." Many participant faculty worked with others in their department: for example, Bob, Rick, and Morty all taught the same course sequence, so they often discussed teaching. Jerry often handed off his courses to incoming junior faculty, or collaborated with other faculty members in his department. Rusty worked with a team of instructors in his department, and often bounced ideas off of them. Sometimes, the participant faculty helped determine curriculum, adjusting where they thought it was needed, and working together to ensure that their department maintained accreditation, despite their personal reservations about the current process-oriented nature of the accreditation process.

Faculty members emphasized their goal of having students leave the classroom with a strong understanding of the core concepts of the class, as part of their discipline of engineering. The faculty members ensured student learning in a variety of ways, including using technology like discussion boards, of creating their own textbooks based off notes. In the class itself, participant faculty used a variety of teaching methods. Morty tried to innovate their classes despite the lack of incentives from departments and colleges. By focusing on the fact that student grades were raised by two-thirds of a letter grade by flipping the classroom, and by

seeing how much more invested students were in the content, Morty was able to see how his time investment paid off:

> And not only that but when they attempt the problem, even if they fail I think they're much more dialed in when you then go over the solution. They're invested in it. Where if you simply go over the problem and they've never attempted it, they are not invested in it and they may not even understand - at least if they attempted it, they understand what the problem was trying to teach them.

Demonstrating how to solve a problem, including making mistakes, was something all participant faculty members emphasized in their teaching practice. Some, like Dean or Rick, wanted students to see their mistakes or make mistakes of their own, like Dean pointed out:

> I also realized that, you know, the experiences in my life which were the most educational were those where I was able to make mistakes, where people put me in a situation or where I got to try something myself and I got to look back and say did it work or did it not work or did I get the anticipated results?

Others, like Hank or Jerry, wanted to keep students cognitively engaged. Hank stated, "If I put (the problem) on the blackboard, they gotta be awake, they gotta keep up, they gotta work. And I develop it right there, we go along together – what's the next step, and together we work through the problem."

Activity systems analysis

After writing the narrative of the findings, I used activity systems analysis to understand the data as it related to my research questions, which are:

1. How do engineering faculty approach planning and teaching their course?

2. How do engineering faculty use their course syllabuses and related documents in the course design activity?

In the following section, I will share the activity for each research question. In activity systems analysis, object-oriented activity is the unit of analysis (Yamagata-Lynch, 2010). This is done using Engeström 's model of activity systems, which is drawn as a triangle model. The top triangle is Vygotskys' subject-tool-object mediated activity triangle, which focuses on the individual involved in the activity. The lower part of the overall triangle – the rules, community, and division of labor – bring socio-historical context into the object-oriented activity. Tensions, or systemic contradictions, are found in the activity when the conditions within the activity may hinder the subject's ability to achieve their goal (Yamagata-Lynch, 2010).

Activity 1: Participant faculty and their courses

In this activity, participant faculty were the subject who engaged in the activity with the object of preparing for and teaching a semester long course. The outcome of the activity was to ultimately have students acquire enough knowledge in the course so that they would be able to build on it and continue on in their professional careers. An additional outcome was for the faculty member to finish teaching the course for that semester with the possibility of teaching it again in the future. In this activity, there were several tools: the participant faculty member's position as a stakeholder; the participant faculty member's lived experiences as professionals and educators; the course syllabus; the course website, including the course LMS like Canvas or Blackboard; additional course materials needed for the class; and the course data related to the class, which includes student feedback, formative and summative assessments, and grades. In

this activity, the lived experiences of the faculty members counted as one of the tools because previous courses and the prior lived experiences of the faculty member helped them develop the course syllabus.

Expanding the activity system further, the rules that bound the activity were the ABET criteria they must satisfy for accreditation, graduation requirements decided by the department and the college, and any requirements of faculty by their department and college like course load, requirements for tenure and promotion, and so on. The community of the activity included the students in the class, the department which includes faculty peers and graduate students, the college, and the external community of the discipline itself. Finally, the division of labor of this activity included the participant faculty member, any teaching assistants or co-instructors including guest lecturers, and other faculty in the department.

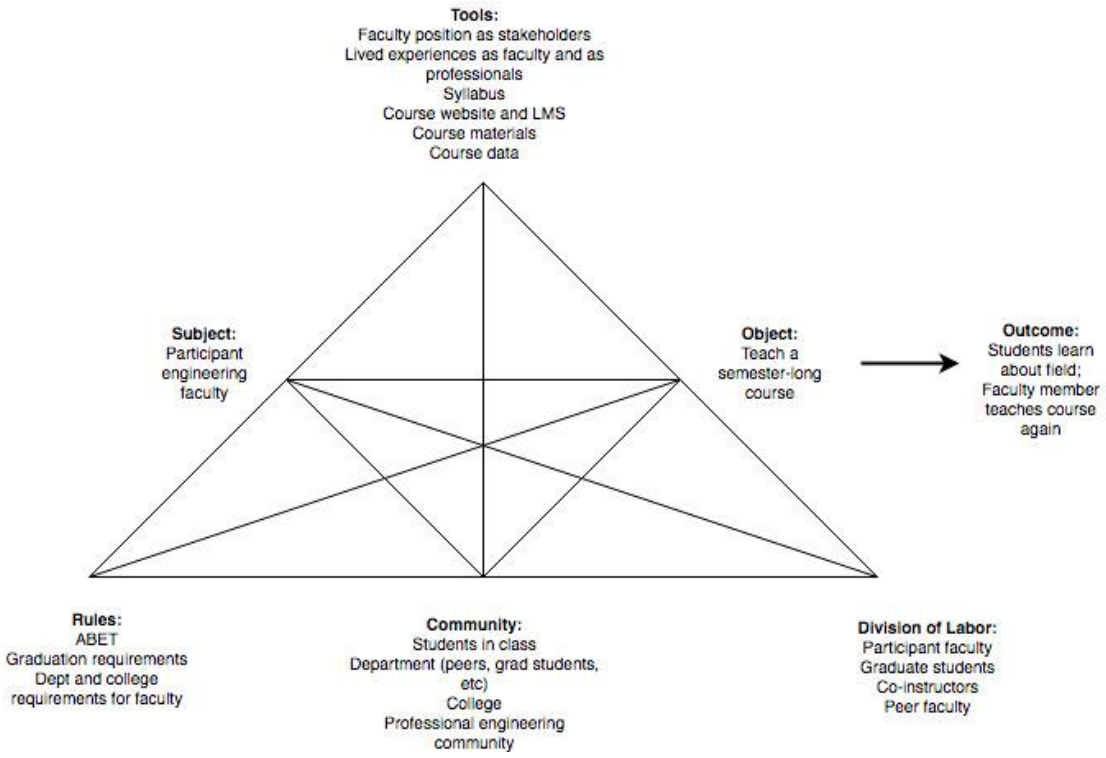


Figure 3. Overall Activity as participant faculty engage in teaching a semester-long course.

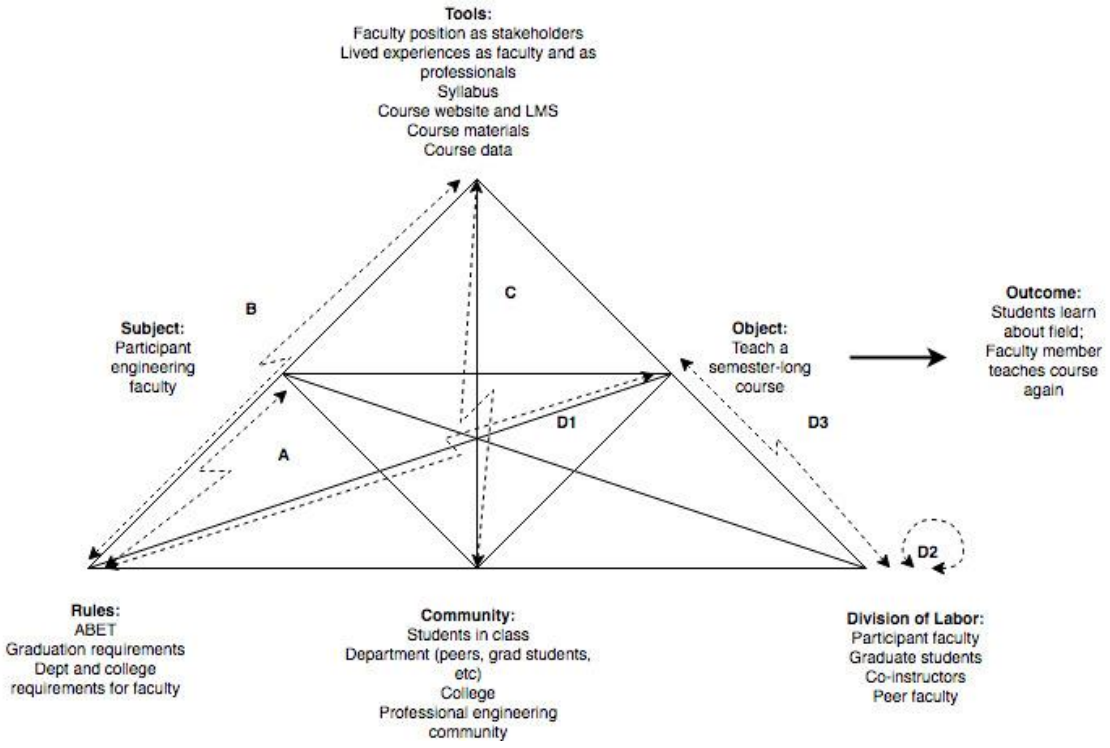


Figure 4. Activity 1 with identified tensions

As analysis progressed, tensions were identified that impacted the activity (see Figure 4 for tensions). According to Engeström (2001) tensions are not problems but rather pressures that result in change within the activity. As a result, the tensions identified here are areas of contradictions that had the ability to create change within the activity. In the above activity, the following tensions were identified:

A. Tension between subject and rules

B. Tension between tools and rules

C. Tension between tools and community

D. Tension between rules, division of labor, and the object of the activity

Tension between subject and rules

Rules have the potential to create sources of tension for participant faculty which could either help them engage in the activity, or prevent them from completing the activity. In the case of the rules of this activity, the rules sometimes a created something useful, or gave faculty members additional work.

