Teaching Pathways in the Academy:

A Narrative Study of Engineering Faculty at Institutions with Varying Teaching and Research Activity

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Abstract— ***Graduate school is most commonly viewed as the entryway and the main site for socialization in the academic career of a faculty member. While faculty positions can vary widely by institution type, most graduate students are prepared for future academic positions during time spent at doctoral universities with very high research activity. However, the experiences of engineering faculty beginning their careers at institutions with varying teaching and research activity, i.e. institutions other than doctoral universities with very high research activity, remain understudied. The research project described in this work-in-progress paper details the plans to accomplish the following research objective: to document and describe the narrative accounts of the academic pathways and the teaching conceptions and methods of engineering assistant professors at institutions with varying teaching and research activity. This paper details the motivation, relevant literature, and methodological approach to a narrative research study that will specifically address two overarching research questions: 1) how do faculty experience the transition from graduate school and other previous educational and/or work experiences to their current faculty position?, and 2) how do faculty describe their current teaching conceptions and methods? In this paper, I summarize key decisions made while crafting my research proposal, including rationale for choosing narrative analysis and various validity considerations. I conclude with a discussion about potential implications of my work, including the creation of "inanimate more competent others" to assist graduate students making decisions about their academic pathways.***

Keywords— ***faculty pathways; engineering; teaching conceptions; teaching philosophy; graduate education; faculty preparation; higher education; college teaching***

I. Introduction

Teaching quality at colleges and universities in the United States has been in the spotlight for many years. Poor teaching has been blamed by many students for the reason they leave engineering [1]. One obvious question to ask when considering teaching quality is: how are faculty members trained to teach engineering? Graduate school is most commonly viewed as the main point of entry and site for socialization into the academic career of a faculty member [2]. Socialization for doctoral students includes the process of making sense of the academic career and/or other career pathways after graduation [2]. This socialization involves a great deal of preparation in the forms of mentoring and advising, which significantly shapes a graduate student's perception of their future career. However, it has been noted that college teaching is a skilled profession unlike others in that it generally does not involve specific mentoring as part of the educational process [3]. Furthermore, some college teaching positions focus on the teaching aspect more than others, and STEM (science, technology, engineering, and math) doctoral students are often not provided awareness of these different types of roles [4]. In summary, graduate school often does not explicitly include training in teaching skills.

In general, graduate training significantly relies on a type of apprenticeship model, where an advisor typically mentors a graduate student for a faculty position similar to her/his own, i.e., one that focuses mainly on research [6]. However, there has been critique of the lack of mentorship and training of doctoral students in the teaching and services realms of academic responsibility [7]. If a graduate student is preparing for a position at a different type of institution, this lack of attention to teaching skills could be even more impactful. Another consequence is that engineering education continues to suffer from inappropriate and inadequate teaching approaches at both the undergraduate and graduate levels [8], [9]. For example, while more appropriate teaching methods for engineering have been identified, including those that can improve student learning, engagement, and interest, engineering faculty have generally been slow to adopt these methods [9], [10]. Instead, many engineering faculties continue to rely on lecturing [8], [9]. Given that the teaching component of faculty positions often receives little or no attention as compared to research preparation in graduate school, new faculty members are often not prepared to handle the balance the teaching and research demands of a faculty role [2], [5]. This issue may be even more pronounced for new faculty at an institution that puts more emphasis on teaching, since their teaching load will likely be higher and the quality of their teaching may be scrutinized more closely.

While the typical quality of engineering teaching has been questioned, some faculty are working to improve their

teaching practices. For example, Bird and Kellam [11] conducted a narrative study examining the stories of three engineering faculty as they make the change to student-centered teaching. These studies are positive indicators that the quality of engineering teaching is improving in some contexts. However, these studies have mostly focused on faculty in research-oriented positions at doctoral universities with the highest research activity classification.

