

Becoming Teachers: Early Career Engineering Faculty

by

Jennifer Rosemary Pollard

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Higher Education)
in the University of Michigan
2021

Doctoral Committee:

Professor Lisa R. Lattuca, Chair
Professor Emerita Patricia King
Professor Emerita Janet H. Lawrence
Professor Anne McNeil
Professor Vilma M. Mesa

Jennifer R. Pollard

jrpollar@umich.edu

ORCID iD: [0000-0002-5537-1568](https://orcid.org/0000-0002-5537-1568)

© Jennifer R. Pollard 2021

Dedication

This dissertation is dedicated to the participants who made this study possible and to all who are committed to continuous improvement, both as teachers and learners.

Acknowledgements

The realization of this project would not have been possible without the help, advice, and support of many individuals and offices.

First, I offer an abundance of thanks to my advisor and dissertation chair Professor Lisa R. Lattuca who provided tireless academic guidance and moral support. Thank you for asking questions that helped me to clarify both my questions and my answers. When I experienced self-doubt, you held up a higher and brighter vision of me than I had the inner resources to do in those challenging moments. To my dissertation committee members Professors Patricia King, Janet Lawrence, Vilma Mesa, and Anne McNeil, thank you for every question that you posed to me from proposal to dissertation draft to defense. You helped me to think about and clarify some very essential issues. Dr. Patricia King, you have a way of framing feedback that is especially kind and developmental while also pushing me to think more deeply. Indeed, the warm spirit you manifested through your comments and helpful email messages helped to provide calm in the final moments of refining my work.

Next, I convey profound gratitude to my participants whom I cannot name as I must preserve their anonymity. You have shared with me your journeys and this is no small gift as indeed, the professional is always personal. As I listened to and read your interviews time and time again, your presence was strong with me and I never ceased to be touched by the unique experiences of each of your journeys.

Now, I must thank my Higher Education (CSHPE) colleagues and friends with whom mutual commiseration about the challenges of the doctoral journey was often the order of the

moment, while yet at other times talk of theory permeated the most personal of conversations. I cannot name everyone but there are a few people to whom I would like to convey special thanks. Erika Mosyjowski, Michele Randolph, Gloryvee Fonseca-Bolorin, and Gordon Palmer, thank you for always having a word in season to add to the fortification of my spirit. Melinda Richardson, what can I say about your unremitting magnitude of spirit? You are the best administrator but more than that, a solid friend. Thank you for all you have done to make my journey easier – from financial advice to pep talks and affirmation of my place in the CSHPE (Center for Higher and Postsecondary Education) community.

A special word of thanks goes to my colleagues in Educational Studies, Anne Cawley, Benjamin Tupper, and Carolyn Masserang who served as great STEM education friends and partners for learning in the Comparative Case Studies Course. You listened carefully, asked meaningful questions, and lent tangible support during my initial piloting process. To Professor Pamela Moss who facilitated this course, your belief in the promise of my work (in its embryonic stages), was invaluable. You certainly helped to provide a foundation for the success of my project.

To Traci Lombre, a very important member of my Jazz family, a writing partner, and peer counselor, thank you for being an understanding friend, confidante, and academic comrade. I so look forward to all that will come of your own dissertation research. From you, I have been blessed to gain new knowledge and insight about aspects of Jazz history and culture. Also, you were such a solid, patient, and thoughtful listener as I shared both the knowledge that I was gaining through my project and my anxieties around making a meaningful research contribution.

I also owe much gratitude to the Center for the Education of Women (CEW), School of Education (SOE) Office of Student Affairs, and the Rackham Graduate School (RGS), with

special mention of Eileen Brussolo (SOE) and Darlene Ray-Johnson (RGS). Thank you for the role you played in ensuring that I had the financial support to continue my work and maintain the best self-care possible as I pressed towards the finish.

Now, I attend to the beginnings and the foundations of my being in the world. Thank you to my mother Joyce, father Eustace, my aunts Monica and Hazel, and many others in my extended family for creating an environment that fostered my love for reading, learning, studying, questioning, creating, and contributing to human development and community.

Last but not least, thanks to God – Prime Mover, Alpha, and Omega who provides health, strength, and the love that motivates my work.

Table of Contents

Dedication	ii
Acknowledgements	iii
List of Tables	ix
List of Appendices	x
Glossary of Terms	xi
Abstract	xviii
Chapter 1: Introduction	1
Overview of Research on Faculty Socialization	4
Studying Experiences that Shape Teaching Identity Among New Engineering Faculty	7
Contributions of the Study	10
Chapter 2: Literature Review	14
Faculty Socialization	14
Faculty Socialization as a Journey of Lifelong Learning	16
Socialization and Preparation of STEM Faculty Around Teaching	17
Institutional Contexts that Shape Teaching Practices of Early Career STEM Faculty	18
The Communities of Practice Lens	34
Three Dimensions of Community Membership	35
Competent Membership	37
Negotiation of Meaning: Participation and Reification	39
Legitimate Peripheral Participation and Inbound Trajectory	40
Identity: “Nexus of Multi-memberships” and Journeys Across “Landscapes of Practice”	41
Modes of Belonging: Engagement, Imagination, and Alignment	44
Power, Agency and the Negotiability and Ownership of Meaning	46
Selected Literature on Faculty Professional Identity: Support for the COP Framework	47
Competence: Mutuality of Engagement, Negotiability of the Repertoire and Accountability to the Enterprise	48

Engaging in Practice, Negotiating Meaning, Belonging and, Becoming.....	51
Identity Trajectories	52
Participation in Economies of Meaning and Ownership of Meaning	55
Modes of Identification Beyond Engagement: Imagination and Alignment	55
Chapter 3: Research Methodology.....	57
Perspectives Guiding the Inquiry	57
Research Setting and Sample	65
Data Sources.....	67
Data Collection.....	70
Data Analysis	72
Trustworthiness of Research Process and Limitations.....	77
Protection of Human Subjects and IRB Process	79
Chapter 4: On the Cusp: Teaching and Learning Journey Before the Tenure Track	81
Faculty Who Narrated Less Preparedness for Teaching	86
Faculty Who Narrated More Preparedness for Teaching.....	106
Summary and Analysis.....	126
Chapter 5: Learning And Identity Construction In Community And Across Landscapes Of Practice.....	130
Context and Conversation: Making Meaning of Departmental Messages About Teaching...	135
Experiencing the Assignment of Teaching Responsibilities Close to Core Identity	139
Experiencing Teaching Knowledge and Resources Resident Within the Department	142
Meaningful Moments of Identity Negotiation: Interacting with the Student Community.....	150
Moments of Learning and Identity Negotiation Across the Professional Landscape	164
Chapter Summary.....	169
Chapter 6: Identity Trajectories: Threads Through Space And Time.....	171
Common Threads in Participants' Identity Trajectories	172
The Trajectory Sub-types	173
Journeys to Care-Centered Teacher Identities: Experiences of Meaning	174
Manifestations of Care: Expressions and Demonstrations as New Faculty.....	183
Summary of Leading with Care	199

Journeys to Leading with Disciplinary Commitments	199
Making Students Ideal for the Discipline: Expressions and Demonstrations	201
Summary: Leading with Disciplinary Commitments.....	210
Special Case of Alex: A More Complex Identity Trajectory?	211
What do We Learn from the Idea of Identity Trajectories?	213
Chapter 7: Discussion	219
Theoretical Framing and Methods	221
Summary of Results and Propositions for Future Research.....	224
Implications for Practice	241
Conclusion.....	243
References.....	276

List of Tables

Table 3.1: Depiction of the Three-dimensional Narrative Structure Guiding Analysis.....	73
Table 4.1: Participant Table.....	84
Table 6.1: Leading with Care: Meaningful Experiences.....	195
Table 6.2: Leading with Disciplinary Concerns or Commitments.....	208
Table D.1: Codebook.....	253

List of Appendices

APPENDIX A: Interview 1 (Protocol 1)	246
APPENDIX B: Interview Protocol 2 (End of Semester 2)	248
APPENDIX C: Interview Protocol 3 (End of Semester 3)	250
APPENDIX D: Codebook	253
APPENDIX E: Email Invitation to the Study.....	275

Glossary of Terms

Becoming

Becoming refers to the process of identity construction – shaping into a particular kind of person in relation to a community of practice (Wenger, 1998).

Belonging (Modes of belonging: engagement, alignment, imagination)

The communities of practice framework introduces *engagement*, alignment, and imagination as ways in which community members engage in and express belonging to a community of practice (Wenger, 1998; Wenger-Trayner & Wenger-Trayner, 2015). *Engagement* refers to taking part in a community practice but also may refer to exploring practices outside the boundaries of the focal community. *Alignment* involves bringing into agreement one's participation with those of “a community's regime of competence” (p. 22) or the broader mandates of the institution in which the focal community of practice is located. *Imagination* is a broad concept that includes such activities as creating a mental picture of what similar professionals in other localities are engaging in, contemplating, or creating mental images of who or what one will be as a professional in the future but equally also, producing creative ideas around engaging in practice whether these are variations to approaches and methods or new ideas.

Boundaries

Boundaries are lines between communities of practice that tend to have markers, such as various forms of qualification and discourse (Wenger, 1998, p. 104). Some boundaries are unclear or have tacit markers. However, there may be peripheries or openings across boundaries creating a greater amount of porosity that readily facilitates learning excursions of those who do not necessarily seek full membership in a new community but intend to learn or borrow from its practices. These learning excursions may include observation or some degree of engagement in practice.

Brokering

Brokering occurs as community members bring practices from their membership in one community into another community in which they also have membership. For example, an engineering faculty member may have peripheral membership in a community of engineering education researchers and may learn active learning approaches therein, which can implement in their teaching work as engineering faculty.

Community

Community “is a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence (Wenger, 1998, p. 5).

Community of Practice

A community of practice is a group of individuals who share an investment in and a commitment to a domain – defined as an expertise or configuration of interests; in pursuing these interests or in growing their expertise, individuals engage in interactions that facilitate learning and identity construction.

Community Dimensions: Joint Enterprise, Mutual Engagement, Shared Repertoire

Wenger (1998) argues that there are three dimensions through which practice defines community membership: a *joint enterprise*, *mutual engagement*, and a *shared repertoire*. A *joint enterprise* essentially is the interest or set of projects, held in common around which the community has organized itself. *Mutual engagement* refers not only to direct interactions among community members but also indirect interactions. In fact, one does not have to be present with others to fulfill the requirements of mutual engagement but could do so through, for example, reifications such as course syllabi, that one might replicate or adapt. A *shared repertoire* is a set of meaning making resources of a community and includes “routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has adopted in the course of its existence, and which have become part of its practice” (Wenger, 1998, p. 83).

Competence (Dimensions of competence: mutuality of engagement, accountability to the enterprise, and negotiability of the repertoire

Competence has not just to do with possessing a body of domain-relevant knowledge or collection of skills but involves a facility with ways of participating in the community. These include “mutuality of engagement” (Wenger, 1998, p. 137), which is “the ability to engage with other members and respond in kind to their actions,” thereby building “an identity of participation” (p. 137); “accountability to the enterprise” (p. 137), which refers to the participants’ capacity to understand the community’s enterprise “deeply enough to take some responsibility for it and contribute to its ongoing negotiation by the community” (p. 137); and “negotiability of the repertoire” (p. 137) which signifies participants’ “ability to make use of the repertoire of the practice and engage [meaningfully] in it” p. 137). This means that a member would have acquired “enough participation in the history of a practice to recognize it in the elements of its repertoire” (Wenger, 1998, p. 137) and the capacity “to make this history newly meaningful” (Wenger, 1998, p. 137).

There is another aspect of competence, though, as community members have a say and provide, depending on the situation, firm, or flexible criteria on what counts as competence. Some of the ways in which communities communicate competence are tacit and this is a likely cause of the ambiguity that faculty who are expected to be autonomous may feel entering their new tenure-track positions. For example, if the core competency emphasized in recruitment and interviewing of new faculty is on content and research knowledge and the capacity to acquire good teaching

evaluation scores as qualifying a faculty member for competent membership, they may face a vacuum for feedback when it comes to actual planning and instructional process, especially if their participation in past communities (e.g., as a teaching assistant or as a student observer did not provide the experiences that would have fostered such knowledge and negotiation of meanings around it.

Curriculum

The content and instructional activities that faculty design for students to experience in courses in an academic program.

Deep (as in deep learning or deep understanding)

I defined deep learning as learning that involves more than rote engagement with content material or memorization of facts. It is learning that provides insight into more fundamental understandings of how aspects of content (e.g., concepts relate to each other or understanding aspects of a given problem context). It is the kind of learning or understanding that helps individuals approach novel problems that involve familiar underlying principles or components.

Domain

A domain is an area of expertise or configuration of interests held in common by a group of people.

Early Career Faculty

Tenure-track faculty members in years one to three of their first faculty position.

Engagement

Taking part in actions concerning the domain represented by the community of practice.

Enterprise (joint)

A joint enterprise is comprised of the collection of interests or projects, held in common around which the community has organized itself and into which new members are invited as new hires or into which peripheral memberships are offered to prospective hires (e.g., graduate students in the case of an academic community). It is a “source of community coherence” (Wenger, 1998, p. 77).

Identity

Identity as defined in this study captures “how learning changes who we are and creates personal histories of becoming in the context of our communities” (Wenger, 1998, p. 5).