Sometimes, needing to change a course for external reasons yielded positive change. For example, Dean taught a three-course sequence of required lab courses needed to graduate. The course sequence was based on the graduation needs of the department, and some elements of the course were required for ABET accreditation. Instead of being something that could cause problems, Dean saw the three-course sequence as an opportunity for him to work with his students and help them build on their skills – specifically their ability to write lab reports – over the three courses:

> since I get to teach them over a three-course sequence I don't have to fix it all in one semester and that's why I think our students are becoming much better writers is because that's where I think the continuity of my position has really made a big difference in the department.

Other required course sequences, like those taught by Bob, Rick, and Morty, allowed for collaboration between faculty members that resulted in discussion between faculty and improvements to the course. Rick had mentioned having faculty in his department who care about a certain topic as a positive benefit, and that they all seemed to be aligned with the goals of the course sequence. Sometimes, when faculty worked as a team, it was also positive. Rusty and his co-instructors taught courses that were required of all incoming engineering students, and which followed a program outlined by the College of Engineering. Within these parameters,

Rusty and his colleagues were able to make modifications, but the parameters and working as a team helped confine the course to specific content. The changes they made often focused on innovative course delivery options, like the flipped classroom model that Rusty was considering.

Other rules bound the activity in a more constricting way. ABET accreditation was something that emerged as a potential impediment in the object-oriented activity. As discussed in the narrative summary, most participant faculty mentioned their role in the ABET accreditation process and some expressed frustration. Critiques centered around the feeling that ABET assessment was counter to how faculty already assessed their students. Morty had pointed out that faculty could informally assess student performance without the forced rigor of ABET:

> We know what they're good and bad at, we are always – even the people who are research oriented – try to change their courses so that where they're weak, that they spend the time or change the way they lecture so students improve.

Additionally, the requirements of engineering faculty members had the possibility to create difficulties. Rusty pointed out that teaching did not matter as much as publications, graduated students, funding, or other metrics. Hank stated that, "you could be the best teacher in the whole wide world and if you don't have the research and publications, then you don't have enough beans to count, then you don't get promoted." Morty flipped his classroom only when he was a tenured full professor, and there was still concern that he was not publishing enough, or spending too little time on research.

The rule of prioritizing research over teaching could have created problems when participant faculty worked on their courses; however, that did not seem to be the case here. Because participant faculty were all tenured or teaching faculty, the rule created less tension for

them now than it might have at different stages in their careers, such as if they were not tenured. Instead, it was something that existed but which did not need to be followed exactly.

Tension between tools and rules

Rules like graduation requirements can create the structure of the course, inform the way that faculty may structure their course materials like their website or digital tools like an LMS, and impact not only the grades or feedback from students but also how it is evaluated year after year. In Dean's example discussed earlier, ABET's specific writing requirements affected what students learned and the syllabus and course reflected that. But a course syllabus, course materials, digital tools, and even data are tangible tools that can be physically changed. A course syllabus can be updated to include ABET standards. A course website can provide information on requirements for graduation. Less obvious are the mental and psychological tools that help faculty members throughout the semester. This tool draws from their experiences as faculty members, as educators, as engineers, and as stakeholders in the department.

Tension can exist between how participant faculty used their experiences as educators during the activity of preparing for and teaching a course in light of requirements for assessment from ABET. Morty, Bob, Hank, and other participant faculty remarked on their ability to assess students by means other than the more formalized standards of accreditation. Being able to informally assess students meant relying on their prior experiences as educators to guide their decision-making. Like the tension between the subject and rules, participant faculty had reached a point in their career were the tension was not of the scale it could have been earlier, when participant faculty were less-experienced. In this activity, participant faculty used their lived experiences as instructors to assess students. They also used the lived experiences to

accommodate what ABET wanted in terms of rubrics and guides, but when it came to their own courses, they relied more on their years of teaching.

Tension between the tool and the community

Not reading the syllabus or not engaging with the syllabus created tension between the tools and the community. This was because students were not using a tool created by the faculty member for a course. Another form of tension was the fact that, if students were using it - like those who were reading the grade scale - they were only using it for a fraction of its intended purpose. Participant faculty used the syllabus to communicate course guidelines and objectives, as well as when things are due and how. According to participant faculty, not all students paid attention to due dates; Dean pointed out that he thought students would be happier if he texted them the information instead of having to read it on the syllabus or in an email. Bob had commented on students asking questions about information clearly explained in the syllabus on the first day of class. This was frustrating to faculty, and could explain why, as Hora (2016) pointed out, some faculty barely revise their material year to year, relying on what works because of all the requirements of their jobs.

The community not using the tools provided also applies to the use of course websites, LMS, or other course materials. Morty shared videos of his flipped classroom on his website, but he made a note on the site that student success was dependent on watching the videos before class:

> If you have watched the video lectures and come to class then you should find the quizzes relatively easy to complete. If you simply read the class notes, there is a good chance you will be able to complete the quizzes, but the video lectures will add additional

details, so you may not be able to answer every question by simply reading the notes. Additionally, you will probably find it problematic to answer the questions if you do not watch the videos.

Morty's long note on his course website was meant to address the issue of students not using tools to complete the course. By clueing students into the usefulness of the tool, it had the potential to mitigate whatever problems occurred when students did not take advantage of the course materials offered to them. The community failing to use the tools offered hindered their ability to learn the material and succeed in the course, and also meant that syllabuses and course websites needed additional instructions to direct the student. The lived experiences of faculty members meant that these instructions reflected their understanding of student behavior and were another way to help with the potential for problems, turning the tension into a learning experience.

Tension between rules, division of labor, and object of the activity

The final identified area of tension was between the object of the activity and the differing values of the rules and division of labor as they mediate the activity. This area of tension spans multiple components of the activity – specifically, the rules, the division of labor, and the object itself. This is a possibility, as Yamagata-Lynch (2010) points out, because "components in an activity system not only mediate each other for the subject to attain the objective but can mediate each other to stop the subject from attaining the object" (p.100). In this case, the rules and the division of labor each have the potential to create contradictions within the activity as the subject moves towards their goal.

There is tension between the rules, and the object of the activity. The goal may be teaching a course, but the multiple facets of the rules – ABET, the content requirements of courses needed to graduate, the departmental or college standards related to faculty members – influence different parts. For example, a faculty member teaching a course may struggle with spending time on the course itself because teaching, as Morty pointed out, is not incentivized. As a result, they put less time into the course and reuse their content (Hora, 2016). Another example might be that a faculty member may also put less time into a course when they are the only ones teaching it, without graduate assistants or co-instructors, because they do not have the time to spare.

In this activity, participant faculty were often the only ones planning a course, creating internal tension within the division of labor. Because participant faculty were ultimately responsible for the course content and delivery, this created time constraints which, depending on circumstances, could also create complications. Rusty was the only participant faculty member who planned and taught their courses with a co-instructor. While Jerry had guest instructors, he still completed the majority of the course planning and preparation. As shown in the syllabus analysis of Bob's syllabuses, undergraduate classes that were taken by freshman and sophomores had additional support from graduate students. This changed in the upperclassmen courses (400 level) and disappeared entirely with graduate courses. Bob was not the only professor whose received support for their large undergraduate classes: all participant faculty who taught undergraduate courses had graduate teaching assistants for grading assistance and help, but the planning was ultimately the responsibility of the faculty member.

Outcome

The outcome of participant faculty who pursued the object of teaching a semester-long engineering course was that students who completed the course would continue on in their professional career, and that the faculty member would continue to teach the course the next semester that it would be offered. In this activity, participant faculty members continued to teach their courses, which ensured that the outcome was continually met each semester. Consistently meeting the outcome can be seen as demonstrating that the tensions that exist within the activity do not prevent the activity from attaining its object but rather enhance each attempt through multiple iterations. With each iteration, participant faculty's use of their lived experiences as a tool in the activity helped them to continually achieve their object.

Activity 2: Using the course syllabus in the course design activity

In this second activity, participant faculty were the subject engaged in an activity with the object of creating a syllabus or a website with specific intentions. The first intention is that the syllabus communicated course standards to students effectively. The second intention was that the participant faculty would be able to prepare, administer, and teach a semester-long course. The outcome of the activity was that faculty created a model course that they could build upon in subsequent semesters, learning from their successes and failures. This activity differs from the prior activity in that the emphasis was on the syllabus, or a course website, as the primary tool.