Table 1
Number and Percentage of Engineering Programs at Various Institutions [12], [13]

Carnegie Institution Type	Number of Institution Type (Engineering)	% out of 300	Number of Institution Type (All)
DU-Highest	104	34.7	335 (all DU)
DU-Higher	70	23.3	--
DU-Moderate	28	9.3	--
Master's	69	23.0	741
Baccalaureate	24	8.0	583
Special Focus	5	1.7	1005

The Carnegie Classification of Institutions of Higher Education categorizes institutions by research activity as well as the number and type of degrees conferred [13]. When considering the breakdown of engineering institutions within the Carnegie Classification scheme, it can be seen in Table 1 that most engineering schools are of the Doctoral University with very high research activity (DU-Highest) classification. However, while most engineers are indeed trained at this type of institution, there are still many institutions of different classification types, including 23% that are Master's institutions. Ninety-eight institutions of 300 (~33%) are not doctoral institutions at all. With almost 30% of institutions without doctoral university designations, it is natural to ask how those institutions are different, especially in terms of faculty experiences, including approaches to teaching and research. For example, Pifer, Baker, and Lunsford [14] have noted these differences in faculty experiences at liberal arts colleges in particular. Also included in Table 1 are the total number of doctoral, master's, baccalaureate, and special focus institutions across higher education as a whole. From this comparison, it is evident that the high percentage of doctoral universities is specific to engineering, warranting further research about other institution types to understand faculty experiences at a deeper level.

Additionally, over two-thirds of the total number of tenured and tenure-track engineering faculty in the U.S. are at institutions that are classified as the highest research activity doctoral university. While faculty at these institutions are most prevalent, non-highest research activity institution faculty have not been given very much attention in the engineering education literature [15]. A concern that arises from the lack of attention towards faculty members at other types of institutions is that the education of approximately one-third of the bachelor's degrees in engineering is relatively mysterious. For example, in 2010, of the 79,639 bachelor's degrees conferred in engineering, 31,615 of these were granted at non-DU Highest institutions [16]. It is also presumed that institutions with less emphasis on research activity would conversely focus most on teaching, but how that focus is actually realized is largely unknown. If more attention is paid to teaching engineering at these types of institutions, much could be learned about teaching engineering successfully. Since faculty at institutions with varying teaching and research activity likely spend more time on teaching [15], perhaps they have tried more research-based instructional strategies. Yet while these faculties may spend more time on teaching, it might also be the case that heavy teaching loads deter efforts to improve student learning and engagement. While there is likely a balance between effective and high quality teaching and strain to manage heavier teaching loads, the stories and experiences of faculty at alternate institutions have not been sufficiently explored. Thus, the objective of this research is to document and describe the narrative accounts of the academic pathways and the teaching conceptions and methods of engineering assistant professors at alternate institutions. Specifically, this will be achieved by answering the following research questions:

1) How do faculty experience the transition from graduate school and/or other previous educational and/or work experiences to their current faculty position?
    a. How do faculty experience the process of applying to and choosing the institution in which they are currently employed?
    b. How do faculty describe their graduate student experiences and other preparation for their current faculty position?
2) How do faculty describe their current teaching conceptions and methods?
    a. How have these conceptions been influenced by graduate school experiences and current institutional experiences?
    b. How do the teaching conceptions of faculty in this study compare to one another?

This work-in-progress paper describes findings from relevant literature and explains the methodological approach for the proposed study. These sections of the paper provide important background and justification for studying pathways to teaching and current teaching methods of engineering assistant professors at institutions of varying teaching and research activity.

II. Literature Review

When considering the breakdown of U.S. engineering departments and degree programs by the number of tenured and tenure-track faculty, it can be seen that just over one-third of faculty are at institutions other than the highest research activity doctoral university. Table 2 summarizes the distribution of faculty members. If most of the literature about faculty members is mainly or only considering the experiences

of faculty at doctoral universities with the highest research activity classification, then we are potentially left without an understanding of faculty experiences at other types of institutions. Most faculty positions, at all institution types also have one important task in common: new faculty are required to teach in some capacity.