According to the communities of practice framework, teacher identity is a set of layered meanings that individuals across time negotiate through participation in sociocultural contexts that involve teaching or that they have made meaning of as being relevant to teaching.

Through engagement in the community through participating in practice (e.g., actual teaching, talk about teaching, teaching-related collaborations, observations; utilization of various artifacts such as syllabi; engagement in teaching spaces [classroom and otherwise]; experiencing and interpreting institutional policy articulated at the local level; building relationships with people

who one views as teaching professionals or persons who have a credible say on what constitutes teaching, individuals develop a set of stances, beliefs, values, practices, and commitments that create a core through-line or what Wenger terms a reification of self in relation to practice (Wenger, 1998). Identity in Wenger's and other sociocultural frames is always a work in progress as an individual through further participation in the community of practice or other communities of practice may create new meanings. Yet, given Wenger's notion of layers of participation "creating a coherence through time" (Wenger, 1998, p. 157), there is a consistent core that is maintained albeit that ongoing learning will cause the individual to acquire new meanings that will cause their identity to evolve and influence how they configure their practice,

Identity Reconciliation

Different identities and community memberships imply different practices, meanings, and so on. Thus, the individual faces the task of constructing an identity that can include these differences "into one nexus" (Wenger, 1998, p. 160).

Identity Trajectory

Identity as a trajectory is "not a fixed course" (Wenger, 1998, p. 154) but has "a momentum of its own in addition to a field of influences" (p. 154). Trajectories demonstrate coherence across time that "connects the past, the present, and the future" (p. 154). Trajectories "provide a context in which to determine what, among all the things that are potentially significant, actually becomes significant learning. A sense of trajectory gives us ways of sorting out what matters and what does not, what contributes to our identity and what remains marginal" (p. 155).

Identifications (Modulation of)

Given the demands to be knowledgeable, for example, knowing what others are doing in one's discipline internationally, our multiple memberships in professional associations, and the demands of accreditation bodies, we need to modulate "our identification and disidentification" in order to claim *knowledgeability* (which beyond competence in a single domain refers to the integration of knowledge taken from various sources in the landscape that have a claim to competence) (Wenger-Trayner & Wenger-Trayner, 2015). For example, engineering faculty might best claim knowledgeability in teaching if they have enough engagement with the community of engineering education researchers, albeit peripheral, yet sufficient to achieve a high quality of teaching.

Instruction

Instruction encapsulates the aspects of teaching that involve the instructor interacting with the student to facilitate learning both in person and through assessments and other forms of feedback and guidance that support student learning. Thus, it also involves the means through which faculty plan and manage the teaching and learning process.

Knowledgeability

Beyond competence in a single domain, knowledgeability refers to the integration of knowledge taken from various sources (domains) in the landscape that have a claim to competence in one's professional domain (Wenger-Trayner & Wenger-Trayner, 2015).

Landscapes of Practice

A complex arrangement of communities that have some meaningful claim to competence such that to be truly competent, or rather knowledgeable, one has to meaningfully engage with the community, for example, regulatory bodies and professional associations, in addition to one's departmental community (Wenger-Trayner & Wenger-Trayner, 2015).

Learning

Learning involves a process of engaging in social practices, making meaning of those practices, developing membership in a community of practice, and taking stances that constitute identity with respect to the community (i.e., becoming a particular type of person in relation to the community) (Wenger, 1998, p. 5).

Legitimate Peripheral Participation

Through legitimate peripheral participation, an individual takes up some aspect of the practice of the community, experiences a sense of mutual engagement, and through practice develops some facility with the repertoires found within what the community recognizes as competence. This engagement may end in a path to full community membership. Individuals typically do not seek full membership in all communities with which they have some relationship and, in some cases, peripheral membership in some communities is enough to assist them in gaining knowledge that serves their core community and identity.

Observation

Wenger states that “observation can be useful, but only as a prelude to legitimate engagement” (Wenger, 1998, p. 100) or engagement in legitimate peripheral participation. However, he also writes that people are allowed “various forms of casual but legitimate access to a practice without subjecting them to the demands of full membership” (p. 117) and that this “kind of peripherality can include observation” (p. 117). Whether Wenger would view observation of teaching as legitimate peripheral participation – for example, if one were invited to observe another instructor for teacher professional development purposes or observed teaching as a student in a classroom – is thus unclear.

Meaning (including negotiation of meaning through participation and reification), economies of meaning, and ownership of meaning)

Meaning refers to the evolving capacity to “experience our life and the world as meaningful” (Wenger, 1998, p. 5).

Meaning-making is the central work of individuals in a community of practice and is a critically important pillar of the communities of practice framework. Wenger (1998) builds his theory on the fundamental assumption that “learning is as much a part of our human nature as eating or sleeping, that it is life-sustaining and inevitable” (p. 3). Further, he holds “what learning is to produce” (p. 4) is “meaning” (p. 4). His framing suggests that the pursuit of meaning is a natural drive that human beings have. Further, whether individuals are in the presence of others or their own company, meaning-making is always a social process, given that in our inner dialogue we are always engaged in negotiating meanings that exist because communities have constructed them.

In the COP framework, negotiation of meaning involves a community member's engagement in practice through participation and reification. *Participation* refers simply to taking part in practice reflecting the community's enterprises. However, *reification*, which could be misconstrued as simply a static product, is meant to capture both process and product. Wenger (1998) characterizes reification as including "a wide range of processes that include making, designing, representing, naming, encoding; and describing as well as perceiving, interpreting, using, reusing, decoding, and recasting" (p. 59). Thus, while a reification can be a tool or concept that has currency in a community, its meaning and use can change, even subtly, as members of the community engage with it over time, and with the perspectives with which newcomers engage with it.

Economies of Meaning is a term referring to the structure of a community and the structuring of people in relation to the community that affords particular degrees of power to determine meanings and indeed, the meanings that are most important in a community of practice.

Ownership of Meaning comes into play as "participants can have various degrees of control over the meanings that a community produces, and thus differential abilities to make use of them and modify them" (Wenger, 1998, p. 200).

Multiple Memberships

Multiple memberships refer to the notion that people belong to different communities characterized by different practices or configurations thereof.

Negotiability of Repertoire

Negotiability is constituted of "the ability, facility, and legitimacy to contribute to, take responsibility for, and shape the meanings that matter within a social configuration" (p. 197).

Newcomers

Newcomers are individuals who are on an inbound trajectory to community membership.

Old-timers

Established members of a community of practice who represent the community's history including identity possibilities.

Paradigmatic Trajectories

Paradigmatic trajectories are real people or "composite stories" (Wenger, 1998, p. 156) that serve as models for negotiating learning and identity trajectories in relation to the community of practice (e.g., senior faculty in an academic department).

Practice

Practice encapsulates "the shared historical and social resources, frameworks and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5).

Repertoire (Shared)

A shared repertoire is a set of meaning-making resources of a community and includes “routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has adopted in the course of its existence, and which of become part of its practice” (Wenger, 1998, p. 83).

Student-Centered Teaching

Student-centered teaching consists of an array of teaching practices that center on the learning needs of students, considering their backgrounds including culture, academic preparation levels, learning history, developmental stages, how they best learn material and skills, and overall, their emotional experiences around learning and overall, their areas of strength and areas of challenge.

Teaching

Teaching involves the range of activities involved in meeting the educational needs of individuals typically through the delivery or facilitation of knowledge, skill-building, and intellectual growth centered in an organized disciplinary curriculum. It involves a range of activities from course development and planning that includes articulating one’s course within an overall curriculum to in and out-of-classroom instructional and assessment activities and guidance provided to students that supports their learning. It may include engagement with non-academic partners that can advance student learning, for example through work placements and internships. Teaching may be done singly or in a co-teaching or team-teaching situation in which collaboration is needed to decide on the responsibilities of each partner in the teaching team and how the collective work will advance student learning. Teaching may also involve any other activities of which faculty have made meaning as constituting this work.

Teaching Practices

Teaching practices are mainly the methods through which faculty enact or facilitate instruction and assessment but may also include the ways in which they engage in the course planning process, for example, having a working internal or external template for how they decide on the balance of course elements (e.g., the ratio of lecture time to group work time). I view teaching practices more holistically in contrast to behaviors that operate more at the micro-level and might involve such things as speaking at a very quick or slow pace).

Vulnerability

Vulnerability is what I consider to be the experience of lacking something essential or that of being in a less than optimal situation. This kind of vulnerability often results in empathy (the individual’s capacity or openness to be moved by or connect to the experience of another). Vulnerability may also be characterized by receptivity to support or assistance from others.

Abstract

Concerns about the quality of postsecondary engineering education have long been a feature of the higher education discourse. The socialization process for engineering faculty and STEM faculty, in general, has been deemed to hinder faculty uptake of progressive teaching practices in the form of research-based, student-centered pedagogies. In this regard, some researchers have argued that to understand the uptake of these practices, studies must examine if and how teacher identities motivate faculty to invest in their teaching. Thus, it is of critical importance that scholars study the teacher identity construction processes that early career engineering and other STEM faculty experience as they navigate academic contexts.

The present study employed the communities of practice identity framework to explore how early career engineering faculty in a research extensive institution constructed a teacher professional identity. This conceptualization views identities as multiple and as negotiated through engagement in practice within and across communities of practice that have meaning for faculty's conceptualization and enactment of teaching and other professional roles. This inquiry employed a narrative approach to data collection and data analysis. Ten participants who were in their first tenure-track faculty positions, and within three years of hiring, were interviewed three times during the academic year. The inquiry focused on faculty's interactions both as learners and teachers before they became faculty and those in which they engaged during their first years on the tenure track. Interviews were transcribed verbatim and data were coded, yielding categories and themes that were further refined through a process of analytic memoing. The

codes were read across participants but also in the context of participants' narratives to illuminate participants' individual identity journeys.

The analysis revealed that while the participants were students, they critically observed teaching and learning interactions that formed the foundations for engaging with and making meaning of their work as graduate teaching assistants. With these experiences, faculty entered their new tenure-track positions during which they engaged with a loosely configured community of practice around teaching in their departments. While they also engaged the practice landscape within and outside of the university, participants' interactions with students emerged as those that most informed how they shaped their teaching selves. These observations led to five propositions to guide future research. This study also documents the emergence of two identity trajectory sub-types, falling under an overall trajectory reflecting a learning and developmental orientation to teaching. Together these findings challenge the deficit narrative that frames engineering faculty (and STEM faculty more generally), and particularly those in research-intensive universities, as uninterested in teaching and unwilling to invest time in teaching-related activities. Finally, this study offers recommendations for future research and faculty development practice that takes a strengths-based approach to teacher development among early career engineering faculty.

Chapter 1: Introduction

Concerns about the quality of postsecondary STEM education have long been a feature of the higher education discourse (e.g., Fairweather, 2008; Seymour & Hewitt, 1997; Seymour & Hunter, 2019). This persistent issue is a matter of continued concern given the need for institutions to both attract and retain students including those underrepresented in STEM, who could potentially contribute to the nation's science and technology workforce needs (e.g., National Science Board, 2019). Seymour and Hewitt's (1997) influential publication, *Talking About Leaving*, brought these issues to the fore in a compelling fashion as these researchers presented multiple issues influencing students to switch out of STEM degree programs.

In this study, STEM undergraduates across institutional types reported experiences of poor teaching quality. Issues relating to curricular design included lectures that were too quickly paced and badly coordinated, and courses overloaded with content, with poor alignment among components. Further, non-interactive lectures dominated the student experience of teaching and learning in STEM courses. Additionally, students reported difficulty in accessing timely and suitable academic help. In a follow-up to Seymour and Hewitt's original study, a member of the research team, Hunter (2019) reported that students' concerns about the quality of the teaching and learning experience in STEM courses continued to be prevalent. Students shared concerns about content pitched at inappropriately high levels, disengaged teaching, and other presentation-related issues. Further, they reported that faculty were often unapproachable and engaged in intimidating behaviors that created distance between themselves and students. Additionally, as reported by Harper et al. (2019) (yet another member of the research team), some students also

indicated that it was quite apparent to them that some faculty did not value teaching. These findings underscore those of student retention research demonstrating that the quality of the teaching and learning experience plays a significant role in the persistence of first-year college students across disciplines (e.g., Braxton et al., 2008; Pascarella et al., 2008). Moreover, researchers have demonstrated that the use of evidence-based, active learning approaches enhances the quality of teaching in STEM disciplines. This enhanced teaching and learning experience positively affects the learning of all students but has a disproportionately beneficial impact on underrepresented minority and low-income students (Theobald et al., 2020) who are most at risk of leaving STEM majors.