The rules that bound the activity were portrayed in two separate categories: the internal influences of the faculty when it comes to teaching, learning, and course administration, and the external influences that come from departments, colleges, and universities. The community included individuals that the faculty member worked with in the department like graduate

teaching assistants, co-instructors, or other instructors who teach the class. As seen in Figure 5, the division of labor was practically non-existent – most course design and syllabus writing were done individually and independent of others unless a faculty member was working as part of a team or they were using materials someone else passed on to them, as mentioned in the earlier activity. In both this activity and the prior activity, the division of labor consistently had an internal tension.

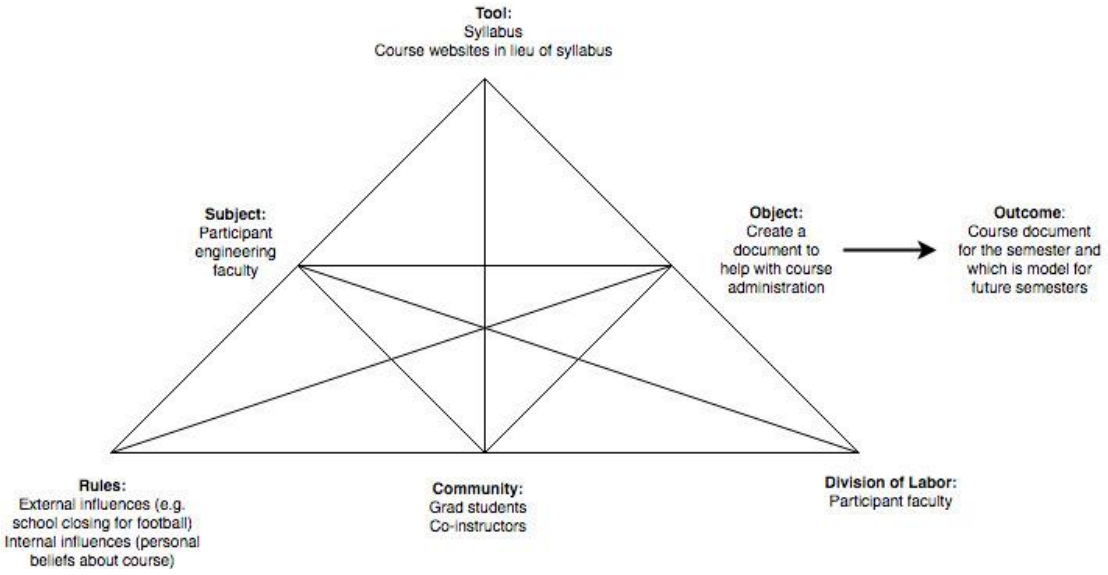


Figure 5. Activity 2

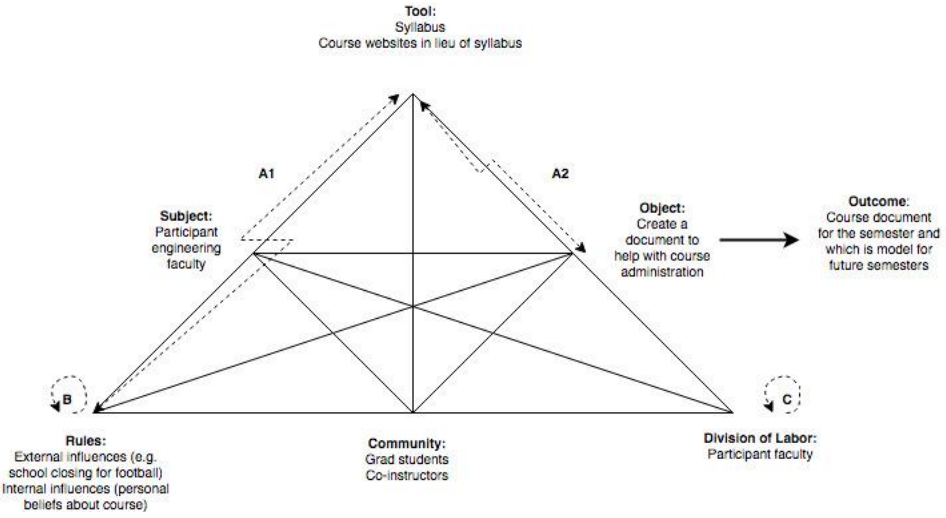


Figure 6. Activity 2 with identified tensions

The following tensions were identified in the activity system in Figure 6:

A. Tension between tools, rules, and object (A1, A2)

B. Tension within rules

C. Tension within division of labor

Tension between tools, rules, and object

Tensions were found between the syllabus and the rules. In this activity, it took the form of external influences like university closings modifying the syllabus schedule. Modifying the schedule created problems with completing the object of the activity, preparing and administering a course. While participant faculty had experience with knowing how long it took to cover requisite material, it nevertheless upset their schedule to miss class. However, participant faculty expressed that moving around dates was something they agreed with more when it was their call, not external. Closing the university for football upset the entire schedule

of the university on short notice, which meant that participant faculty had to be more flexible than normal. In this case, it took away a day that many classes met and added more at the end of the semester, as well as changing the time for exams. Participant faculty adjusted their schedule to this change despite the difficulty it caused because they had already allotted a set number of days to specific material.

Participant faculty were not averse to updating the syllabus – especially the course schedule. They seemed to be willing to accommodate student learning as well as external factors. The syllabus or course website was also influenced by their own internal beliefs about the course. The syllabus or course website was designed to be a way to communicate course guidelines but also was a fluid document that was updated as needed. Participant faculty like Hank moved exam dates around if students requested it, because the schedule was tentative and what was more important was learning. All participant faculty expressed beliefs that the syllabus, and especially the course schedule, was a tool that could be modified when needed. Faculty who had a course website, like Morty, expressed their appreciation for the dynamic nature of a course site because it meant that modifications could be made quickly when he deemed it necessary.

Tension within rules

All participant faculty members stated that they would modify their course schedule if needed, but preferred that the decision came from them. Extending deadlines, moving due dates, re-teaching material was important for student learning, but also fulfilled their role as stakeholders within the course activity. When they were told by external sources – the university, the college, ABET – to change something, that was a different circumstance. Shifting dates

around for a university football closure was met by frustration but ultimately it did not prevent the activity from being completed. Participant faculty still completed the course on a modified schedule.

Outcomes

The object of this activity was that participant faculty would create a course document that communicated important ideas related to the course and which would help them teach the semester-long course. The outcome of this activity was that participant faculty have a syllabus that allows them to have a model course they can follow year to year. In this activity, participant faculty continually enhanced their tool (course syllabus) semester to semester by engaging in multiple iterations of the activity. When complications arose like the university closing for a football came, or students asking that exam dates be moved back, participant faculty adapted as needed. The university closing was a frustration that had the potential to affect the entire activity but the existing tool and the internal beliefs of faculty made it possible to mediate the tension and pursue the object. This highlights the situation aspect of object-oriented activity.

Conclusion

In this chapter, I have shared what themes emerged from the data, as well as how those themes were reflected in the two activity systems shared above. Focusing on the common syllabus elements, the importance of connecting with students, and the role of stakeholder that participant faculty had helped to elaborate on the phenomenon related to the activities participant faculty engaged in as they wrote their course syllabus and taught their courses. This chapter has been focused on sharing the data; Chapter 5 will elaborate on the findings and provide discussion, as well as directions for future research.

Chapter 5: Conclusions, Implications, and Recommendations

This dissertation focuses on understanding what instructional choices engineering faculty members are making in lieu of adopting newer teaching strategies discussed in engineering education literature. In this chapter, I will share the findings of the activity systems analyses completed in Chapter 4, as well as any implications that can be drawn from the findings and how that might affect future research in these areas. First, I summarize the activity systems analysis before sharing the findings from the activities. Then, I will look at areas of future research based on the conclusions that I have drawn. Finally, I will also re-evaluate my own positionality at the end of this study.

Activity systems summaries

In the first activity related to the research question *How do engineering faculty approach planning and teaching their course?* the subject of the activity were participant faculty engaged in the activity of teaching a course, with the outcome being successful course completion for both the instructor and the students. Tensions within the activity involved the rules that restricted the activity, including departmental requirements (i.e. promotion, publication, tenure, committees) and ABET accreditation standards.

In activities, tensions between different parts can sometimes prevent the activity or can enhance the activity (Yamagata-Lynch, 2010). While there were instances where the presence of tensions enhanced the outcome, for the most part the tensions that existed minimally affected the participant faculty from engaging in the activity. Participant faculty members were able to use mental tools, such as their positions as stakeholders and their lived experiences as educators, to mediate the activity constructively, making the rules less prohibitive. Faculty relied heavily on

these specific mental tools because other tools used in the course – the physical course syllabus and related documents– were not fully realized as a shared tool by all students. Failure of the community to recognize the value of a shared tool means that another must be used to mediate the activity and to help the subject achieve the object. In the case of engineering faculty, the tool that is most important is their beliefs about their position as stakeholder, and how their lived experiences as faculty created and in turn influence those beliefs.