Table 2
Number and Percentage of Tenured and Tenure-Track Faculty at Various Institutional Types [12], [13]

Carnegie Institution Type	Tenured / Tenure-Track Faculty	% out of 24,003
DU: Highest	15,047	62.7
DU: Higher	4,735	19.7
DU: Moderate	1,145	4.8
Master's	2,407	10.0
Baccalaureate	453	1.9
Special Focus	216	0.9

A number of scholars have examined processes associated with acquiring knowledge and skills needed to teach at the college level. Austin and McDaniels [16] propose a three-step progression that examines graduate teaching assistants' (TA) dependence on their supervisors. These stages of TA socialization have a major implication, namely that proper socialization as a university teacher takes practice and time. One recent study more specifically considered future STEM faculty and the role of teaching development (TD) during graduate school, and this work points to the importance and positive long-lasting impact TD can have on faculty careers [4]. One single experience will not be sufficient for graduate students to develop into teachers, although it seems that many new faculties with teaching roles are hired with just a singular prior teaching experience. [2], [17].

Scholars have also looked at ways of explaining the graduate student and future faculty experience. Bieber and Worley [18] examined the development of schema that graduate students conceptualize about faculty life. Yet in the case of graduate students pursuing positions at institutions of varying teaching and research activity, research on faculty schema has mostly been built based on faculty at DU-Highest institutions, since that is where graduate students are being trained as future faculties. The community at DU-Highest institutions can be considered through a community of practice lens [19], [20]. A community of practice, which can be the community of an institution or even a small group, can be very impactful on the socialization experiences of graduate students.

The schema graduate students develop about faculty in the community of practice of a DU-Highest institution will likely impact their teaching conceptions. Teaching conceptions represent the lenses through which one teachers, including the beliefs and understandings about knowledge, students, and the content [21]. Two notable studies that examined conceptions about teaching are highly relevant to this work. Torres-Alaya [22] found that doctoral students in engineering develop the following conceptions about teaching, namely that teaching is: 1) delivering knowledge, 2) helping students understand and apply concepts, 3) motivating students, 4) helping students learn how to approach problems, and 5) preparing students to make socially conscious decisions [25]. Contrastingly, Borgford-Parnell examined the conceptions of effective teachers and found that effective teachers in research universities have conceptions which he called a Pedagogy of Larger Concerns [21]. These consist of: 1) teacher's power is leavened with responsibility, 2) students are synonymous with positive vision of future, 3) learning to learn takes precedence, 4) teachers are essential to student learning, and 5) new learning fits to the student's lifetime of learning [21] (Borgford-Parnell, 2006). The conceptions of new faculty in engineering at alternate institutions may fall somewhere between Torres-Alaya and Borgford-Parnell's findings, potentially reflecting how conceptions about teaching develop over time.

Since the pathways of graduate students pursuing non-DU highest faculty positions are largely unknown, and therefore the teaching conceptions of these faculty members are unknown, this topic is worthy of study. Narrative inquiry will be used to expose individual stories about the pathways and practices of assistant professors of engineering.

III. Methods

I chose a narrative inquiry [23], [24] approach to examine 12-16 assistant professors at four types of institutions in a multiple case study [25], [26]. Narrative stories are sought in order to provide a thick description [30] of the experiences of engineering assistant professors and to provide stories with which readers will readily able to connect [28]. Assistant professors in tenure-track positions will be examined exclusively in this study.

The primary source of data for this study will be semi-structured ethnographic interviews [29] with 12-16 engineering assistant professors at alternate institutions. One interview with each participant will be conducted surrounding two main topics: 1) graduate school experiences and preparation for a faculty role, and 2) current perceptions and development of teaching conceptions and methods. Additionally, I will collect two documents which I will have participants explain during the interview in order to elicit richer explanations of their teaching conceptions and methods. The interviews will be audio recorded and conducted over the phone or via Skype in case of geographic constraints. Each participant's story will be considered as an individual case.

I will be conducting the interviews using an ethnographic interview approach in which the researcher views the interviewee as the informant [29]. I will explain to the participant that I view them as the expert, will encourage them to do most of the talking, and ask them to focus on specific events. The analysis of narratives relies on critical events within a participant's story [23]. With the assumption that the interviewee is the expert on the subject, I will allow for their topics, thoughts, and ideas to guide the conversation within

my semi-structured interview protocol. I will also allow for the participant to tell their story with as few interruptions as possible so that direct quotes can be used in the findings.