Contextual Barriers to Faculty Investment in Teaching

While several efforts have been put in place to educate, prepare, and encourage engineering and other STEM faculty to use evidence-based teaching approaches, uptake has lagged behind awareness (e.g., Borrego et al., 2010; Stains et al., 2018). The literature has revealed several constraints that serve as barriers to the implementation of these methods. Studies have documented an array of constraining forces that STEM faculty face within their departmental and institutional environments that militate against their investment in teacher identities characterized by the evidence-based practices (e.g., Brownell & Tanner) that improve students learning processes and outcomes (e.g., Theobald et al., 2020). These barriers include demands for content coverage (e.g., Shadle et al., 2017), inadequate time for teaching preparation (e.g., Brownell & Tanner, 2012; Shadle et al., 2017), and demands and expectations centered around departmental norms for teaching, for example, the degree to which student-centered approaches are encouraged (e.g., Lund & Stains, 2015). Moreover, it has been ubiquitous in the literature that within research universities, departmental and the broader

institutional contexts, directly and indirectly, send messages that constructing a teaching identity is unimportant or less important than cultivating a researcher identity (e.g., Brownell & Tanner, 2012; Miller et al., 2017). The faculty reward system relating to professional advancement and attainment of tenure in research universities favors faculty investment in research over teaching (e.g., AAU, 2017; Indorf et al., 2021; Miller et al., 2017). In this regard, new faculty, especially those in research institutions, often receive messages that the research enterprise should not be compromised by too much time spent on teaching (Austin et al., 2009; Brownell & Tanner, 2012). Further, STEM departments in research institutions require that new faculty prioritize not only the establishment of research laboratories and supervision of graduate students but also that they devote much time and effort to the challenging task of securing external funding to support their labs (McGroarty et al., 2014). Thus, faculty face a role priority structure that constrains them to invest more into research than a teaching identity (e.g., Brownell & Tanner, 2012). This is of concern because research increasingly suggests that faculty members' teaching identities – the principles, values, and commitments that inform how they approach and enact their teaching role – may play a critical role in illuminating how improvements in STEM teaching might be facilitated (e.g., Ash et al., 2009; Oleson & Hora, 2014; Steinert et al., 2019).

Recent research has complicated the typical picture of STEM faculty bound by a multitude of contextual barriers that impede their engagement in research-based teaching practices. Such inquiry has revealed that the presence of teaching-related resources and supports in STEM faculty members' work environments (e.g., supportive colleagues) may help to counteract or override the impact of the barriers that have been long cited in the literature (e.g., Bathgate et al., 2019; Wieman, 2017). The presence of such supports can encourage faculty to invest the time and effort required to implement evidence-based practices (e.g., Sturtevant &

Wheeler, 2019). Among the supports that facilitate change towards evidence-based practices are initiatives that foster reflective practice and the development of reflective teachers (e.g., Henderson et al., 2011; Samaras et al., 2019). Such teachers “use their own knowledge/experience/skill to improve their instructional practices” (Henderson et al., 2011, p. 961). This notion runs counter to the “narrative of constraint” that Terosky et al., 2014, p. 58) argue needs to be shifted by acknowledging faculty members’ existing sense of agency and, potentially, departmental and institutional provisions that support the exercise and growth of such agency. The kinds of investments that faculty make in learning about and using evidence-based and engaging instruction constitute not only an investment in changed practice but an investment in themselves as teachers that is reflected both in altered beliefs and practices (e.g., framing pedagogical improvement as research or experiment and using inquiry-based methods) (e.g., Akerson et al., 2002), making ongoing commitments to pedagogical development (e.g., Ash et al., 2009; Martensson et al., 2011), and even change leadership (e.g., Ash et al., 2009; Bouwma-Gearhart, 2012; Martensson et al., 2011).

Overview of Research on Faculty Socialization

The focus of inquiry on new faculty has typically been on their socialization to the faculty role in terms of research, teaching, and service responsibilities, taking place both at the departmental and institutional level (e.g., Tierney & Bensimon, 1996). The socialization process involves the new entrant learning, through observation and interaction, the norms and practices of their new departmental community and the broader institution (e.g., Corcoran & Clark, 1984; Tierney & Bensimon, 1996). Further, socialization begins before entry into a new faculty position, typically in graduate school, and does not stop after the first few years in the faculty position but continues across the career lifespan (e.g., Baldwin et al., 2008; Neumann, 2009). Earlier frameworks characterized faculty socialization as a unidirectional process of vicarious

learning or role modeling and reinforcement or punishment for trial-and-error efforts at role enactment (e.g., Blackburn & Fox, 1974). However, later frameworks described the process as bidirectional, indicating that new faculty also contribute their own understandings of work roles, for example, to their new community or communities. Thus, a greater focus on individual agency began to emerge (Tierney & Bensimon, 1996; Tierney & Rhoads, 1993), with attention to faculty members' personal agency increasing over time (e.g., Campbell & O'Meara, 2014).

While socialization lenses such as the aforementioned have been instructive in illuminating stages through which early career faculty progress as they enter and adjust to their academic communities, more recently, identity lenses have been employed in studies set in higher education institutions. For Baker and Lattuca (2010), this is an essential step given that socialization theories have not delved into the processes through which faculty build the knowledge that equips them to engage in different aspects of their work. This knowledge is located and forged in communities that have particular epistemic beliefs and values and in relation to which early career academics engage in ongoing identity construction. Concerning teaching, in particular, research indicates that faculty draw on multiple life experiences in developing teaching identities. These include experiences as students and instructors and interactions with colleagues and family members (e.g., Oleson & Hora, 2014). Indeed, as the latter researchers close their report, they point to the importance of “exploring the role of different types of prior experience in terms of identity formation” (p. 43) in future studies. This is because the kinds of teacher identities faculty build across their academic journeys have implications for their conceptions of teaching and the ways in which they enact the work. Similarly, other STEM education researchers have addressed the importance of identity considerations in both research and pedagogical development interventions or support for early

career faculty (e.g., Brownell & Tanner, 2012; Steinert et al., 2019). Indeed, this focus on identity has been multivocal and has led to a proliferation of research on professional academic identities in higher education (e.g., Trede et al., 2012).

Professional Academic Identity Literature

My review of studies that examine the construction of professional academic identities (both teaching and research) among faculty and doctoral students revealed the use of multiple theoretical frameworks. However, the communities of practice theory, other sociocultural lenses, and narrative frames that illuminate individuals' meaning-making of interactions in context, emerged as the dominant lenses. Overall, the literature reveals that faculty identities are multiple and that resonances and tensions exist among these identities; moreover, these identities can be in tension with other identities faculty encounter in their communities of practice (e.g., Jawitz, 2009a). For example, as early career faculty enter their new departments, they might encounter senior faculty who might have different understandings of their roles as teachers. Moreover, identity work is a feature not only of the early career phase but across the career lifespan (e.g., McCune, 2019). Further, tensions will likely be more evident under policies that significantly alter the structure and requirements of professional work roles and community configurations (e.g., Skelton, 2012b). Such altered conditions may bring about not only constraints and challenges to typical faculty identities but also opportunities such as affordances for alternative identities such as those of teaching specialists. Such novel identity opportunities may prove satisfying to some segments of the academic workforce (e.g., Skelton, 2012a). Further, under wide-ranging conditions (from optimal levels of autonomy to autonomy levels assailed by managerialism), faculty are agentic in the moves they make to build, maintain, or strategically reframe or recast their academic identities (e.g., Levin & Hernandez, 2014), often through

narrative or discursive means (e.g., Clarke et al., 2012). This does not obviate the necessity of institutional support. Rather, it has been demonstrated that institutional positioning of teaching through high profile and deeply institutionalized teaching development opportunities can contribute to faculty investment in building their teaching identities (e.g., Adler et al., 2015; Martensson et al., 2011).

Studying Experiences that Shape Teaching Identity Among New Engineering Faculty

In the previous section, I highlighted the predominance of the notion of identity tensions in the literature on professional academic identity construction. This is because the context for teaching and learning is rich in social feedback, providing cues concerning the professional identities that are valued or not valued in particular academic communities. Such feedback is both direct and indirect (e.g., in work environments in which some aspects of faculty's professional role expectations are not clearly defined and where related messaging is yet present albeit in tacit forms). These socializing messages are present from the time individuals enter their academic journeys as undergraduates (e.g., Oleson & Hora, 2014). When they were students, both inside and outside of the classroom (e.g., in office hours), early career faculty would have learned and processed information about teaching and learning (e.g., Bathmaker & Avis, 2005; Oleson & Hora, 2014). Further, as new faculty, they learn about teaching practices to varying degrees depending on their access to senior faculty and peers, by listening to the teaching talk that occurs among colleagues in their departments (e.g., Blanton & Stylianou, 2009; Remmik et al., 2011). These interactions allow them to gain exposure to a range of ideas about teaching and they may choose to identify with these notions or to disavow them (e.g., Bathmaker & Avis, 2005; Remmik et al., 2013).

Sociocultural theories of learning and identity construction are well-suited to the study of how early career STEM faculty become teachers because they frame learning and identity construction as interlinked, and as occurring in social and historical context. These learning and identity construction processes do not occur passively, with individuals at the mercy of their environments, but involve inwardly processed and outwardly expressed negotiations with their sociocultural and temporal (historical) contexts (Wenger, 1998). In this regard, individuals not only engage in activities that are socially, culturally, and historically informed, but they participate in shaping the meanings of these activities, thereby making “ongoing contributions whether in concrete actions or in stretching to understand the actions and ideas of others” (Rogoff, 1995, p. 151). This class of theories constitutes an especially appropriate lens through which to frame a study on faculty experiences of becoming teachers, given that faculty’s professional lives, work and development are shaped by the departmental, disciplinary, and institutional contexts in which they learn and work as new faculty and, similarly, in which they engaged as graduate students. Acknowledging that individuals are not necessarily at the mercy of the contexts in which their professional work is located, articulations of sociocultural theory also address the role of individual motivation (e.g., Wells, 2011; Wenger, 1998) and agency (e.g., Billett, 2008; Wenger, 1998) in learning and becoming professionals of one kind or another. This agency does not, however, belie the identity tensions that are present to one degree or another as individuals negotiate multiple identities and navigate the communities to which those identities are connected (Wenger-Trayner & Wenger-Trayner, 2015).

The initial years of teaching are critical ones. Within these years, faculty members are operating within contexts in which they will employ and test (whether intentionally or by default) their knowledge of, and skills in teaching. As early career faculty begin to participate in

the practice of teaching, they are likely to engage in some level of reflection on the value of their existing teaching knowledge, conceptions, and attitudes, as well as illuminate strengths that they might build upon and inadequacies that they need to address. It is particularly important that the experiences of this initial period be understood because building a high-quality STEM teaching force is essential to the persistence and retention of all students (e.g., Seymour & Hunter, 2019; Xu, 2016). Further, if the STEM teaching norms are to be changed within colleges and universities over time, it will be necessary to ascertain the kinds of impetus and supports faculty need to remain committed not only to the teaching aspect of their work but to teaching that is student-centered and evidence-based (e.g., Sturtevant & Wheeler, 2019). Given the need for commitments to this kind of teaching practice, there is equally a need to understand the processes through which early career faculty construct teaching identities that are conducive to such commitments (e.g., Martensson et al., 2011).

Engineering is among the STEM disciplines in which increased uptake of evidence-based practices is needed to retain students, particularly underrepresented students, on whom such pedagogical practices have been demonstrated to make a marked difference in terms of STEM academic achievement (e.g., Theobald et al., 2020). Given the relationship between the kinds of teacher identities faculty hold and the teaching practices and improvement efforts they employ, inquiry into engineer's teacher identities is more than timely. Thus, I situated my study at the intersection of the continuing calls for improvement in STEM teaching and the notion of teacher identity as linked to practice. Accordingly, I sought to illuminate potential mechanisms through which teacher identities are established by early career engineering faculty. To do so, I explored the research question:

How do new engineering faculty in research-intensive universities build teacher identities in the early years of their careers, and in particular, what experiences and contexts shape their identities and practices as teachers?

Framed by communities of practice theory (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner (2015) and guided by a narrative approach to data collection that honors the lived experience of individuals across time and space (Connelly & Clandinin, 1990), this study employed multiple semi-structured interviews of early career engineering faculty working in a research-intensive university across a full academic year to explore their learning and identity construction as it relates to the teaching role. Acknowledging that learning and identity construction occur within and in relation to sociocultural contexts, I sought to understand how teacher identities are shaped by the meanings that faculty make of their teaching-related experiences within these varying contexts and how these inform their teaching practice and their teacher identities. Through this inquiry, I learned how early career engineering faculty brought their past identities into the present and how these identities contended with the identity messages and resources present in their new environments. Further, I learned the ways in which their identity trajectories were connected to their teaching concerns, commitments, values, and approaches.

Contributions of the Study

This study adds to the significant body of literature that has found academic professional identities to be multiple, evolving, and subject to both internal tensions (e.g., Clarke et al., 2012; Warhurst, 2006) and those experienced because of the constraining norms of academic departments (e.g., Ceglie & Settlage, 2019). Given the high degree of agency faculty participants in this study demonstrated in engaging with the work of teaching and constructing a teacher

identity, the present inquiry also aligns with calls for explorations of professional academic identity formation that intentionally focus on agency (e.g., Jawitz, 2007; McAlpine et al., 2014; Sikes, 2006). In this way, my study helps to counter the deficit narratives that have dominated much of the discourse on STEM faculty concerning their teaching roles, both in terms of the “narrative of constraint” (Terosky et al., 2014, p. 58) and the notion that faculty uncritically model themselves as teachers after professors who have taught them in the past (e.g., Oleson & Hora, 2014). The findings of my study demonstrate that some engineering faculty, despite high research demands that are multiple and interlocking (e.g., setting up labs, recruiting and supervising doctoral students, and sourcing funding), are not only interested in teaching but take it seriously. They spend time planning and reflecting on their work, demonstrate a willingness to try novel approaches, and invest time in crafting different ways of making learning accessible and meaningful to students. Additionally, to their role as teachers, early career engineering faculty not only bring knowledge acquired from past experiences but the identities that their negotiation of these experiences have helped to forge (e.g., Bathmaker & Avis, 2005; Oleson & Hora, 2014). The present study revealed the existence of two identity trajectory sub-types of early career engineering faculty who demonstrated a *learning and developmental approach* to their role as teachers – *leading with care* and leading with *disciplinary concerns and related commitments to scholarly habits* – identities that had their genesis in their experiences both as students and teaching assistants.