The course syllabus was not the sole tool that helped participant faculty plan or teach their classes, even though it was an integral tool. In the second activity related to the research question *How do engineering faculty use their course syllabuses and related documents in the course design activity?* participant faculty were engaged in writing a course syllabus that communicated course objectives and course schedules, with the outcome that the syllabus would be used whenever participant faculty taught that course. Within this activity, there was tension between the syllabus and course website/documents, and the external and internal rules that could change each semester. In this particular example, an external factor was the university closing for a football game, which forced participant faculty to revise their course schedule.

Participant faculty did not hesitate to revise their course schedules and syllabus based on their own internal beliefs; for example, participant faculty stated that they would shift exams and move other dates if students approached them and asked, or if they needed to reteach or review a topic. But when external factors like the university closing presented complications because they introduced a tension, faculty used their own internal beliefs to meditate any external factors and to continually revise their tool (syllabus) to continually engage in the activity.

Activity findings

There are two important findings of the activities I described. The first is that faculty used their lived experiences and their position as stakeholder to overcome any potential tensions within the activity. The second finding is that the syllabus is a tool which is continually revised and enhanced each year, but there may be more to the syllabus than just being a tool in the activity, and what role it plays in the activity may mean re-examining the role of the syllabus as a sociocultural tool. In the next section, I will elaborate on both of these findings.

Stakeholders and experiences

The first research question, *How do engineering faculty approach planning and teaching their course?* can be answered easier than the second research question about the role of the course syllabus. In response to the first research question, this study can make the claim that faculty use their past experiences as instructors and as stakeholders as a tool to help them make course decisions, determine course content, and to teach their courses. This itself is not a new idea, as the literature states that instructors base their teaching off prior experiences (Kane, Sandretto, and Heath, 2002; Lindblom-Ylänne et al, 2006; Oleson and Hora, 2014). What is different about this finding is the place of the lived experiences, let alone positionality, as a tool within a mediated activity.

When researchers discuss the influence of faculty beliefs on teaching, the perspective is about all faculty across disciplines, and narrowly about how they teach or interact with students. The research context usually relates to teacher-centered versus student-centered teaching or how faculty teach as they were taught. Franklin (2013) brings a newer perspective of how her participant's identity as a phenomenologist directly impacted his teaching and his course design

decisions. Because he was a phenomenologist teaching a class about phenomenology, his lived experiences could be considered a tool that aided in his course planning and teaching.

Additionally, Franklin's phenomenologist was a stakeholder in his classroom. He was training a newer generation of phenomenologists, and as such had a stake in ensuring that their experiences within his classroom prepared them to do phenomenological research. This is similar to the position of stakeholder adopted by my participant faculty when it came to their teaching, and their departments.

Stakeholder is not an idea that appear in literature about engineering faculty members as a position that they might adopt as they teach, and when coupled with lived experiences bring a different perspective to understanding how it influenced participant faculty in their classrooms. During interviews, all participant faculty assumed ownership of their course, and their planning and teaching work. Teaching was a responsibility that they shouldered proudly, and their success as educators made up a non-trivial part of their identity as faculty members. They still identified as stakeholders despite the fact that many of them pointed out how little teaching is rewarded or incentivized in colleges of engineering. The tools included lived experiences and the position of stakeholder, and these mental artifacts managed to mitigate any potential problems. This might be because most of the participants had been teaching for over twenty-five years and focused more on what they believed to be important from their experience as opposed to any external rule imposed on them, like ABET.

Because nearly all participant faculty were already tenured, and the remaining participant faculty member, Dean, was a non-tenure track teaching staff, this meant that they did not need to worry about some external pressures related to promotion and tenure the same way that junior faculty might. They had already been promoted, or promotion was not an option for their job

category. The rules of promotion and tenure could potentially to influence the activity (Matusovich et al, 2014) but, in actuality, had very little influence on the activity itself due to the tools that faculty members used related to their experiences and position as stakeholders.

A conclusion that can be drawn from this finding is that faculty members lived experiences and positionality, when validated through awards, through success at teaching, and through the successes of students in their courses, can be a useful tool for future practice (Morris and Usher, 2011). Because efficacy is future-focused and predictive based on prior success and failures (Fives and Looney, 2009), faculty can use this to inform their teaching practices. Most importantly, they may not need to try new ideas if they feel their old methods are working, and have the proof in student grades, student feedback, teaching awards, and other measures that matter to them. As such, they may not adopt newer pedagogies but rather continue to teach the way that experiences shows were successful.

The syllabus

Because lived experiences as faculty and positions as stakeholders act as mental artifacts or tools in the activity, the question then becomes about the role of the course syllabus as a tool. In Chapter 1, I quoted Hora and Ferrere (2013), specifically:

> Viewing the syllabus as a device underscores the fact that it functions in ways similar to other more commonly studied artifacts such as instructional technology or departmental governance systems, in that it presents to the individual a constrained set of possibilities in regard to future practice (i.e., affordances). The implications of this view are twofold: first, that syllabuses are artifacts created with specific intentions and goals in mind for

users, and, second, that syllabuses will act as important mediators between faculty members' intentions and their ultimate classroom practice (p.245).

Revisiting this quote at the conclusion, I do agree that syllabuses are artifacts with specific purpose, but I do not know if they are mediators between faculty members' intentions and their practice. In the first activity, the syllabus played a minor role and created tensions when students did not fully utilize the syllabus or course documents. While syllabuses were constructed to communicate course information, the course schedule or a course website seemed to be equally important if not more important.

In the second activity, the syllabus was touched only when needed to, but the course schedule was most often adapted by the participant faculty members. They expressed that they did not mind modifying the course schedule themselves but disliked it when the course schedule was affected by external factors like a Thursday night football game. Adapting the syllabus to meet the needs of student learning versus the athletic department was a major point of contention. But, participant faculty once again drew on their position as stakeholder and their established beliefs about teaching and learning formed by viewing themselves as stakeholders.

Based on the findings, a conclusion that can be drawn from this is that the role of the course syllabus may not be straightforward or concrete. The course syllabus may not be a mediator or may not even play a role in course design, depending on the faculty member and the context. The course syllabus may be something more abstract, such as a mental artifact like lived experiences and positionality. This contradicts literature on course syllabuses which position as syllabus as tangible, concrete, contractual, and essential to the structure of the course itself (Slattery and Carlson, 2006; Thompson, 2007). Rhetorically, the syllabus is meant to communicate to a large community that includes students, faculty, and even those within the

discipline or field (Afros and Schryer, 2009) but if different members of the community use (or choose not to use) the tool for its intended purpose, how does that change the rhetorical significance of the syllabus? If the syllabus is not the concrete tool that most of the literature positions it to be, then the role of the syllabus within a course may change. The course syllabus, course website, and related documents are also potentially something different for faculty and students; while faculty members are concerned about transmitting vital course information, student use it for different purposes. The role of the syllabus is not as ubiquitous as originally anticipated, but as an abstraction can be something else entirely.

Implications and limitations

In this dissertation, I sought to understand why engineering faculty members did not adopt newer education practices encouraged by engineering education researchers. My research questions focused on what faculty were doing currently, and how they were approaching their planning and course design. This was because I believed that, by understanding what was currently being done, I could understand why suggested practices were being not implemented and re-evaluate the current state of engineering education.

The findings of this study conclude that engineering faculty members may not adopt the newer instructional strategies because they do not feel that they need to; their experiences as faculty members and their positions within departments as stakeholders validate the ways and methods they use to teach their courses. They tend to acknowledge the suggestions by ABET, by their department, and by engineering education researchers, but ultimately favor the tried-and-true ways that they know work because they have seen it work consistently and because it is something that they have pride and a stake in.

Instead of being worried about innovation, participant faculty worried more about their students understanding what they taught. Additionally, the methods that participant faculty shared as being part of their teaching required students to be actively engaged in the learning process. Participant faculty wanted student to learn through answering questions, working through problems, or watching the faculty member make mistakes. Participant faculty members learned more heavily on ideas about learning that related to constructivism than originally anticipated, and these ideas were less instructor-focused than the literature make them out to be.

Encouraging students to have an active stake in their learning process was different than what engineering educators implied was happening in the classroom. The participant faculty interviewed for this dissertation used a variety of methods, often falling back to what worked which was direct instruction. But instead of lectures and passive learning, participant faculty kept students cognitively engaged throughout. From a teaching perspective, active cognitive engagement is just as important as using problem-based learning to enhance critical thinking. Further, though faculty members did not label their teaching as problem-based learning or other education jargon, many of the same elements of encouraging complex cognitive processes were present in their lessons. This understanding makes it difficult to state that engineering faculty are not innovating in their classes, when there may not be a need to innovate.

Finally, this study differs from many other studies about engineering faculty on its use of cultural historical activity theory and activity systems analysis to provide a holistic look at engineering education. Data collected and shared in Chapter 4, and the themes that emerged, are rich, nuanced, and to a degree unexpected. I believe these findings represent a more socio-cultural perspective on engineering education as a human activity. Most research looks at specific constructs, like pedagogical content knowledge, or adoption of instructional strategies.