Assistant professors seeking tenure in engineering will be identified at varying higher education institutions. I will identify 12-16 participants for this study through my personal connections and networks. I have chosen to examine at least three assistant professors at each of the four institutional types for two reasons. First, I want readers to avoid associating a particular institutional type with one individual's experience as would happen if one participant was drawn from each institutional type. Second, I want readers to avoid comparing two participants' experiences, which could exaggerate similarities and/or differences. My goal is for readers to become aware of the variation in experiences and to connect with the narratives, and three participants at each institution type will likely be able to accomplish this goal. In the case where one of my participants does not engage fully with the research, I will interview a fourth participant at an institutional type as needed. The following criteria will be used to identity the participants through quota sampling [30]:

- Assistant professor seeking tenure
- Employed at one of four institutional types: DU-higher, DU-moderate, Master's, or Baccalaureate
- Within the first three years of appointment
- Fewer than three years of experience between doctoral conferral and start of faculty appointment
- Doctorate earned at a DU-highest institution
- 3-4 will be women
- 3-4 will be ethnic minorities

IV. Validity and Reliability

In narrative research, validity is concerned with well-grounded research that can be supported by the data collected [23]. Since the stories that are collected are not intended to be representations of reality, but rather, representations of reality as experienced by individuals, validity of narrative research should be assessed according to whether it is 'believable' for readers. However, in order to provide believable narratives, I need to make sure to collect the stories of individuals in an authentic manner, allowing my participants to tell their stories truthfully and without judgement from me. Another way to ensure validity of the participant's story being told is to involve the participant in the narrative construction through member checking and demonstrating alignment between the interview data and the constructed narrative [28]. Finally, one more way I can ensure that my narratives are believable and truthful is to write them from the first person perspective and include direct quotes from the original transcripts.

Walther, Sochacka, & Kellam [31] also suggest a framework to analyze interpretive qualitative research. Specifically, this framework proposes a quality management process model to approach the validity and reliability of making the data and handling the data [31]. This framework considers theoretical, procedural, communicative, and pragmatic validation, and finally process reliability. In making the data, the most important consideration I will be using will be through the process of purposeful sampling. Also, in order to achieve validation of handling the data, I will make many efforts to make sure my version of participants' narratives are grounded in the participants' versions. Member checking will be a crucial component of my data analysis and providing communicative validation.

V. Implications and Expected Results

The findings from this study are expected to contribute to the extant literature and engineering education community, specifically the graduate student education and mentoring community, in four main ways. First, graduate student preparation for faculty roles might consider more diverse teacher and researcher preparation as a part of graduate education. Second, by exploring the narratives and pathways of these current faculty, future faculty will be made aware of alternate career paths in the academy. I envision the narratives to serve as an "inanimate more competent other" [32] for future graduates students, where the narratives provided by current faculty at institutions with varying teaching and research activity can provide insight and guidance to future faculty seeking these roles. This idea is presented in Figure 1, where I provide a hypothetical scenario about a graduate student's interaction with a narrative. Third, and somewhat more indirectly, this research will provide an understanding of practices for evaluating teaching for hiring and tenure requirements. This insight can help inform hiring and tenure and promotion practices at various types of institutions. Fourth, this study will identify teaching methods and conceptions that might impact the effectiveness of engineering teaching across institutional types. Since the faculty that will be examined in this study focus more heavily on teaching than the majority of engineering faculty, it is likely that this specific population will have insight into highly effective teaching that all faculty will benefit knowing about.

Eduardo, a PhD student at a Doctoral University with the highest research activity classification:
Edwardo is starting to look for job opportunities after graduation and has realized he really wants to pursue his passion for teaching but not give up his love for research completely. He comes across a narrative that explains how an assistant professor manages the balance between teaching and research at a Doctoral University with a moderate research activity classification. Edwardo feels like he found a role model and an example for a pathway he is interested in pursuing.

Figure 1: hypothetical interaction with narrative

This study may be of particular interest to graduate students and those who mentor graduate students who are interested in pursuing non-traditional pathways in the academy, as well as current engineering faculty at all institution types. Additionally, faculty developers, graduate program chairs, and department heads will likely find value in this work.

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