An additional contribution of my study is that it adds to the small body of literature that illuminates the role of interactions with students inside and outside of the classroom in early career faculty’s learning and identity construction around teaching (e.g., Bathmaker & Avis, 2005; Blanton & Stylianou, 2009; Mathe & Hapazari, 2019). I found that students helped to

inform faculty's considerations of what it means to be a competent teacher in engineering. Further, my findings help to show, through the communities of practice lens, that experiences faculty bring from their journeys as undergraduates are not simply those that help to inform their beliefs about teaching and learning, but these student identities are also put into contention with the identities and needs of students that the new faculty encounter as they teach their courses. Indeed, faculty travel back and forth in their minds, through imagination (as conceptualized by Wenger), reflecting on their past, and other familiar student identities as they negotiate what it means to be a teacher.

Conclusion

The findings of the present inquiry convey that some early engineering career faculty in research-intensive environments take a learning and developmental orientation to teaching to which they apply a great deal of agency. This is a finding that conveys a narrative of hope and commitment to competence that contend against “narrative (s) of constraint” (Terosky et al., 2014, p. 58) and deficit framings of faculty in STEM disciplines, especially those in research-intensive environments. These research findings resonate with those of past inquiries, add illumination to previous results, and offer support for several directions of inquiry. This is in addition to proffering propositions that can guide the development of research questions that pursue lines of research that may provide nuance to the present findings. Finally, the present research suggests some recommendations for practice, which I cautiously tender given the small scale of the study and the single university context in which it was situated. Chief among these recommendations is that the learning potential of departmental communities resident within faculty members committed to lifelong development as teachers, be facilitated and incentivized

through simple, time-efficient modes of communication that offer a balance between structure and agency.

Chapter 2: Literature Review

In this chapter, I explore literature that focuses on concepts and ideas emerging from research on the relationship that faculty have with their work. This literature encompasses socialization frameworks. I consider overarching faculty socialization frameworks and contexts that researchers have found to impact how faculty approach, and undertake the work of teaching, to illuminate their implications for the formation of STEM faculty teacher identities. Following this portion of the review, I discuss the sociocultural identity theory that served as the conceptual framework for the present inquiry (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner, 2015). Finally, I review selected literature that further illuminates the value of the sensitizing concepts from the communities of practice framework as a whole in studying how early career engineering faculty become teachers.

Faculty Socialization

Socialization has been conceptualized and studied from multiple perspectives – psychoanalytic theory, behavioral, cognitive-developmental, social learning theory, and others (Zigler & Seitz, 1978). Further, the early research in this area was heavily focused on child-rearing and development – how forms of parenting shaped the behavior of the growing child (Zigler & Child in Zigler & Seitz, 1978). However, addressing adult socialization, Mortimer and Simmons (1978) held that irrespective of age, “socialization is a two-fold process” (p. 422) involving the group and the individual. From the group standpoint, “socialization is a mechanism through which new members learn the values, norms, knowledge, beliefs, and the interpersonal

skills that facilitate role performance and further group goals” (p.422). And, from the individual standpoint, socialization is “the process of learning to participate in social life” (p. 422).

Early studies of faculty socialization tended to frame the process as unidirectional. In this conceptualization, faculty members learned through observing and interacting with members of their departmental communities (and the broader institution). These interactions included those with formal structural features of the work context (such as reward systems) and informal structural features (such as more senior peers) that conveyed expectations for how members of the community should enact their professional roles (Corcoran & Clark, 1984). This learning process was complemented through rewards and/or punishments for new faculty’s trial and error efforts at enacting aspects of the faculty role (e.g., Blackburn & Fox, 1974). Moreover, there was a strong emphasis on the faculty members’ need to understand and meet the expectations of more senior colleagues (e.g., Corcoran & Clark, 1984). However, over time, researchers increasingly began to frame the early career faculty member as possessing a greater degree of agency. In this vein, Tierney and Bensimon (1996) described faculty socialization as “a highly charged process through which different individuals and groups come together to determine organizational beliefs and attitudes” (p. 37). Building on earlier work by Tierney and Rhoads (1993), they frame socialization as occurring in a reciprocal fashion such that new faculty’s adaption to the norms and mores of the organizations in which they work was only part of the picture. Tierney and Bensimon (1996) contend that given facilitative institutional conditions, faculty also have the potential to develop new interpretations of their work and engage in agentic, non-prescriptive negotiations of their new academic environment and influence change in their work and/or conditions of work. Tierney and Bensimon (1996), like earlier theorists (e.g., Corcoran & Clark, 1984), also note that the faculty socialization process starts before they have any encounter with

the hiring institution. This process is termed “anticipatory socialization” (e.g., Tierney & Bensimon, p. 37), and is situated primarily within graduate school where students both observe and interact with professors on both formal and informal levels and also includes experiences in any prior faculty positions. After entry into their hiring institutions, new faculty embark upon a process of “organizational socialization” (p. 37) that consists of “initial entry” (p. 37), including interviewing and onboarding activities. The final stage is referred to as “role continuance” (p. 37) and takes place throughout the faculty member’s journey towards tenure. This phase includes formal tenure-related structures and processes and informal activities such as peer conversations.

Research on the socialization of faculty has focused heavily on the transition to the roles and responsibilities of the professoriate as articulated not only within the broader institution but also within their academic departments (e.g., Tierney & Bensimon, 1996). The new faculty member must learn about the balance among research, teaching, and service that is most in their favor if they are to achieve tenure. To this purpose, they must come to understand written and unwritten rules regarding how to negotiate their new department and the broader institution as well (e.g., Tierney & Bensimon, 1996). While the foregoing rules are learned by observation and experience, informal (e.g., Leslie et al., 2005) and formal mentoring (e.g., Cawyer et al., 2002; Thomas et al., 2015) may assist the process. Professional socialization is an ongoing, dynamic process and does not stop when an academic gains tenure as there are ways in which he or she continues to learn, for example, about what their research, teaching, service, and leadership or administrative profile should look like at mid-career (e.g., Baldwin et al., 2008; Neumann, 2009).

Faculty Socialization as a Journey of Lifelong Learning

More recently, scholars researching faculty careers have expanded the framing of socialization by focusing attention on the learning in which faculty engage throughout the entire

course of their faculty careers (e.g., Neumann, 2009; O'Meara et al., 2008). While the concepts of socialization and learning share similarities, Baker and Lattuca (2010) contend that scholars have treated the two concepts separately both on theoretical and empirical levels. They note that in studies of doctoral education, this separation has resulted in a focus on how individuals are socialized to the professorate while offering little insight into the processes through which they build the knowledge and expertise that support the different facets of their work. This conceptualization presumes, Baker and Lattuca (2010) argue, that disciplinary content knowledge is unaffected by the context (values, norms, standards, and expectations) in which it is developed and deployed. Such a view, they contend, overlooks the consideration that the knowledge of a field is a product of a community of individuals with particular commitments, including epistemic beliefs and values. Further, drawing upon sociocultural and developmental network frameworks, they assert that there is a connection between the learning in which doctoral students engage and the building of professional identity. Further, they offer that the impact of doctoral education, beyond the acquisition of content knowledge and skills from the curriculum, is best explored by situated theories of learning and identity that help one to grasp a fuller scope of the processes through which they become professional academics – processes, afforded through interactions with their academic communities. While Baker and Lattuca (2010) focused on doctoral students, given that this is the period just before they become early career faculty, the theorization of these researchers added value to contextualizing the present inquiry.

Socialization and Preparation of STEM Faculty Around Teaching

Within the professional socialization research, the weightiest issue, especially in research-intensive institutions, is that of developing the researcher aspect of the faculty role. This is a natural consequence of the reality that an academic gains tenure primarily based on the

quality of their research production and the positioning of this research in reputable venues (Tierney & Bensimon, 1996). Further, while teaching has typically been emphasized at two-year, for-profit, and liberal arts colleges, socialization in research universities has tended to prioritize research (Austin, 1990; Robert & Carlsen, 2017).

Institutional Contexts that Shape Teaching Practices of Early Career STEM Faculty

Inadequate socialization for STEM doctoral students in the area of teaching has long been noted in the literature (e.g., Austin, 2002). While formal and informal professional development opportunities for those seeking to improve their teaching practices exist and have been increasing (e.g., Mathieu et al., 2020; Pfund et al., 2012), institutional contexts may discourage participation in such activities and programs and thus fail to support the development of evidence-based teaching practices and the development of teacher identities among STEM faculty. There has typically been a lack of opportunity for mentorship and feedback on teaching during doctoral training (Austin et al., 2009; Janke & Colbeck, 2008; Luft et al., 2004). Moreover, STEM graduate students are often actively discouraged from putting much time and effort into teaching so as not to compromise their research productivity (Austin et al., 2009; Brownell & Tanner, 2012). Additionally, some graduate students are likely to have observed faculty behaviors such as using grant money to ‘buy out’ of teaching assignments to create more time for research (Janke & Colbeck, 2008). Such behavior is not uncommon in the top 100 research universities, in which around 80 % of STEM doctoral degrees are earned (Pfund et al., 2012). In a research university context, rewards for teaching are typically substantially less plentiful than those for research (Fairweather, 2005; Tierney & Bensimon, 1996). Researchers have identified these arrangements or structures as barriers to STEM faculty making optimal investments in the teaching aspect of their work (e.g., O’Meara et al., 2008; Serow et al., 1999; Walczyk et al.,

2007) and in particular, investments made in becoming teachers whose work is characterized by student-centered, evidence-based practices (Lund & Stains, 2015; Sturtevant & Wheeler, 2019).

Research has revealed that even in engineering departments across the nation in which faculty awareness of research-informed practices was high, uptake by faculty failed to match awareness levels (Borrego et al., 2010). Moreover, while studies demonstrate that STEM faculty bring a range of experiences to bear on their teaching, their teaching practices seem to be informed principally by their previous instructional experiences and experiences as students (Jamieson & Lohmann, 2012; Oleson & Hora, 2014). Given the continued dominance of lecture-based teaching in STEM fields (e.g., Seymour & Hewitt, 1997; Seymour & Hunter, 2019), it is apparent that as students, many early career faculty did not experience many evidence-based teaching approaches from the instructors of their STEM courses.

Notwithstanding these troubling constraints, there is evidence that the implementation of well-structured, adequately funded, highly institutionalized, teacher professional development programs can lead to favorable outcomes on STEM faculty's attitudes to and implementation of research-based teaching practices, redounding to the benefit of students taking these courses (e.g., AAU, 2017). In this connection, Ash et al. (2009) found that initial faculty participation in well-structured communities of practice for teacher development yielded teacher identities informed by evidence-based practices, the development of transformational leaders in the evidence-based pedagogies, and commitments to ongoing professional learning. Of particular importance from the perspective of my inquiry, this literature suggests that a fruitful research approach would include the use of identity frameworks to understand the motivation of early career STEM faculty to invest in learning about teaching and in the discovery of themselves as teachers (e.g., Akerson et al., 2002; Bouwma-Gearhart, 2012; Brogt, 2007). These studies

suggest that building a strong teacher identity can motivate even more investment in teaching and ongoing professional development (e.g., Ash et al., 2009; Bouwma-Gearhart, 2012; Martensson et al., 2011).

Beyond concerns about the inadequacy of pedagogical preparation among STEM faculty and rewards for investment in teaching, several studies have highlighted structural constraints that faculty face within the classroom, departmental and institutional environments. These include real or perceived curricular constraints such as demands to cover the full content of the curriculum (Bailey & Nagamine, 2012; Henderson & Dancy, 2007; Shadle et al., 2017), lack of time (Brown et al., 2006; Brownell & Tanner, 2012; Henderson & Dancy, 2007; Shadle et al., 2017), the physical structure of the classroom (Henderson & Dancy, 2007; Shadle et al., 2017) and class size (Brown et al., 2006; Henderson & Dancy, 2007; Shadle et al., 2017). However, social factors are also implicated, including lack of departmental or collegial support (Henderson & Dancy, 2007; Sunal et al., 2001); concerns about students' possible or actual negative reaction to the introduction of active teaching approaches (e.g., Finelli et al., 2013; Henderson & Dancy, 2007; Shadle et al., 2017); and the need for knowledge about or training in new instructional methods (Brownell & Tanner, 2012; Shadle et al., 2017).