Like mentioned in Chapter 2, this research is often tightly-focused, and does not advance a socio-cultural or socio-historical perspective despite calls from scholars like Hora (2016) to enhance the research.

I believe I barely scratched the surface of what can be learned for engineering education using perspectives like CHAT and activity systems analysis. Looking at course design as a complex human activity with multiple demands and tensions is a good start to bringing a socio-cultural perspective to engineering education. One new observation is considering the role that mental and physical tools play when tools are not used or recognized as shared tools by the community. When a tool that is intended to be shared, like a course syllabus, is not shared by the community (students) participating in a joint activity (enrolled in a course), the activity is affected. The lack of use of the tool by some members of the community in this activity changed elements of the social activity (Arievitch, 2008); in this case, it created tensions that participant faculty overcame by drawing on other tools within their repertoire. Because a tool is a cultural product (Wertsch, 2000) and inevitably changes both the subject and the object of the activity through use (Kapetlinin and Nardi, 2012), then understanding how the subject compensates for the community not using a shared tool, or how that changes the object of the activity, is a new possibility.

Limitations

A limitation of this study remains the self-selected participant faculty members. Conclusions for this study may be different if more participant faculty were not tenured or were junior faculty. In Chapter 3, I mentioned not being able to recruit any junior faculty or faculty

from underrepresented populations, specifically women. A significant theme that emerged in this study was the role of lived experiences as determining instructional choices. I do not think that theme would be the same if women or underrepresented populations had been participants in this study. I think there would have been a shift, though I do not know exactly what would have shifted, but I know the lived experiences of faculty would have differed due to different demands.

Future research

I have more questions coming out of this study than I did entering it, but that might be because this topic still has areas for future research. Potential future research ranges from looking more that the community and collective activity to understanding the role of the syllabus.[? check this sentence] In this section, I will share some potential future research topics.

One area would be to complete an in-depth activity systems analysis of Bob, Rick, and Morty as stakeholders within a specific course sequence. All three have been teaching for more than twenty-five years, and have been in the same department for all of them. Focusing narrowly on specific faculty who have experience might provide a unique lens from which to view this topic, specifically if research was conducted by observing their teaching or any meetings that faculty have related to planning. It is probably likely that any planning done by these faculty members is informal, however, but observing them could provide new insight.

Another area for future research would be on how faculty as stakeholders create a community of practice within their classroom. Throughout this research, I was aware of and drawn back to the literature on communities of practice. A community of practice, as Wenger (1998) notes, has three dimensions: mutual engagement, joint enterprise, and shared repertoire.

Mutual engagement, or individuals working together in the same activity or for the same purpose, can be seen in a class because everyone there is looking to learn the information from the faculty member. If students work together with the faculty member, they are engaging in a joint enterprise. Both of the concepts could exist within the classrooms of participant faculty, but it is impossible to confirm this because it is not just participant faculty engaged in a community of practice but also students. In order to confirm mutual engagement and joint enterprise, students would need to be observed and interviewed.

The final dimension of a community of practice is a shared repertoire. This includes the resources created by the community to negotiate meaning. Wenger (1998) states that they "gain coherence not in and from themselves as specific activities, symbols, or artifacts, but from the fact that they belong to the practice of a community pursuing an enterprise" (p.82). Repertoires can include gestures, words, stories, routines, tools, activities, concepts – all produced by the community and integrated into its' practice by negotiation (Wenger, 1998). A course syllabus, course schedule, discussion board, learning management system, or website, can be considered part of the shared repertoire, making this an easier element of a community of practice to find in the data of this study.

A successful study about communities of practice would require the perspective of the students as well as the instructors. After all, it is up to the student to carry forward what is learned in the community of practice. Embedding within a class, following the instructor through a semester, talking to students who have taken the course, all would help elaborate on whether or not these classrooms are actually communities of practice. Future research would be to study one of the participant faculty members as they plan their course, and incorporate student voices and perspectives.

This might be especially powerful because if these classrooms are communities of practice, they were not artificially created like they often are in engineering education, STEM education, or even just general higher education literature. These communities were created organically over many years as participant faculty members grew into their role of stakeholder. They emerged in a way that is usually seen naturally, but often is forced in education. I strongly believe that there is potential in examining what might be a naturally-occurring community of practice.

Another area of further study might involve the team-planning process of Rusty and his colleagues. Rusty was the only participant faculty member who worked as part of a team and co-taught. Understanding how a team changes their syllabus might be an interesting topic of research, especially if they pursue a flipped classroom.

Something that I only started to discover, and which was only briefly touched on, was the idea of a syllabus as a mental model, heuristic, or something else that could be easily manipulated mentally. Hora (2016) talks about this, but re-examining the role of a course syllabus, in this instance, would be interesting. A course syllabus, used by faculty members to communicate and students to understand, is an example of the shared repertoire. A syllabus is a tool that is incorporated into the community of practice through negotiation that gives it meaning. It then becomes a rule of thumb. A course syllabus is also the abstract made concrete (Sfard, 1998). In its abstract sense, it allows faculty members to convey their course design and rules sto students, and for students to understand the course trajectory. In its explicit sense, it's a document and tool that students and instructors can use to set parameters for grades, assignments, schedules, etc. The rules of the class, the schedule of class assignments, the procedures for submitting homework – these elements are abstractions, created by the instructor

as means to an end but given meaning in their participation within the course throughout the semester.

Just as the syllabus is not a legal contract, and more of a guide, it is also not set in stone and consistently negotiated by the faculty member and students. Sometimes the negotiation is overt, like when students ask for an extension because another faculty has an exam scheduled the same as, as happened in Hank's class on occasion. Sometimes the negotiation is more subtle, such as the faculty member re-negotiating the schedule when he can tell that the students have yet to master the material.

From a socio-cultural perspective, understanding if a syllabus fits the criteria for Galperin's orienting object has the potential to provide a new look at syllabuses. Galperin, who was a contemporary of Vygotsky and Leontiev, believed that tools were first externally created and, after repeated usage, became internal mechanisms that helped students learn. A way to think of this is multiplication tables: students start by writing them over and over again, then practicing using them, and finally committing them to memory where they can use them over and over again. Most of the research on Galperin is confined to K-12 and children, but there may be an extension here, Galperin's belief that we move from physical, material tools to mental tools may apply to the syllabus, and may be an area for future research (Arievitch and Hanen, 2005).

I believe that, by working with a faculty member to be present during the course planning process, it might be possible to see how the syllabus can become an orienting object. I think that working with Dean, who is now on his four year of teaching, might be one way to do this. Dean may be reusing the same syllabuses, but because he is still new to teaching and new to the classes, I think it might provide a different perspective. Dean is not tenured, non-tenure track,

and has only been teaching for a short period of time. While he positioned himself as a stakeholder due to the three-course sequence he taught, his position as stakeholder was tempered by his limited experience compared to the other participant faculty, but also his passion for teaching which helps his teaching faculty position. Working with Dean to understand how he plans his courses, how he builds his syllabus, how his syllabus might become an orienting object, and how it informs his practice, might be a rich socio-cultural perspective that I am seriously considering pursuing.

A final thought at the end of this study is who controls the narrative of engineering faculty and their teaching. Everything that I found made sense, to me, when discussing teaching and learning. But the narrative that is emerging in the engineering education literature is that faculty may not care about innovation, when the reality of this specific dissertation is that they do care, but the way they see teaching and course decisions differs from engineering education researchers. Because the discussion seems to be dominated by engineering education researchers, maybe they are the ones who are controlling the narrative and what is being discussed, and maybe this study will validate the lived experiences of engineering faculty. Further studies may also be able to understand what the narrative is in this emerging field, but it is outside the scope of this dissertation.

Conclusion: positionality

When I started this dissertation, I was unsure of what I would find through the use of course syllabuses. As an educator, course syllabuses were a chance for me to put my ideas down on paper and to mentally plan out the course, but I was unsure of how this reflected for engineering faculty as all of the literature implied that syllabuses were not that important and

were very sparse. This conclusion was supported by the data in this dissertation, but what I did not expect was the rich use of course websites by some of the participant faculty of this study, nor did I expect the course schedule to be the heart of the course.

I did find more information about what faculty do in their courses to support my original belief that engineering faculty members were teaching well, they were just not adopting newer teaching strategies. What I did not expect to find was the degree to which engineering faculty saw themselves as stakeholders, or how they used their lived experiences instead of their syllabus in their course design. These insights came through activity systems analysis, and through the socio-cultural approach that I took towards the data collection and analysis and shift my own perception. Because I wanted to understand the entirety of the activity, I was able to see more clearly the ways in which potential tensions impact faculty engaged in the activity.

At the end of this study, knowing the role that experiences and positionality play in engineering educators' course decisions is a satisfying concluding answer to my first question. Working with engineering faculty now, hearing from their students how much they like their teaching, or seeing the effort that they place on their instruction, I feel like I can better understand where they are coming from, even if I cannot relate. I am intrigued at the idea of a syllabus as a mental model, and find that to be a more likely conclusion that needs further exploration.

References

ABET. (2015). *Accreditation policy and procedure manual*. Baltimore, MD: ABET.

Afros, E., & Schryer, C.F. (2009). The genre of syllabus in higher education. *Journal of English for Academic Purposes, 8*(3), 224-233.