The Impact of Discipline on Teaching

Research indicates that faculty members' academic disciplines also have an impact on their teaching preferences and choices. In their review of early evidence, Braxton and Hargens (1996) reported that, in general, faculty in high consensus or hard disciplines such as natural sciences that are characterized by a large core of highly codified extant knowledge and high levels of consensus, were less likely to prefer teaching than those in low consensus fields such as humanities and social sciences. Further, they found that the teaching approaches of faculty in

high consensus fields were less student-centered. Supporting this finding, Neumann et al. (2002), reported that faculty in low consensus fields typically employed more discussion methods, whereas those in high consensus fields tended to employ lectures and labs. In terms of assessing student knowledge, Braxton and Hargens (1996) note that questions requiring “analysis and synthesis” (p. 34) were strongly featured in examinations for courses in low consensus fields, whereas examinations in high consensus fields called for memorization of content for application to problem-solving. These modes of assessment have implications for the kinds of teaching and learning approaches that are applied in each case. Given the prevalence of verification labs in STEM disciplines, the student learning process has not typically been marked by high student engagement. Donald’s (2002) research has linked variations in faculty members’ course planning and perceptions of students to disciplinary affiliation as well. What must also be said about these typical patterns is that cultural shifts have begun such that faculty in high consensus fields – the sciences – have begun to some degree to employ student-centered methods as reflected in publications including *Reform in Undergraduate Science Teaching for the 21st Century* (Sunal, et al., 2004). Further, Stains et al. (2018) whose study of 2008 class sessions across 709 STEM courses revealed that while lecture was dominant, this mode of teaching was often accompanied by one or more student-centered teaching practices. Regarding engineering in particular, albeit that uptake of evidence-based teaching practices has lagged behind awareness, the increased awareness is at least encouraging (Borrego et al., 2010).

Studying the Teacher Identity Construction of STEM Faculty

The foregoing discussion reveals an array of contextual factors that may constrain early career faculty’s engagement in more effective approaches to teaching (i.e., evidence-based methods) and meaningful socialization as teachers. However, the literature also reveals an

emerging shift of interest, investment, and recognition of evidenced-based practices and the attendant need for prospective science and engineering faculty to be aware of and trained in these practices (e.g., AAU, 2017; Austin et al., 2009). Further, in recent times, multiple avenues for training prospective and early career STEM faculty in the area of teaching have emerged (e.g., Baker et al., 2014; Mathieu et al., 2020). These developments have provided hope for the preparation and emergence of larger numbers of STEM faculty constructing teacher identities that are characterized by evidence-based teaching practices. Having considered the many influences on how STEM faculty may engage with the teaching role and develop as teachers, it is clear that sociocultural identity lenses hold promise to help researchers understand how interactions in social contexts (e.g., work environments) facilitate teacher identity construction in early career engineering faculty.

The Landscape of Higher Education Research on Professional Academic Identity

While K-12 education researchers have for many years been at the forefront of inquiry on teacher identity as reflected in multiple literature reviews (e.g., Beauchamp & Thomas, 2009; Beijaard et al., 2004), an emerging body of research in higher education has begun to explore not only academic identity in general (e.g., Jazvac-Martek, 2009; Murray & Male, 2005) or research identity (e.g., McGregor et al., 2010; Murphy et al., 2014), but also teacher identity in particular (e.g., Blanton & Stylianou, 2009; Jones, 2010; Kreber, 2010; Martensson et al., 2011; Mathison, 2015; Nevgi & Lofstrom, 2015; Skelton, 2012a).

This body of research reveals that professional identities include multiple sub-identities (e.g., Andrew et al., 2009; Arvaja, 2018; Jawitz, 2007); that tensions among individuals' existing professional identities or between their current and aspirational identities are inevitable, although the degree of tension will likely vary according to the demands of the context (e.g., Andrew et

al., 2009; Duffy, 2013), and that tensions are likely to occur between early career faculty and more experienced faculty around the matter of teaching, depending on the nature of the departmental culture, for example, whether teaching discourses and meanings are compatible (e.g., Blanton & Stylianou, 2009; Jawitz, 2009a). Indeed, it has been demonstrated that when new faculty enter traditional STEM teaching environments, they may experience a lack of support in the area of teaching even when structures such as mentorship programs are put in place (e.g., Blanton & Stylianou, 2009). Further, tensions are likely to be heightened when new faculty who have been trained in student-centered practices enter academic departments in which they do not share a common language with senior faculty (potential mentors) to facilitate discussions that support and help to advance their emerging student-centered teacher identities (e.g., Blanton & Stylianou, 2009; Warhurst, 2008).

Another subset of the studies reveals that identity-related tensions may be more evident under institutional and departmental policies that alter the structure and expectations of academic work roles and communities (e.g., Clegg, 2008; Skelton, 2012b). This subset of studies dominates the literature because of the transformation in international higher education that is marked by marketization, managerialism, and highly structured accountability measures that have drawn international higher education researchers to intensify research on professional academic identities (e.g., Clegg, 2008; Guzmán-Valenzuela & Barnett, 2013; Kreber, 2010) including teacher identities, in particular. While these studies unveil the constraints that faculty experience on their professional identities, they also reveal faculty members as active agents in the actions they undertake to build, maintain, or strategically reframe their academic identities (e.g., Levin & Hernandez, 2014; Sikes, 2006; Ylijoki & Ursin, 2013).

Among the research demonstrating that agency is an important component of professional identity construction, a group of studies focused on narratives (e.g., Churchman & King, 2009), discourses (e.g., Bottoms et al., 2013), or inner dialogue (i.e., reflection on engagement in practice) (e.g., Clegg, 2008) as means through which faculty make meaning of their experiences and create their professional identities within the sociocultural environments that they encounter throughout their career journeys. These narratives are varied, e.g., reflecting performativity (e.g., Clegg, 2008; Skelton, 2012b), agency (e.g., Clegg, 2008), survival (e.g., Levin & Hernandez, 2014), and covert forms of resistance to academic regimes that pose a threat to their professional identities (e.g., Churchman & King, 2009; Clegg, 2008; Skelton, 2012b). Further, inner dialogue was demonstrated to be central to the identity work required to negotiate and reconcile multiple professional identities (e.g., Arvaja, 2018; Van Lankveld et al., 2017), especially in particularly complicated contexts such as those in which teaching is viewed as holding lower status in comparison to research (e.g., Van Lankveld et al., 2017). However, notwithstanding demonstrations of agency through this kind of identity work, researchers agree that it is essential that departmental and other institutional supports be provided to promote student-centered teacher identities (e.g., Blanton & Stylianou, 2009; Sturtevant & Wheeler, 2019; Warhurst, 2008).

Within the literature reviewed, there was a notable absence of research that addresses the teacher identities of early career engineering faculty and even in STEM more generally; the exception to this pattern was found in the medical education literature (e.g., Jauregui et al., 2019; O'Sullivan & Irby, 2014; Steinert et al., 2003, 2019; Stone et al., 2002). In this literature, the importance of teacher identity to understanding the emergence of and commitments to high-quality teaching was made clear (see, Steinert et al., 2019 for a review of other relevant studies).

Given the potential motivational import of professional identity for continued investment in teaching (e.g., Ash et al., 2009) and the impact of the cultural context of academic departments on the construction of professional identity, the professional experiences and identity construction of early career engineering tenure-track professors proves a fruitful focus of inquiry.

Conceptualizing Academic Professional Identity in Higher Education Settings

Leading higher education scholars Trowler and Knight (2000) offer important considerations for theorizing the entry of faculty into new work environments and frame their “process of coming to know” (p. 27) as one of “identity construction” (p. 28). In addition to studies of faculty identity construction, researchers have focused attention on the professional identity construction of doctoral students, with a significant emphasis on their identities as research scholars (e.g., Murphy et al., 2014; Murakami-Ramalho et al., 2013). Again, similar to arguments in the K-12 literature, identity is viewed as a motivating influence in terms of how individuals understand, frame, approach and invest in their professional work. Research on STEM faculty pedagogical development, whether pursued in large communities of practice (e.g., Ash et al., 2009; Lieff et al., 2012) or in partnerships constituted of small working groups (Akerson et al., 2002; Brogt, 2007), suggests that identity is a motivating factor for investment in teaching.

The higher education literature reviewed for this study included research on the construction of academic professional identity in general, as well as studies that focused more narrowly on the development of researcher and/or teacher identity. Of the 93 articles in my corpus of relevant studies, about half focused on teacher identity specifically, and just under half focused on academic identity in general (i.e., including both teaching and research identities). While a subset of these articles focused on doctoral students (e.g., Murphy et al., 2014;

Murakami-Ramalho et al., 2013), the majority examined faculty members' identity construction. Several studies addressed early career faculty (e.g., Jawitz, 2007; Liu & Xu, 2011; Murray & Male, 2005; Warhurst, 2006), but most included participants at multiple career levels (e.g., Andrew et al., 2009; Burton et al., 2013; Churchman & King, 2009; Jawitz, 2009a; Skelton, 2012a).

In the following sections, I discuss the theoretical grounding that researchers employed to guide their studies of faculty identity development. While a variety of theories were utilized, studies employing sociocultural or socioculturally oriented frameworks dominate the current literature. After a brief overview of the corpus, I explain the thrust of each group of studies, emphasizing the broad contours of the theoretical approaches, before identifying and describing in detail the conceptual grounding I chose for my study.

Before examining these theoretical perspectives in greater detail, an accounting of the major categories of perspectives is helpful. More than half of the studies reviewed employed theoretical perspectives based on communities of practice (e.g., Blanton & Stylianou, 2009; Jawitz, 2007; Viskovic, 2006) or similar sociocultural perspectives (e.g., Billot, 2010; Burton et al., 2013; Smith & Boyd, 2012). Another subset of academic identity studies, around 16% of the corpus, were guided by frameworks that conceptualize narrative (that is, the telling of stories about oneself) as a meaning-making mechanism in identity construction (e.g., Churchman & King, 2009) or that employ a dialogical approach to understanding identity. The latter conception focuses on the internal dialogue individuals engage in as they negotiate identities (e.g., Arvaja, 2018). The studies that are guided by these narrative framings share similar assumptions about identity development as those utilizing the community of practice or other sociocultural frameworks, as I demonstrate in the following section. Another small subset of studies, about 9%

of the studies reviewed, employed psychological concepts or frames to illuminate the process of identity formation. For example, Reibold and Alamia (2008) used the notion of identity formation through experimentation with possible selves, a concept developed by Markus and Nurius (1986) and popularized by Ibarra (2004), while Jazvac-Martek (2009) framed the process of identity formation as one of role validation provided by significant others in desired communities. In terms of factors shaping identity (or identity building blocks), such concepts as self-efficacy (e.g., Mathe & Hapazari, 2019; Nevgi & Lofstrom, 2015) and self-image (Nevgi & Lofstrom, 2015) appear in this group of studies. Another subset of studies (around six percent), addressed how institutional power differentials affect the formation of academic identity (e.g., Archer, 2008a, 2008b; Clarke et al., 2012; Skelton, 2012a, 2012b). Finally, a few studies varied from these larger patterns, applying unique theories to illuminate professional identity construction among faculty. These frameworks included the social process theory of leadership (Bolden et al., 2014) and Archer's social realism theory (Guzmán-Valenzuela & Barnett, 2013, p. 204).

In the following sections, I discuss the primary assumptions of the four dominant theoretical approaches that have guided studies of faculty development in recent years. In broad terms, across frameworks, professional identity construction is conceptualized as a dynamic process that involves the individual making meaning of interactions either in sociocultural contexts or in some way drawing upon social information to establish these understandings. Frameworks in the literature include: (a) communities of practice and other sociocultural theories; (b) narrative and dialogical identity approaches; (c) psychological frameworks and concepts; and (d) power analyses. Following this brief overview, I explain my decision to

employ concepts from the communities of practice framework (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner, 2015) to guide my study.

Communities of Practice and Other Sociocultural Theories. Studies that utilized either the communities of practice (COP) framework (e.g., Bathmaker & Avis, 2005; Blanton & Stylianou, 2009; Burton et al., 2013; Jawitz, 2007, 2009a, 2009b; Smith & Boyd, 2012; Viskovic, 2006; Warhurst, 2006, 2008) or other sociocultural frameworks (e.g., Billot, 2010; Fanghanel & Trowler, 2008; Levin & Hernandez, 2014) portrayed professional academic identity as evolving across time and location. Further, the theories as applied in these studies, framed faculty members as having multiple identities and/or community memberships and located professional learning and identity construction in the context of practice in some domain of knowledge. These frames also acknowledged that identity tensions would occur within the individual faculty member (and between faculty members) and that these tensions would be influenced by interactions in various contexts. Thus, faculty would need to undertake the identity work of balancing or reconciling identities. Further, these studies conceptualized faculty as active participants and meaning-making agents who negotiated multiple identities as they learned in and through practice.

Narrative Identity and Dialogical Identity Approaches. Narrative identity theories as employed in the reviewed studies conceptualized narrative as a means through which faculty make meaning of their experience and construct identity through the telling and retelling of stories about their experiences across time and location (Carrillo & Baguley, 2011; Churchman & King, 2009; Fitzmaurice, 2013; Jones, 2010; Khan, 2011; McAlpine et al., 2014; Remmik et al., 2013; Trevitt & Perera, 2009; Triantafyllaki, 2010; Ylijoki & Ursin, 2013). Dialogical identity theory focuses on narrative as well, but view this story-telling as an inner dialogue

between the faculty member and various I-positions, such as “I” as researcher and “I” as teacher, and multiple internalized voices relevant to the negotiation of these identities (Arvaja, 2018; Van Lankveld et al., 2017). As used in studies of faculty identity development, these narrative and dialogical identity frameworks are similar to sociocultural and situative theories in their assumptions that individuals must navigate multiple sociocultural contexts over time and negotiate multiple identities (such as university teacher and researcher) to construct their professional identity. For example, Van Lankveld et al. (2017) note that dialogical theory works in tandem with the social practice theory “figured worlds” (Holland et al., 1998), explaining that the latter provides insight into the occurrence of the contextually or culturally informed identity tensions faced by faculty members while dialogic theory helps to illuminate how faculty integrate new roles into their identity to reduce these tensions. Applying narrative identity frames to studying teacher identities in higher education, Remmik et al. (2013) focused on faculty narratives – understood as the stories that faculty tell themselves and others to communicate who they are. These stories reflected their identity journeys, which encompassed the work of navigating multiple contexts, roles, and identities. Narrative and dialogic conceptualizations of identity lift up the voices, stories, and/or internal dialogue of individuals as they negotiate their identities across time and contexts and, as demonstrated by Van Lankveld et al. (2017) and others, are compatible with sociocultural identity lenses.

Psychological Theories or Concepts. Among the studies employing psychological theories and concepts, two were grounded in notions of role identity (Jazvac-Martek, 2009; Lieff et al., 2012) and focused attention on how doctoral students (pre-faculty) and faculty depend on messages and cues from significant others representing identities in desired communities, in an experience of “legitimization and self-verification” (Jazvac-Martek, 2009, p. 255). Murray and

Male (2005) employed the concepts of substantial and situational selves, which focus on how individuals create alignment between the new identities being forged in new work contexts (situational selves) and pre-existing identities (substantial selves) in a process of identity solidification. Reybold and Alamia (2008) employed a framing of possible selves – selves that have “embedded transition storylines” (p. 122) and “image norms or generalized standards for success” (p. 122) – to explore identity transition phases experienced by women faculty. Other studies combined a variety of self-related variables including self-efficacy (Kumar et al., 2011; Mathe & Hapazari, 2019; Nevgi & Lofstrom, 2015). Utilizing sociocognitive career theory, Kumar et al. (2011) operationalized self-efficacy as well as other concepts in this theory (i.e., outcome expectations, interests, goals, experiential factors, and environmental features to illuminate factors that motivate clinician-educators who “privilege teaching over research” (p. 497). Nevgi and Lofstrom (2015) investigated self-image, motivation to teach, motivation to develop as a teacher, and task perception (i.e., how teachers defined their work) to identify the factors that influenced teacher identity. While studies framed through these lenses tell stories of individuals engaging with their work and other social situations, social context is positioned less prominently than obtains in sociocultural studies and framings. Instead, these psychologically grounded studies center sociocognitive processes and mechanisms that individuals employed – constructs that served as identity building blocks.

Theories Focused on Power. A subset of studies, all but one of which were situated in international contexts (see Peach & Bieber, 2015, for the exception), centered power as a critical construct (Archer, 2008a, 2008b; Clarke et al., 2012; Harman & McDowell, 2011; Skelton, 2012a, 2012b). The majority of these studies addressed the local impacts of managerialist approaches to higher education in European contexts as reflected, for example in “audit culture”

(Archer, 2008b, p. 270), on the forging of academic identities among new faculty. In the U.S. context, Peach and Bieber (2015) examined the power dynamics experienced by faculty who taught online. This study revealed that although faculty experienced a sense of elevation through the autonomy and visibility afforded by teaching online, teaching in this location also made them subject to the unexpected, deleterious impact of departmental power dynamics on their teaching identities. This power was manifested through the lack of administrative acknowledgment of the additional workload required to teach online, and increased quality “surveillance” (p. 33) that placed these *virtual* faculty at a comparative disadvantage to colleagues who taught in-person classes. The foregoing studies framed power predominately through Foucauldian lenses (e.g., Archer, 2008b; Harman & McDowell, 2011) but one study employed Bourdieu’s conceptualization of power (Archer, 2008a).

Communities of Practice as a Conceptual Framework for the Present Inquiry

From among the identity conceptualizations, I decided to frame the current inquiry using the communities of practice framework (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner (2015), supported by a narrative approach to data collection and analysis (Connelly & Clandinin, 1990). This approach helped me to access the lived experiences of early career faculty across time and location. The communities of practice framework conceptualizes the phenomena of learning and identity construction as inextricably linked and as occurring within and across multiple influential contexts. This conceptual framework aligned with my goal of illuminating how teacher identities are shaped by experiences within varying contexts that early career engineering faculty navigate and draw upon to inform their teaching work and their teacher identities.

While a major criticism of the communities of practice framework has been its lack of attention to power dynamics (e.g., Fox, 2000; Fuller et al., 2005; Roberts, 2006), Wenger (1998) *does* address power both within the community of practice and within broader institutions in which such communities are located. On one hand, a person's identity as a legitimate member of a community gives them "the power to belong" (p. 207). However, on the other hand, Wenger acknowledges that "there is the vulnerability of...identifying with...some communities that contribute to defining who we are and thus have a hold on us" (p. 207). An individual may also experience pressure to align with broader organizational requirements. In this regard, the power exercised by the broader institution can "seep" (p. 197) into the identity of employees. Thus, Wenger acknowledges the presence and impact of power although it is neither central to his theory nor is it framed as pervasive.

Among the studies in the corpus of relevant literature reviewed, power analyses mainly focused on the academic identity implications of conditions of work that created changes in power dynamics, such as regimes of "control" (e.g., Peach & Bieber, 2015, p. 27) or hierarchies (Harman & McDowell, p. 48). Additionally, the questions and the contexts studied were markedly different from those that obtained in my research study. My goal was to understand the meaning-making of early career engineering faculty members about their teaching practice and how these meanings contribute to the construction of a teaching identity. The power of these local contexts is of interest to the extent that faculty recognize that it exists and the degree to which it influences their teaching practices and identities. However, the primary focus of my study was the role that participation in practice plays in shaping meaning and learning and how the latter affect the construction of teaching identities. To the extent that relations of power exist at the local level of the community, I believe that the communities of practice framework

adequately addresses the issue of power as will be explained in the following articulation of my conceptual framework.

Conceptual Framework

In general, sociocultural frameworks focus our attention on how individuals' interactions with their environments both the overt and tacit, both the human and the material, inform how they engage in workplace learning and identity construction, which are framed as interlocking processes (e.g., Holland et al., 1998; Wenger, 1998). This is particularly important to the present inquiry, given that departmental affordances, resources, and supports for constructing teacher identities in research-intensive environments have been known to be limited or constrained. One critically important affordance of sociocultural approaches over individually centered cognitivist frameworks is the manner in which they guide our attention to important considerations regarding the history and culture that lie in the learning and identity-building resources that reside tacitly in the workplace, and conceivably in other related contexts in which individuals may have learned and identified with what it means to be a professional of one kind or another.

Although sociocultural frameworks focus substantially on the impacts of contexts across time and spaces on the forging of identity, they also articulate ways in which individuals bring human agency to bear on their interactions with their environments (e.g., Holland et al., 1998; Wenger, 1998). These frameworks allow researchers to go beyond banking models of knowledge and skill acquisition to focus on how the meanings that individuals experience concerning different practices might motivate particular identities, and conversely, how particular identity trajectories might motivate individuals to be drawn to certain meanings, perspectives, and interactions that allow them to advance those perspectives. For example, a faculty member who benefited from student-centered teaching and learning as an undergraduate might have a desire

not only to employ these practices as a new faculty member but might actively seek out conversations with colleagues who have such skills or training. Such interactions could lead them to conduct independent research into such practices and engage in email interactions with colleagues both within her department, similar locally negotiated practices at other institutions, or even different disciplinary communities within the institutional landscape of practice that share student-centered interests.

The Communities of Practice Lens

A community of practice is a group of individuals that share an investment in and a commitment to a domain – defined as an expertise or configuration of interests; in pursuing these interests or in growing their expertise, they engage in interactions that facilitate learning and identity construction (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner, 2015). I assume that for faculty members in a research-intensive engineering department, two particularly relevant domains that create communities of practice are the related domains of engineering research and teaching.

A basic premise of the communities of practice framework is that learning and identity construction processes take place through individuals' interactions within communities dedicated to some domain of knowledge or other collective interest. In addition, Wenger's theory assumes that individual's experiences of learning occur across landscapes of practice comprised of different communities of practice. The individual has different levels of membership in these various communities, ranging from core to peripheral (Wenger, 1998). In the case of new engineering faculty entering research and teaching communities of practice at the national and local levels, individuals bring practices and meanings of practice drawn from their experiences of being a student, a research advisee, a teaching assistant, or even a parent. Within their new

academic departments, their interactions with others and with the culture and norms of the department and the discipline serve as resources for learning and identity building. They interact with other members of these communities who exist along the continuum from *newcomer* to *old-timer*. As new members of these communities of practice, they engage with stories, artifacts, documents, discourses, and other materials that reflect the particular community's *history of learning* – how it has, over time, maintained or adjusted the nature of its enterprises and projects (e.g., the project of teaching or the project of research), its competencies, and its modes of engagement in its work. This engagement is a mechanism by which new faculty can be exposed to *paradigmatic trajectories*. Wenger views the latter as “models” (p.156) that help to make a community of practice “a field of possible trajectories and thus the proposal of an identity” (p. 156) from which the newcomers can potentially draw as a resource for undertaking their own learning and identity work.

In the following sections, I identify the key elements of the communities of practice (hereafter, COP) framework that served as sensitizing concepts in my study. Sensitizing concepts shape research procedures and analytical tools but do not constrain the interpretation of study findings; they thus allow, as needed, for analytical and interpretative freedom. In each of the following sections, I present my assumptions about how these elements might influence the learning and identity development of new engineering faculty members in a flagship research university. Following the discussion of the conceptual framework and its key elements, I move to a review of relevant literature that illuminates the utility of the concepts.

Three Dimensions of Community Membership

Wenger (1998) argues that there are three dimensions through which practice defines community membership: *a joint enterprise, mutual engagement, and a shared repertoire*. A joint

enterprise essentially is the interest or set of projects, held in common around which the community has organized itself and into which new members are invited as new hires and into which *peripheral memberships* are offered to prospective hires (e.g., graduate students in the case of an academic community). It is a “source of community coherence” (p. 77) that is needed to support the collective enterprise (e.g., of engineering education). For engineering and other faculty in a research-intensive environment, the joint enterprise could be defined in terms of a high-priority research mandate that emphasizes developing a research identity, along with a subordinate but less significant teacher identity. Mutual engagement refers not only to direct interactions among community members but also indirect interactions. In fact, one does not have to be present with others to fulfill the requirements of mutual engagement. New faculty might engage with stories about old-timers, syllabi, notes on the use of individual response systems, and other artifacts that help them come to a sense of mutual understanding about the nature of the teaching enterprise. It also must be noted that not all mutual engagement is positive, but can involve a range of “disagreements, tensions, and conflicts” (Wenger, 1998, p. 77). For example, conceivably, someone might resist an advisory by their program chair, to seek help for teaching at the teaching center, because they are not sufficiently invested in the teaching part of the department’s enterprise.

A shared repertoire is a set of meaning-making resources of a community and includes “routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has adopted in the course of its existence, and which have become part of its practice” (Wenger, 1998, p. 83). While these are core dimensions of a community, they are not static but in a constant process of being negotiated, with emergent meaning making and new contributions to which not everyone will necessarily agree, and in some instances, to

which total agreement may not be a requisite for core membership. Thus, while the shared repertoire of the department around teaching might have traditionally favored transmission-based and didactic approaches in its histories of learning around teaching, there may be an emerging core of student-engagement practices, e.g., individual response systems such as i-clickers, that the department, over a shorter part of its history, has deemed to be valuable. Thus, a new faculty member must make meaning of this shared repertoire and determine how they will negotiate their own participation in and contribution to it.

Competent Membership

Defining and negotiating *competence* constitute critical components of the identity work that the community undertakes and, according to Wenger (1998), it is healthy to be in an ongoing process of such negotiation, so as not to remain stagnant in its practice. Competence has not only to do with possessing a body of knowledge or collection of skills but also involves a facility with ways of participating in the community. These include *mutuality of engagement*, which is “the ability to engage with other members and respond in kind to their actions,” thereby building “an identity of participation” (p. 137); *accountability to the enterprise*, which refers to the participants’ capacity to understand the community’s enterprise “deeply enough to take some responsibility for it and contribute to its ongoing negotiation by the community” (p. 137); and *negotiability of the repertoire*, which signifies participants’ “ability to make use of the repertoire of the practice and engage [meaningfully] in it” p. 137). This means that a member would have acquired “enough participation in the history of a practice to recognize it in the elements of its repertoire” (Wenger, 1998, p. 137) and the capacity “to make this history newly meaningful” (Wenger, 1998, p. 137). This is to say that while “our engagement in practice may have patterns” (p. 52), it is through rendering “such patterns anew that gives rise to an experience of meaning”

(p. 52). *Meaning-making* is the central work of individuals in a COP and is a critically important pillar of the COP framework. Wenger (1998) builds his theory on the fundamental assumption that “learning is as much a part of our human nature as eating or sleeping, that it is life-sustaining and inevitable” (p. 3). Further, he holds “what learning is to produce” (p. 4) is “meaning” (p. 4). His framing suggests that the pursuit of meaning is a natural drive that human beings possess. Further, whether individuals are in the presence of others or their own company, meaning making is always a social process, given that in our inner dialogue, we are always engaged in negotiating meanings that exist because communities have constructed them.