Allendoerfer, C., Wilson, D., Kim, M.J., & Burpee, E. (2014). Mapping beliefs about teaching to patterns of instruction within science, technology, engineering, and mathematics. *Teaching in Higher Education, 19*(7), 758-771.

American Society for Engineering Education. (1994). Report on evaluation of engineering education (reprint of 1955 report). *Journal of Engineering Education, 83*(1), 74-94.

Austin, A.E., & Baldwin, R.G. (1995) "Faculty motivation for teaching." In P. Seldin (Ed.) *Improving college teaching* (p.37-45). Bolton, MA: Anker Publishing Company, Inc.

Baecker, D.L. (1998). Uncovering the rhetoric of the syllabus: The case of the missing I. *College Teaching, 46*(2), 58-62.

Barab, S.A., Barnett, M., Yamagata-Lynch, L., Squire, K., & Keating, T. (2002). Using activity theory to understand the systemic tensions characterizing a technology-rich introductory astronomy course. *Mind, Culture, and Activity, 9* (2), 76-107.

Bell, T., & Hunter, L. (2013) Supporting access to science and engineering through scientific argumentation. In G. Wells & A. Edwards (Eds.), *Pedagogy in higher education: A cultural historical approach* (pp.123-139). New York, NY: Cambridge University Press.

Boeije, H.R. (2010). Analysis in Qualitative Research. Washington, DC: Sage.

Boote, D., and Beile, P. (2005). Scholars before researchers: On the centrality of the dissertation literature review in research preparation. *Educational Researcher, 34*(6), 3-15.

Borrego, M. (2007). Conceptual difficulties experienced by trained engineers learning educational research methods. *Journal of Engineering Education, 96*(2) 91-102.

Borrego, M., Froyd, J.F., & Hall, T.S. (2010). Diffusions of engineering education innovations: A survey of the awareness and adoption rates in U.S. engineering departments. *Journal of Engineering Education, 99*(3), 185-207.

Bouwma-Gearhart, J. (2012). Science faculty improving teaching practice: identifying needs and finding meaningful professional development. *International Journal of Teaching and Learning in Higher Education, 24*(2), 180-188

Bowen, G.A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative Research 8*(1), 137-152.

Burton, J.P., Bamberry, N., & Harris-Boundy, J. (2005). Developing personal teaching efficacy in new teachers in university settings. *Academy of Management Learning & Education, 4*(2), 160-173.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: SAGE.

Cole, M. (2010). What's culture got to do with it? Educational research as a necessarily interdisciplinary enterprise. *Educational Researcher, 39* (6), 461-470.

Dancy, M., & Henderson, C. (2010). Pedagogical practices and instructional change of physics faculty. *American Journal of Physics 78*(10), 1056-1063.

DeChenne, S.E., Enochs, L., & Needham, M. (2012). Science, technology, engineering, and mathematics graduate teaching assistants teaching self-efficacy. *Journal of the Scholarship of Teaching and Learning, 12*(4), 102-123.

Dunkin, M.J. (2002). Novice and award-winning teachers' concepts and beliefs about teaching in higher education: Effectiveness, efficacy, and evaluation. In N. Hativa and P. Goodyear (Eds.) *Teacher Thinking, Beliefs, and Knowledge in Higher Education* (pp.41-58). Norwell, MA: Kluwer Academic Publishers.

Dunkin, M.J. & Precians, R.P. (1992). Award-winning university teachers' concepts of teaching. *Higher Education, 24*(4), 483–502.

Ellis, V. (2013). Teacher education in the public university: The challenge of democratizing knowledge production. In G. Wells & A. Edwards (Eds.), *Pedagogy in higher education: A cultural historical approach* (pp.198-214). New York, NY: Cambridge University Press.

Engeström, Y. (1999). Activity theory and the individual and social transformation. In Y. Engeström, R. Miettinen, and R-L Punamäki (Eds), P*erspectives on Activity Theory* (pp. 19-38). New York, NY: Cambridge University Press.

Engeström, Y. (2015). *Learning by expanding: an activity-theoretical approach to developmental research*. (2nd ed.). New York, NY: Cambridge University Press.

Fairweather, J.S. (2002). The mythologies of faculty productivity: Implications for institutional policy and decision making. *The Journal of Higher Education, 73*(1), 26-48.

Finelli, C.J, Daly, S.R., & Richardson, K.M. (2014). Bridging the research-to-practice gap: Designing an institutional change plan using local evidence. *Journal of Engineering Education, 103*(2), 331-361

Fives, H., & Looney, L. (2009). College instructors' sense of teaching and collective efficacy. *International Journal of Teaching and Learning in Higher Education, 20*(2), 182-191.

Fontana, A., & Frey, J.H. (2000). The interview: From structured questions to negotiated text. In N.K. Denzil and Y.S. Lincoln (Eds.) *Handbook of Qualitative Research* (2nd ed) (pp.645-673). Thousand Oaks, CA: Sage.

Franklin, K. A. "Conversations with a Phenomenologist: A Phenomenologically Oriented Case Study of Instructional Planning. " PhD diss., University of Tennessee, 2013. http://trace.tennessee.edu/utk_graddiss/1721

Froyd, J.E., & Lohman, J.R. (2014) Chronological and ontological development of engineering education as a field of scientific inquiry. In A. Johiri and B.M. Olds (Eds.) *The Cambridge Handbook of Engineering Education* (pp.3-26). New York, NY: Cambridge University Press.

Froyd, J.E., Wankat, P.C., & Smith, K.A. (2012). Five major shifts in 100 years of engineering education. *Proceedings of the IEEE*, 100(13), 1344-1360.

Fusch, P. I., & Ness, L. R. (2015). Are We There Yet? Data Saturation in Qualitative Research. *The Qualitative Report, 20*(9), 1408-1416. Retrieved from http://nsuworks.nova.edu/tqr/vol20/iss9/3

Gess-Newsome, J., Southerland, S., Johnson, A., and Woodbury, S. (2003). Educational reform, personal practical theories, and dissatisfaction: The anatomy of change in college science teaching. *American Educational Research Journal 40 (3)*, 731-767.

Gillespie, A., & Zittoun, T. (2000). Studying the movement of thought. In A. Toomela and J. Valsiner (Eds.), *Methodological thinking in psychology: 60 years gone astray?* (pp. 69-88). Charlotte, NC: Information Age Publishing.

Guba, E.G., & Lincoln, Y,S, (2008). Paradigmatic controversies, contradictions, and emerging confluences. In N.K. Denzin & Y.S. Lincoln (Eds.) *The Landscape of Qualitative Research* (pp.255-286). New York, NY: Sage.

Guest, G., Bunce, A., and Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and validity. *Field Research, 18*(1), 59-82.

Haghighi, K. (2005). Quiet no longer: Birth of a new discipline. Journal of Engineering Education, 95(3),, 351-353.

Henderson, C., & Dancy, M.H. (2008). Physics faculty and educational researchers: Divergent expectations as barriers to the diffusion of innovations. *American Journal of Physics 76*(1); doi: 10.1119/1.2800352

Heywood, J. (2005). *Engineering Education: Research and Development in Curriculum and Instruction.* Hoboken, NJ: Wiley-Interscience.

Hodder, I. (2000) Interpretation of documents and material culture. In N. Denzin, and Y. Lincoln (Eds.), *The Handbook of Qualitative Research Second Edition* (pp.703-716.) Thousand Oaks, CA: Sage Publications.

Hora, M.T. (2012). Organizational factors and instructional decision-making: A cognitive perspective. *The Review of Higher Education, 35*(2), 207-235.

Hora, M.T. (2014). Exploring faculty beliefs about student learning and their role in instructional decision making. *The Review of Higher Education, 38*(1), 37-70.

Hora, M.T., & Ferrare, J.J. (2013) Instructional systems of practice: A multidimensional analysis of math and science undergraduate course planning and classroom teaching. *Journal of the Learning Sciences, 22*(2), 212-257, DOI: 10.1080/10508406.2012.729767

Huang, Y.M., Yellin, J.M.H, & Turns, J. (2007, October 19-22). Future engineering faculty: How do they think about teaching? Paper presented at the 35th ASEE/IEEE Frontiers in Education conference. Retrieved June 10, 2015 from IEEE Xplore.

Hyman, L. (2012) Vygotsky's Crisis: Argument, context, relevance. *Studies in History and Philosophy of the Biological and Biomedical Sciences, 43*(2002), 473-483.

Jesiek, B.K., Newswander, L.K., & Borrego, M. (2009). Engineering education research: Discipline, community, or field? *Journal of Engineering Education, 98*(1), 39-52.

Jonassen, D.H., & Rohrer-Murphy, L. (1999) Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development, 47(*1), 61-79.

Kane, R., Sandretto, S., and Heath,C. (2002). Telling half the story: A critical review of research on the teaching beliefs and practices of university academics. *Review of Education Research, 72*(2), 177-228.

Kaptelinin, V. (2005). The object of the activity: Making sense of the sense maker. *Mind, Culture, and Activity,* 12(1), 4-18.

Keats, P. A. (2009). Multiple text analysis in narrative research: Visual, written, and spoken stories of experience. Qualitative Research, 9, 181-195. doi:10.1177/1468794108099320

Kembler,D. (1997). A reconceptulisation of the research into university academic' conceptions of teaching. *Learning and Instruction, 7*(3), 255-276.