An individual mutually engaged in practice may look like that new faculty member who upon entry or before entering into a new position, talks with others in the community about the course they are taking up, and draws to a greater or lesser extent from these sources of knowledge in constructing their course content and instructional approach. In the process of making meaning of the content, pedagogical, or technological information contained in such exchanges, they negotiate the repertoire. In doing so, the new engineering faculty member is likely to put into dialogue their own resources (such as repertoires of competence they previously observed as a student or in which they participated as a teaching assistant) with the new resources reflecting possible teacher identities in the new focal departmental COP. Their sense of accountability to the enterprise of undergraduate teaching, for example, does not have to reflect entirely the focal community’s history of learning (or what practices seem to have dominant currency in that space). Rather, the new faculty member may engage in novel practices (at least new to the focal community) that still reflect high accountability to the enterprise as measured, for example by their teaching evaluation scores.

In summary, competence is one's facility with navigating a community of practice by giving enough attention to its enterprises, shared repertoires, and histories of learning and relevant accountabilities – enough to be able to configure an identity status that reflects a manifestation of competence that the community can recognize. A new faculty member's negotiated meanings concerning teaching in engineering are going to likely be reflective of their accountabilities to relevant community memberships built over time. To develop or evolve different accountabilities that may potentially better serve the teaching enterprise, a new faculty member will need to engage in a complexification of their learning and identity trajectory around teaching. Naturally occurring situations such as encountering unfamiliar student identities in his classroom or conversations with new colleagues might constitute a boundary fruitful for learning.

Negotiation of Meaning: Participation and Reification

In the COP framework, *negotiation of meaning* involves a community member's engagement in practice through *participation* and *reification*. Participation refers simply to taking part in practice reflecting the community's enterprises. However, reification, which could be misconstrued as simply a static product, is meant to capture both process and product. Accordingly, while a reification can be a tool or concept that has currency in a community, its meaning and use can change, even subtly, as members of the community engage with it over time, and with the perspectives with which newcomers engage with it. As an ongoing process, Wenger (1998) characterizes reification as including “a wide range of processes that include making, designing, representing, naming, encoding, and describing as well as perceiving, interpreting, using, reusing, decoding, and recasting” (p. 59). A story of participation and reification might be in order here. For example, teaching in an engineering program in a

research-intensive community might have historically meant relying on lectures. However, over time as new members entered the community, variations on the theme of lecturing might have occurred such that lecturing became interspersed with interactive demonstrations and other hands-on activities that became known in the community to enhance student learning. Not only might reifications such as student work, grades, and evaluations have become available to the community, confirming the value of hybridized teaching practice of this sort but so, too, might conceptions that characterize good teaching and good teachers. In this context, a “constant becoming” (Wenger, 1998, pp. 153-154), through “an interplay of participation and reification” (p. 153) – the work that constitutes meaning-making – is in progress.

Legitimate Peripheral Participation and Inbound Trajectory

For newcomers to engage in the process of traveling an *inbound trajectory* into a community of practice, individuals engage in *legitimate peripheral participation*. In doing so, the individual takes up some aspect of the practice of the community, experiences a sense of mutual engagement, and through practice develops some facility with the repertoires found within what the community recognizes as competence. Through such activity, members of a community demonstrate accountability to the enterprise that the practice is meant to advance. Before becoming a faculty member, an engineering graduate student may have undertaken some aspect of teaching such as laboratory supervision, holding office hours for problem-solving or providing grading and feedback, serving both the supervising faculty member and undergraduate students. Coming into a new faculty position, some faculty may have had a single experience such as this while others may have had many. These experiences and meanings made from them will likely affect their sense of competent membership in the community of practice of their new academic departments. For example, a new engineering faculty member who had lots of

experience explaining concepts during office hours to a variety of students might conceivably bring a certain dexterity in this one-to-one work and to explaining concepts in a classroom situation. Thus their *inbound trajectory* might be smoother than that of someone who has only engaged in legitimate peripheral participation in terms of grading student work.

It must also be noted that there are other trajectories that Wenger (1998) specifies. These include *peripheral trajectories* and *boundary trajectories*. Peripheral trajectories into certain communities may be taken by individuals who require only limited forms of participation to acquire the learning they need to serve their core identities and core memberships. For example, an engineering faculty member may seek out engineering education research (EER) to assist them in teaching their courses but not seek to become a full member of the EER community. By contrast, an engineering faculty member might pursue a boundary trajectory – equally spanning the engineering academic community and the EER community, thereby making significant investments in both communities and by extension, in both identities. Moreover, the aforementioned engineering professor might decide that they want to become a full member of the EER community while also sustaining membership in the community of engineering professors. Individuals in such a position might tip to varying degrees in the direction of emphasizing one identity slightly more than the other or find inventive ways to more tightly weave them together.

Identity: “Nexus of Multi-memberships” and Journeys Across “Landscapes of Practice”

According to Wenger (1998), because individuals, to different degrees, hold memberships in multiple communities, they are faced with the task of reconciling identities (e.g., a faculty member’s identity as a practitioner/technical person and his identity as a researcher). Within each community in which an individual has membership, they are constantly negotiating

the meanings of practice. Thus, members of communities are not without agency in terms of the degree to which they take up the meanings that exist within the practice, or the degree to which they agentially seek to inform practice. When members engage in practice, they reflect upon it, make determinations about the elements they will configure to suit their individual styles (or perhaps identities reflective of other important communities of which they are/have been members or aspire to be members). This negotiation of meaning is a process of participation and reification (Wenger, 1998, pp. 55-57) of one's practice. As individuals negotiate such meanings, they have an experience of themselves in terms of these negotiated meanings, and as such, they are constantly constructing their identities in relation to their communities. Thus, a new engineering faculty member may enter a community of practice in which student-centered or research-based practices are not favorably viewed but may bring a different lens on such practices from their past communities, perhaps as an undergraduate learner in project-based courses. Further, given the relative autonomy for teaching in their department, they may feel free to develop a teacher identity that combines both traditional lecture and student-centered or research-based practices without feeling identity-compromised by the ways that they have chosen to negotiate their belongingness to the community.

Wenger (1998) describes identity construction in relation to a community of practice as a “negotiated experience of self in terms of participation and reification” (Wenger, 1998, p. 4). So, as individuals make meaning of practice through participation and reification – participating in practice and engaging in a process of reflection, filtering, and internalization (processes that Wenger does not explicitly define), they reify such things as teaching beliefs and values as well as a practice toolkit. The “negotiation of self” (p. 150) in relation to these elements, suggests a figuring out of the nature of one's relationship to them. It is also one's *learning trajectory* or

convergence of *learning trajectories* in the *landscape of practice* and a “nexus of multimembership” (Wenger, 1998, p. 163) achieved “through a process of reconciliation across boundaries of practice” (p. 163).

Professional communities of practice for engineering faculty exist across national and international landscapes and as such Wenger describes “belonging defined globally but experienced locally” (Wenger, 1998, p. 150). Individuals may be at the periphery of some communities – even to the extent that they can serve as brokers from their peripheral memberships into their core memberships. Further, since communities in the *landscape of practice* have claims to competence in their focal communities, *knowledgeability* becomes an increasing demand. Thus individuals have to be strategic in navigating the landscape of practice in order to optimally configure knowledgeable identities and modulate accountabilities to enhance their capacity to render “meaningful moments of service” (Wenger-Trayner & Wenger-Trayner, 2015, p. 23) to their focal communities and other communities that have a stake in their work (be they student communities or communities of industry professionals). Increasingly important in the landscape of practice are STEM and Engineering Education researchers and in fact, such members inhabit both their own community and those of their engineering disciplinary departments. A new faculty member and even an old-timer getting proximate to these kinds of discipline-based education research identities and attendant accountabilities could experience shifts in engineering teacher identity trajectories across time. This may be highly dependent on the degree to which other identity-supporting resources (e.g., reward, recognition, positioning by the discourse of departmental and schoolwide leadership) help to define the COP and thus, paradigmatic trajectories of value to the community. Thus, competent membership as engineering faculty in research-intensive universities may come increasingly to include a basic

knowledge of or facility with research-based instructional methods, and as such reflect Wenger's knowledgeability as this brokering across boundaries ensues.

Modes of Belonging: Engagement, Imagination, and Alignment

The COP framework also introduces *engagement*, *alignment*, and *imagination* as ways in which community members express belongingness (Wenger, 1998; Wenger-Trayner & Wenger-Trayner, 2015). Engagement refers to taking part in community practice but also can refer to exploring practices outside the boundaries of the focal community. A new faculty member may thus, simply undertake and reconfigure practices that reside in the community's histories of learning or combine this with small acts of visiting other communities and brokering in other practices. For example, through a conversation with a colleague in a similar department at another institution, they might incorporate a student-centered practice or two (such as think-pair-share) into their lecturing style.

A new faculty member may also experience the pressure to engage in alignment – to accord their ways of being and acting with a community's *regime of competence*. For example, a new faculty member's engineering department might be seeking to hire faculty who specialize in research on engineering education and who will help to facilitate initiatives around research-based learning for all faculty. New faculty members who have been on identity trajectories in which more traditional teaching approaches have worked for them as students and as teachers may resist aligning with such practices. Conversely, those whose trajectories contain meanings and negotiated identities that predispose them to be drawn to learning and identity-informing resources around research-based practices may be more likely to align themselves with engineering education faculty.

Imagination is a broad concept that includes such activities as creating a mental picture of what similar professionals in other localities are engaging in, imagining who or what they will become as a professional in the future but equally also, arriving at creative ideas around engaging in practice – whether these are variations to approaches and methods or new ideas. This form of imagination may be actualized through the work of brokering as individuals may not only seek to bring new teaching practices into their community but may be inventive and creatively reshape these approaches to best serve their individual teaching contexts and by extension, that of their focal, locally negotiated departmental community of practice.

The potential relationship among these modes of belonging is perhaps better illuminated by an example. One might imagine the picture of a faculty member who is experiencing alignment pressures to conform to transmissionist approaches to teaching that are reflected in the history of learning of their department. Further, they are faced with messages around restricting their investment of time and effort in teaching activities so that they prioritize setting up their research lab and facilitating the training of their graduate student mentees. They may have also traversed the landscape of practice as a student, having taken in project-based format, the course that they are currently assigned to teach as a new faculty member. In this instance, while they might ideally want to engage in imaginative, student-centered teaching, they might capitulate to initial alignment with the departmental and/or institutional norms and customs. They potentially might deal with this chosen *identity modulation* (Wenger-Trayner & Wenger-Trayner (2015, p. 24) by saying inwardly, “I’ll make gradual changes after I’ve been here a bit longer and have gained more respect among my colleagues.”

Power, Agency and the Negotiability and Ownership of Meaning

On the matter of agency, Wenger (1998) references both the ability and space to negotiate meaning within one's community of practice and the exercise of power. Negotiability is constituted of "the ability, facility, and legitimacy to contribute to, take responsibility for, and shape the meanings that matter within a social configuration" (p. 197). Power emanates from the privilege of community belonging and having some measure of control over practice. Apropos to the autonomy that faculty in research-intensive institutions have for teaching, *ownership of meaning* comes into play as "participants can have various degrees of control over the meanings that a community produces, and thus differential abilities to make use of them and modify them" (p. 200). This ownership of meaning is demonstrated in the context of the community's functioning as an *economy of meaning* in which individual levels of capacity to control what meanings the community adheres to or pursues may vary. Thus, depending on the degree of autonomy afforded, given the history and structure of the community (e.g., more or less horizontal or vertical), early career engineering faculty may have the freedom to choose not to fully align with what appear to be core practices and accordingly, to broker new practices into the community from other communities they have traversed or in which they still retain membership. Further, they may feel greater freedom to introduce into their departmental community new ways of being a teacher that are creatures of their own imaginative contemplation and experimentation that might represent variations on defining themes of their identity trajectories. In the context of a research-intensive institution, where autonomy for teaching is valued (notwithstanding departmental and institutional accountabilities), economies of meaning are fairly wide open and ownership of meaning should be relatively easy to negotiate. However, there may be tacit cues in the department, for example, early orientation to student-centered practices that suggest that full ownership of meaning might not be completely

afforded. In this context, the new faculty member might experience tensions around ownership of meaning due to these mixed messages, concluding for example, that while they have autonomy for their teaching, they should use the teaching center's mid-term evaluation option to align with local practices for new faculty.

Selected Literature on Faculty Professional Identity: Support for the COP Framework

Much of the research on the professional identity of early career higher education faculty has been motivated by the increasing emphasis on research, both in research universities and in upwardly mobile universities seeking to advance their status and prestige. A significant part of the global picture has also been the impact of “managerialism” (e.g., Clegg, 2008) or “marketisation” (Bathmaker & Avis, 2005) that have had implications for the structure of higher education, affecting locally negotiated communities of practice within institutions that must attend to such accountabilities. A large part of this picture is accountability-based funding that is deployed based on metrics reflecting that research requisites have been met (e.g., Skelton, 2012a). The demands of these organizational mandates, translated locally to departmental communities of practice, have been framed when considering the impact on individual academics, as identity challenges or tensions, when considering the impact on individual academics (e.g., Clarke et al., 2012; Clegg, 2008; Skelton, 2012a). Another set of literature includes the tensions experienced by academics making the transition from practice-based work to academic work, with new demands for research and pedagogical expertise as is the case for the domain of nursing (e.g., Duffy, 2013; Smith & Boyd, 2012). While there is a much smaller body of research on the teacher identity construction experience of academics inhabiting communities of practice within the traditional research-intensive university, the broader scholarly and empirical literature has established that research takes priority in these institutions while teaching plays a subordinate companion role (e.g., Jawitz, 2007; Warhurst, 2006). The

body of research on early career academics' professional identities, whatever the institutional landscape (whether research-intensive or otherwise), helps to illuminate the value of concepts advanced in the COP framework.