Kolmos, A., and de Graaf, E. (2014). Problem-based and project-based learning in engineering education. In A. Johiri and B.M. Olds (Eds.) *The Cambridge Handbook of Engineering Education* (pp.141-160). New York, NY: Cambridge University Press.

Krippendorf, K. (2013). *Content Analysis: An introduction to its methodology* (3rd Ed.). Thousand Oaks, CA: Sage Publications.

Kristensen, G.K., and Ravn, M.N. (2015). Voices heard and voices silenced: Recruitment processes in qualitative research studies. *Qualitative Research, 15(*6), 722-737.

Lattuca, L.R., Terenzini, P.T., Harper, B.J., & Yin, A.C. (2010). Academic environments in detail: Holland's theory at the subiscipline level. *Research in Higher Education, 51*(1), 21-39.

Lattuca, L.R., & Stark, J.S. (2009). *Shaping the college curriculum: Academic plans in context*. 2nd ed. San Francisco, CA: Jossey-Bass.

Lee, Y. (2011). More than just story-telling: Cultural-historical activity theory as an under-utilized methodology for educational change research. *Journal of Curriculum Studies,* 43(3),403-424. DOI: 10.1080/00220272.2010.513069

Leontiev, A. N. (1981). The problem of activity in psychology. In J. V. Wertsch (Ed.), *The concept of activity in Soviet psychology* (pp. 37-71). New York: M. E. Sharpe.

Lindblom-Ylänne, S., Trigwell, K., Nevgi, A., & Ashwin, P. (2006). How approaches to teaching are affected by discipline and teaching context. *Studies in Higher Education, 31*(3), 285-298.

Lord, S.M., & Chen, J.S. (2014). Curriculum design in the middle years. In A. Johri & B. M. Olds (Eds.), *Cambridge Handbook of Engineering Education Research (*pp.181-200). New York, NY: Cambridge University Press.

Lough, J.R. (1997). The Carnegie Professors of the Year: Models for Teaching Success. In J.K. Roth (Ed.) *Inspiring Teaching: Carnegie Professors of the Year Speak* (pp. 212-225). Bolton MA: Anker Publishing Company Inc.

Matusovich, H.M, Paretti, M.C., McNair, L.D. & Hixson, C. (2014). Faculty motivation: A gateway to transforming engineering education. *Journal of Engineering Education, 103*(2), 302-330.

McAlpine, L., Weston, C., Timmermans, J., Berthiaume, D. & Fairbank-Roch, G. (2006). Zones: Reconceptualizing teacher thinking in relation to action. *Studies in Higher Education 31*(5), 601-615.

McKenna, A.F. & Yalvac, B. (2007). Characterizing engineering faculty's teaching approaches. *Teaching in Higher Education, 12*(3), 405-418, DOI: 10.1080/13562510701278765

Mehdinezhad,V. (2012). Faculty members' understanding of teaching efficacy criteria and its relation to their characteristics. *International Journal of Instruction, 5*(2), 213-236.

Menges, R. J., & Austin, A. E. (2001). Teaching in higher education In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 1122-1156). Washington, DC: American Education Research Association.

Mills, N. (2011). Teaching assistants' self-efficacy in teaching literature: Sources, personal assessments, and consequences. *The Modern Language Journal, 9*(1), 61-80.

Moore, T.J, Guzey, S.S., Roehrig, G.H., Stohlmann, M., Park, M.S., Kim, Y.R., Callendar, H.L. & Teo, H.J. (2015). Changes in faculty members' instructional beliefs while implementing model-eliciting activities. *Journal of Engineering Education, 104*(3), 279-302.

Morris, D.B, & Usher, E.L. (2011). Developing teaching self-efficacy in research institutions: A study of award winning professors. *Contemporary Educational Psychology 36* (2011), 232-245

National Academy of Engineering. (2005). *Educating the engineer of 2020: Adapting engineering education to the new century*. Washington, D.C.: The National Academies Press.

National Science Board. (2007). Moving forward to improve engineering education. Washington, DC: National Science Board.

Oleson, A., & Hora, M.T. (2014). Teaching the way they were taught? Revisiting the sources of teaching knowledge and the role of prior experience in shaping faculty teaching practices. *Higher Education*, *68*(1), 29-45.

Phipps, A. (2007). Re-inscribing gender binaries: Deconstructing the dominant discourse around women's equality in science, engineering, and technology. *The Sociological Review, 55*(4), 768-787.

Pollio, H.R., & Humphrey, W.L. (1996). What award winning lecturers say about their teaching: It's all about connection. *College Teaching*, *44*(3), 101-106.

Potter, J. & Hepburn,A. (1995). Qualitative interviews in psychology: Problems and possibilities. *Qualitative Research in Psychology*, *2*(4), 281-307.

Prieto, L.R., & Meyers, S.A. (1999). Effects of training and supervision on the self-efficacy of psychology graduate teaching assistants. Teaching of Psychology 26(2), 264-266.

Prosser, M., Ramsden, P., Trigwell, K. and Martin, E. (2003). 'Dissonance in experience of teaching and its relation to the quality of student learning', Studies in Higher Education 28(1), 37–48

Ralston, K., deMarrais, K., & Lewis, J.B. (2003). Learning to interview in the social sciences. *Qualitative Inquiry*, *9*(4), 2003 643-668.

Roth, W., & Lee,Y. (2007). "Vygotsky's neglected legacy": Cultural historical activity theory. *Review of Educational Research, 77*(2), 186-232.

Saldaña, J. (2016). *The coding manual for qualitative researchers*. (3rd edition.) Washington, D.C.: Sage.

Seely, B.E. (2005). Patterns in the history of engineering education reform: A brief essay. In *Educating the engineer of 2020: Adapting engineering education to the new century* (p.114-130). Washington, D.C.: The National Academies Press.

Seldin, P. (1995) "Improving college teaching." In P. Seldin *Improving college teaching* (p.1-13). Bolton, MA: Anker Publishing Company, Inc.

Sheppard, S.D., Macatangay, K., Colby, A., and Sullivan, W.M. (2009). *Educating engineers: Designing for the future of the field.* Stanford, CA: Jossey-Bass.

Slattery, J.M., and Carlson, J.F. (2005). Preparing an effective syllabus: Current best practices. *College Teaching, 53*(4), 159-164.

Southerland, S.A., Gess-Newsome, J., and Johnson, A. (2003). Portraying science in the classroom: The manifestation of scientists' beliefs in classroom practice. *Journal of Research in Science Teaching, 40*(7), 669-691.

Southerland, S.A., Sowell, S., & Enderle, P. (2011). Science Teachers' Pedagogical Discontentment: Its Sources and Potential for Change. *Journal of Science Teacher Education* 2011 (22) 437-457.

Stanton, K.C. and Bradley, T.H. (2013) From course assessment to redesign: a hybrid-vehicle course as a case illustration. *European Journal of Engineering Education, 38*(6), 687-699, DOI: 10.1080/03043797.2013.826181

Stark, J. (2000). Planning introductory college courses: Content, context and form. *Instructional Sciences, 28*, 413-438.

Stark, J.S., Lowther, M.A., Ryan, M.P., & Genthon, M. (1988). Faculty reflect on course planning. *Research in Higher Education, 29*(3), 219-240.

Stetsenko, A. (2005) Activity as object-related: Resolving the dichotomy of individual and collective planes of activity. *Mind, Culture, and Activity, 12*(1), 70-88, DOI: 10.1207/s15327884mca1201_6

Strauss, A., and Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory.* Thousand Oaks, CA: Sage.

Thayer-Bacon, B. (1998). *Philosophy applied to education: Nurturing a democratic community in the classroom*. Upper Saddle River, NJ: Merrill.

Thompson, B. (2007). The syllabus as a communication document: Constructing and presenting the syllabus. *Communication Education, 56*(1), 54-71.

Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to teaching first year university science. *Higher Education, 27*(1), 75-84.

Turns, J., Eliot, M., Neal, R, and Linse, A. (2007). Investigating the teaching concerns of engineering educators. *Journal of Engineering Education, 96*(4) p. 295-308.

Turpen, C., & Finkelstein, N. (2013). Using a cultural historical approach to understand educational change in introductory physics classrooms. In G. Wells & A. Edwards (Eds.), *Pedagogy in higher education: A cultural historical approach* (pp.44-59). New York, NY: Cambridge University Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Walker, J.L. (2012). The use of saturation in qualitative research. *Canadian Journal of Cardiovascular Nursing, 22*(2), 37–41.

Warcholak, N.D. (2015). Analysis of engineering faculty member's planning for instruction (doctoral dissertation). Retrieved from ProQuest Dissertation and Theses Global. (3583420).

Wells, G. (2013). Taking responsibility for learning: CHAT in a large undergraduate class. In G. Wells & A. Edwards (Eds.), *Pedagogy in higher education: A cultural historical approach* (pp.60-72). New York, NY: Cambridge University Press.

Wells, G. & Edwards, A. (2013) Introduction: The changing face of higher education. In G. Wells & A. Edwards (Eds.), *Pedagogy in higher education: A cultural historical approach*. New York, NY: Cambridge University Press.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.

Wertsch, J.V. (2000). Narratives as cultural tools in sociocultural analysis: Official history in Soviet Russia. *Ethos, 28* (4), 511-533.

Wertsch, J.V. (2007). Mediation. In H. Daniels, M. Cole, J.V. Wertsch (Eds.), *The Cambridge Companion to Vygotsky* (pp. 178-192).

Wright, M. (2005). Always at Odds? Congruence in faculty beliefs about teaching at a research university. *The Journal of Higher Education, 76*(3), 331-353

Xu, Y.J. (2007). Gender disparity in STEM disciplines: A study of faculty attrition and turnover intentions. *Research in Higher Education, 49* (5), 607-624

Yamagata-Lynch, L.C. (2010). *Activity Systems Analysis Methods: Understanding complex learning environments.* New York, NY: Springer.

Yamagata-Lynch, L.C., Cowan, J. & Luetkehans, L.M. (2015). Transforming disruptive technology into sustainable technology: understanding the front-end design of an online program at a brick-and-mortar university. *Internet and Higher Education, 26 (*1), 10-18.

Yamagata-Lynch, L. C., Skutnik, A. L., Garty, E, & Do, J. (2016). Interactionist qualitative research as a semiotic mediated activity. *SAGE Open* 6(3).

Appendices

Appendix A: Recruitment Letter

Dear Faculty Member,

I am writing to ask you for your help with a research study that I am conducting related to course syllabuses and course design. I am contacting you because you have been acknowledged by the UT College of Engineering as an outstanding educator at the annual awards banquet.

The purpose of my dissertation research is to understand the role your course syllabus and related documents plays when you are designing a course. This research would fill a gap in the existing literature on course design at the university level.

I ask you to please consider participating in my research in two ways: first, by submitting some demographic data and your course syllabus(es) via a Qualtrics survey; and second, by consenting to a 1-hour interview discussion your course design process. All collected data will remain confidential, and pseudonyms will be used for yourself, your course, and your department.

The link to the Qualtrics survey with the informed consent for the study can be found here: https://utk.co1.qualtrics.com/SE/?SID=SV_cORtaENJZT5p8Jn

Thank you for your time and help,

Sincerely,

Anne Skutnik

Appendix B: Informed Consent

The University of Tennessee

Office of Research

Research Compliance Services

Consent Cover Statement

Understanding what influences engineering faculty course syllabus decisions through Activity Theory

INTRODUCTION
This research study is to understand how engineering faculty use their course syllabuses and supporting documents as design artifacts in their course design. The researcher is asking that you participate in this research study in two ways: 1) by submitting one or more course syllabuses and related documents like course schedules through this Qualtrics survey link, and 2) by consenting to a 1-hour follow-up interview about your course design process that will be audio-recorded and transcribed.

This study will focus on the use of course syllabuses to help faculty members design courses in engineering departments at the university level. Currently there is little literature on the use of syllabuses in engineering education, or how they relate to course design in general. Data from this qualitative dissertation will help to provide a snapshot of how award-winning engineering faculty members at a research engineering design their courses.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY
You have been selected to participate in this study because you have been acknowledged as an exemplary educator by the College of Engineering at their annual awards banquet.

If you elect to participate in this study by completing the demographic survey and document submission, your responses and documents will be collected and analyzed. You will also have the opportunity to volunteer for a 1-hour follow-up interview that will discuss your course design process and use of syllabuses. The interview will be audio-recorded and transcribed.

RISKS
Breach of confidentiality is a possible potential risk that may result from this study due to the small (n=6) number of participants who will be interviewed. Pseudonyms will be created for all participants and their real names, departments, and course titles will not be identified. If at any time during this process you decide to stop the survey or the interview, all data collected will be destroyed.

BENEFITS

There are no direct benefits to your participation in this survey. Although you may not directly benefit from the results of this study, it may help answer questions about how engineering faculty members design their courses.

CONFIDENTIALITY

The information in the study records will be kept confidential. Any digital copies of collected data will be kept on a password-protected computer for three years; all identifying information will be removed and pseudonyms used in the dissertation. All paper copies of informed consent documents will be kept in a locked office of the PI's faculty advisor. Data are only accessible by the researcher, Anne Skutnik, and her supervising research professor, Dr. Lisa Yamagata-Lynch.

CONTACT INFORMATION

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the researcher, Anne Skutnik, at askutnik@vols.utk.edu, and (540) 808-7017, or her advisor, Dr. Lisa Yamagata-Lynch, at lisayl@utk.edu and (865) 974-7712 . If you have questions about your rights as a participant, you may contact the University of Tennessee IRB Compliance Officer at utkirb@utk.edu or (865) 974-7697.

PARTICIPATION

You must be 18 years or older to participate in this study. Your participation in the study is entirely voluntary; you may decline to participate without penalty. You will not be penalized if you request that your information not be used for the study or interview. If you withdraw from the study before data collection is completed your data will be destroyed.

CONSENT

I have read the above information. I have received (or had the opportunity to print) a copy of this form.

Clicking on the button to continue and completing the brief questionnaire and document submission constitutes my consent to participate.

Participant signature Date

Appendix C: Interview Protocol

Hello, my name is Anne Skutnik, and today I will be conducting an interview about engineering course design. This interview will focus on your course design process, specifically related to courses that you have taught and the course syllabuses that you write for these courses, but we will also talk about accreditation and course planning in the process. In the research study, all identifying information will be removed, and I will be using pseudonyms instead. If at any time you decide to no longer participate in this interview, I will stop the recording and it and your information will be destroyed. Are there any questions about this protocol?

Questions:

- Please state your name, your academic department, and your rank.
- How long have you taught here at UT?
- How does your department determine what courses you teach each semester?
- Are they always related to your area of expertise or have you ever had to teach something you were unfamiliar with?
- What do you think about your course syllabus?
- Over the course of your semester, how do you update your syllabus when changes are made (e.g. schedule changes, lab problems)?
    - How often do you update your syllabus?
    - How do you feel when your syllabus changes or your schedule changes?
- What is the structural course planning process like for you?
    - How do you determine what content to teach?
    - How does accreditation factor into your course planning?
- Can you tell me about a time when you were teaching a class and it changed your perspective on how the content should be taught?
- Can you describe your teaching style to me?
- Do you talk about your teaching with colleagues?

Appendix D: List of Codes

ATLAS.ti Report

dissertation syllabuses: codes

- assignments: flexibility about due dates
- assignments: homework: instructions
- assignments: in-class
- assignments: lab
- attendance: general
- attendance: mandatory
- attendance: not mandatory
- attendance: strongly encouraged
- course: course objectives
- course: course prereqs
- course: misc
- course: participation
- course: schedule: date and location of lectures/labs
- course: schedule: flexibility
- exams and quizzes
- grading policy
- instructor: contact: email
- instructor: contact: email and phone
- instructor: contact: phone
- instructor: discusses academic integrity

- instructor: faculty: office hours/location
- instructor: faculty: teaching with assistance
- instructor: getting personal
- instructor: TA: general
- students: expectations
- students: insight into students learning
- students: responsibility
- technology: devices needed for course
- technology: lms
- technology: online resources
- technology: video lectures
- technology: website
- textbook: other
- textbook: recommended textbook
- textbook: required textbook
- university policy: necessary elemts for syllabuses

dissertation interviews

- course design: external influences on curriculum
- course design: graduate courses versus undergraduate
- course design: individual autonomy as faculty member
- course design: internal decisions about curriculum and course load

- course design: iterative process of course revision
- course design: mental schema
- course design: preparation process
- course design: syllabus
- course design: syllabus: course schedule
- course design: syllabus: using course website
- engineering education: accreditation: ABET
- engineering education: historical shift
- faculty: affordance: awards and recognition
- faculty: affordance: faculty as stakeholders
- faculty: affordance: knowledge of pedagogy
- faculty: affordance: tenure
- faculty: constraint: lack of incentives
- faculty: constraint: lack of understanding of pedagogy
- faculty: constraint: realities of faculty life
- faculty: demographics: background
- faculty: demographics: department
- faculty: demographics: rank
- faculty: demographics: years taught
- students: affordance: responsibility
- students: constraint: lack of responsibility
- students: generational change
- teaching: affective: caring about students

- teaching: affective: enjoyment of teaching
- teaching: affective: frustration
- teaching: affective: humility about teaching
- teaching: experience
- teaching: faculty as more knowledgable other
- teaching: general constraints
- teaching: lecture method
- teaching: maintaining engagement
- teaching: relatedness
- teaching: technology tools for teaching

Vita

Anne Leslie Skutnik was born in Virginia. She received her Bachelor's degrees in History and English from Iowa State University, and her Master of Arts in History from Virginia Polytechnic Institute and State University before decided to teach. She taught middle school social studies for several years before returning to academia, where she taught educational psychology to pre-service teachers for four years. She graduated in 2018 with a doctoral degree in Learning Environments and Educational Studies (LEEDS) from the University of Tennessee Knoxville. She is currently the Education and Diversity Coordinator for CURENT, a NSF-DOE funded Engineering Research Center (ERC). This means she knows the difference between power systems and power electronics, which is more than she knew when she started this dissertation.