Competence: Mutuality of Engagement, Negotiability of the Repertoire and Accountability to the Enterprise

Across studies, mutual engagement – interaction with colleagues around the educational enterprise of the department varied in form and degree of interaction. In some instances, the level of engagement ranged from proximal to distal. Particularly in professional development contexts compared to departmental contexts mutual engagement was especially strong (e.g., Blanton & Stylianou, 2009; Warhurst, 2006, 2008). Within the typical departmental situation, mutual engagement was more indirect, occurring through tacit messaging and brief meaningful encounters. For example, Viskovic (2006) found that that across three higher education institutions – a university with a polytechnic background, a technical institute desirous of becoming a university, and a wanaga (an indigenous institution) in New Zealand, all faculty reflected that they had developed most as teachers through “informal, experiential learning” (p. 329), much of which was “tacit” (p. 329) and they “often found it difficult to pin down what had been learned, or when” (p. 329). However, they were able to identify that they learned from collaborating with professional peers, modeling themselves after colleagues, and learning through “doing the work” (p. 329). Interestingly, despite access to pedagogical support provisions across institutional type, within the university context, faculty were least proactive in seeking help and more reactive – only when serious issues arose, whereas, in the wanaga, there was a strong focus on relational values and teaching – central to the institutional and faculty identity. Thus, for the wanaga faculty, there obtained a great deal of direct mutual engagement and accountability to the enterprise.

Mutuality of engagement, negotiability of the repertoire, and accountability to the enterprise can range from simple to very complex, depending on both the structure of individual communities of practice, and the structure of their relations to embedded, closely related, or adjacent communities. For example, in Jawitz's (2007, 2009a, 2009b) studies, the STEM community's mutuality seemed to be one of understood professional autonomy and accountability to the research enterprise with which the teaching enterprise was entwined. By comparison, in the departmental COPs of social sciences and design, mutuality of engagement was constrained because of distinctive roles and identity trajectories for junior and senior faculty. For the social sciences' newcomers (junior faculty), it seemed that although the ultimate goal of their trajectory would be to cross into the adjacent, minimally overlapping research (and graduate teaching) COP, the desired mutual engagement either around research or teaching, for that matter, was not afforded to the newcomers. Rather, the courses to which many of the new faculty were assigned were those that were foisted upon them or those taken up from retirees who were then unavailable as a resource for learning and identity construction around teaching.

Warhurst's research (2006, 2008) revealed that deep mutual engagement around the work of teaching was essentially restricted to the teaching professional development (training) context for new faculty. However, Warhurst (2008) found instances in which a small number of faculty reported that there were senior faculty in their disciplinary departments from whom they benefited in terms of mutual engagement. For example, one participant stated that he had been "working closely with a colleague whom he felt prioritized teaching" (p. 464). Smaller departments in which newcomers had been hired for very specialized expertise seemed to be particularly isolating as the new faculty hired therein experienced COPs in which there was a paucity of colleagues who shared similar research interests and pedagogical content areas.

Further, in many cases, mentors assigned to new faculty often made themselves unavailable for meetings. Moreover, teaching was generally a private affair, and the message sent was that senior faculty would be “averse” (p. 460) to being observed. Where conversations occurred, there was “lots of transmission of information about teaching that was superficial with lack of opportunities for deeper exploration (Warhurst, 2008).

Warhurst (2006, 2008) found that meaning-making opportunities occurred perforce in departments that faced declining enrollments for particular courses; these situations forged the need for faculty to problem solve and collaborate to develop new courses. In these contexts, mutual engagement and accountability to the enterprise were particularly strong. Faculty, in their negotiation of meaning, went beyond considering the essentials of content coverage to deliberate upon the skills that students would need to learn from new courses. Warhurst (2008) asserts that for these faculty, the “meaning” [making] (p. p. 461) in which they engaged “was particularly advanced” (p. 461).

In a study by Blanton and Stylianou (2009), a lack of new faculty’s access to mutual engagement with “old-timers” who spoke the language of research-based practices was a struggle, both for the new faculty, as well as the faculty developers. Even after much exposure to and appreciation of new concepts in professional development, newcomers were still struggling to go beyond language reflecting content coverage and teacher-centered conceptions of teaching. The faculty developers opined that the lack of a shared language for meaning making around student-centered teaching competence was a particular barrier to mutual engagement in the academic departments. Thus, old-timers were ill-equipped to support the student-centered teacher identities for which the pedagogical training had given initial impetus within the new faculty.

Engaging in Practice, Negotiating Meaning, Belonging and, Becoming

A core foundation for the work of becoming a member of a community of practice and negotiating one's position or identity in relation to practice is engaging in the practice and making meaning of it. In Jawitz's research, the process of achieving community belongingness and a negotiated identity with respect to the community's enterprise was taking place in a very complicated context when it came to the departments of social science (e.g., Jawitz, 2007) and design (Jawitz, 2009a) where there was overt tension, especially in the design department (Jawitz, 2009a). For STEM department newcomers, uncertainties seemed to be kept veiled because belongingness in relation to teaching was strongly linked to research, in which newcomers were viewed as having sufficient expertise. Because of this, on the matter of assessing honors papers – a task much like reviewing a research journal article and a central part of the teaching enterprise, there was a tacit understanding that it was best for newcomers to show independence and not seek help with this teaching-related task that would cast doubt on their research skills (Jawitz, 2007). Thus, with respect to teaching, the new STEM faculty experienced limited opportunities for transparently negotiating pedagogical meanings because they inhabited a department in which one critical area of competence seemed to be the ability to decode tacit understandings. Further, this was a context in which raising questions about grading the honors paper could put their highly prized research identities at risk.

Research by Warhurst (2006, 2008) illuminates some limitations in meaning making within the COPs of academic departments by contrast to the meanings made of teaching among new lecturers in the teacher professional development COP. The departmental discourses around teaching included terms such as “delivery” (p. 461), “input” (p. 461), “presentation” (Warhurst, 2006, p. 115), and “information coverage” (p. 115) while those employed in the teacher professional development context afforded the new faculty new meanings around pedagogy that

were student-centered in character. Unfortunately, it seemed that opportunities to negotiate deeper meanings around teaching in academic departments only arose with crises such as sustainability threats arising from diminished yields in student recruitment. For a life sciences faculty member, this at least meant discussions around course redesign that involved raising questions about not simply issues of content coverage but the department should be “trying to achieve in terms of skills and outlook from the students” (Warhurst, 2008, p. 461). It is also noted that “pedagogic meaning making occurring in these ways in the normal course of departmental work constituted a powerful learning process” (p. 461) for some new faculty.

Identity Trajectories

Connected with the notion of identity trajectories (and trajectory types) are the ideas of legitimate peripheral participation (hereafter, referred to as LPP), multi-membership, landscapes of practice, boundaries, identity tensions, boundary work, and brokering of practices across COP boundaries. Jawitz’s (2007, 2009a, 2009b) studies demonstrate that some faculty experienced constrained access to LPP. The lack of LPP for new science faculty existed because of assumptions made about their competency in assessing honors projects, given that this process was deemed similar enough to that required for reviewing journal articles. Concerning teaching more generally, social science faculty lacked access to LPP opportunities, given that senior lecturers inhabited the research community and graduate teaching, while the new faculty resided in the minimally overlapping undergraduate teaching COP. The new social science faculty also experienced high teaching demands that made them feel challenged in terms of how they might follow the paradigmatic trajectory from the undergraduate teaching COP to that of the higher status research/graduate teaching COP. However, some new faculty managed to negotiate a variety of meanings and identity trajectories. For example, one faculty member took the expected trajectory from the undergraduate teaching COP to the research and graduate teaching COP;

however, another was straddling membership in the undergraduate teaching COP to which she was highly committed, while also investing in her trajectory to the research/graduate teaching COP. Further, the latter made connections to COPs in the broader university landscape that allowed her access to better resources for building her teacher identity.

The design department had multiple players (Jawitz, 2009a). In this department, there was a premium on professional practice in terms of respect and seniority. Further, most senior faculty when they were not involved in graduate teaching, spent the bulk of their time on professional practice that enabled them to produce high quality (sometimes award-winning design products). Another group in the department who wanted to advance the quality of teaching resented that senior faculty were focusing more on their design work. Further, given the growing research focus of the institution, there was an emerging core of newcomers from a pure research background. This situation yielded a complex variety of trajectories and a demonstration of the dynamism in identity trajectories that is occasioned by multiple meanings being negotiated within COPs. In this design department, the identities of senior academics were under threat, while newly minted PhD-trained faculty did not have any LPP support for research as senior faculty did not have research backgrounds. These new research faculty engaged in a boundary trajectory in which they gained research support from other locally negotiated communities of practice in their discipline within the global practice landscape while straddling membership as necessary in the undergraduate teaching COP of their local department.

Warhurst (2006) noted a lack of opportunities for LPP in teaching, except in some cases where faculty were given lighter teaching loads or it was assured that the courses were a close match to their content expertise. Further, given that teaching was a private affair and mentors were delinquent for the most part (Warhurst, 2008), the situation was made even worse.

However, many new faculty experienced full “immersion” (p. 463) into teaching courses, without scaffolding or support. Full research and teaching membership was almost a de facto assumption as a result of participants’ hiring into the institutions based on their content knowledge and research expertise. Only in a third of the individual cases were LPP opportunities in teaching facilitated in the departments. Thus, in a sense, the teacher professional development community constituted a space for LPP of a sort, albeit in absence of “old-timers” from the participants’ disciplines. Lack of LPP was due to undesired courses being dumped by senior faculty on new faculty or new faculty taking up retired faculty members’ courses.

Notwithstanding the clash between teacher identities afforded within departmental communities and those nourished through the resources of the teacher’s professional development community, around 12 participants took on “an academic teacher identity” (Warhurst, 2006, p. 119), demonstrated by “various public affirmations of the importance of teaching” (p. 119). These teaching-affirmative activities included presenting teaching-related conference papers in one case, and in another instance, the undertaking of developing a teaching program for doctoral teaching assistants.

Boundary work and brokering were demonstrated by some of the faculty in Warhurst’s research (2006, 2008). This happened in cases where participants in the teacher development training established “pedagogic legitimacy” (Warhurst, 2006, p. 119) with more senior faculty in their academic departments. In one example, a newcomer did so in the context of his engineering department and achieved success in “persuading colleagues to introduce substantial elements of peer assessment into level one modules on a new degree programme” (Warhurst, 2006, p. 119). More generally, members of the teaching development COP, took the initiative to engage with others around pedagogy within their departmental COPs more than was typical for non-members

of the pedagogical training group. Further, to advance their learning and identity construction around teaching, they “also engaged readily with independent, self-regulated pedagogic learning such as reflective practice” (Warhurst, 2006, p. 120), which they had learned through engagement in the teacher professional development COP.

Participation in Economies of Meaning and Ownership of Meaning

In the studies reviewed thus far, differing economies of meaning obtained or were perceived by participants. In many cases, even when there were constraints on academic identity construction in general or teacher identity construction in particular, some newcomer faculty skillfully navigated the “economies of meaning” (Wenger, 1998, p. 201) to make their own claims to competence and to chart their own teacher identity trajectories. In Jawitz’s (2009a) study, multiple claims to competence were in play – those from the highly expert designers (practitioners) who constituted the senior faculty and the graduate teaching COP; the faculty who undertook the load of undergraduate teaching and related administration; and the new doctoral-trained faculty who lacked both teaching and professional practice experience. However, while multiple trajectories were possible, there would likely be fewer legitimate trajectories in the future, given the increasing research mandate of the institution, and its emerging impact on the departmental community of practice.

Modes of Identification Beyond Engagement: Imagination and Alignment

In the literature, there is evidence of early career faculty bringing imagination to bear as they dealt with the demands for alignment with the wider university mandates. Drawing upon COP and activity systems perspectives, Trowler and Knight (2000) noted that faculty moved beyond the confines of departmental norms to exercise agency and creativity in their professional identity work. Further, he indicated that these faculty were “aware of the role of discourses and

draw on and develop them selectively, or subvert or oppose them, just as they do important, sometimes conscious, identity work which goes beyond structural constraints” (p. 35).

In Jawitz’s (2007) research on social science faculty in a research-intensive context where upward mobility in the department meant transitioning to teaching graduate students, the paradigmatic pathway was pretty clear. Yet, one member dared to imagine differently and fall out of alignment with the almost clean delineation made in the department between undergraduate teaching and graduate teaching (which Jawitz cast as two different and marginally overlapping communities of practice). This member navigated her way, via gaining recognition in the community for teaching innovation, and through helping to structure her own formal leadership or administrative avenues for the management of undergraduate teaching, created an alternate identity trajectory off the beaten path that took upwardly mobile faculty out of undergraduate teaching into graduate teaching.

The foregoing literature review helps to illuminate COP concepts that are of great utility in understanding the construction of teacher professional identity among early career academics, and in the case of the present research, early career engineering faculty. The literature tells stories of simple to complex communities of practices, domains, and enterprises, with varying practice resources (including access to legitimate peripheral participation) to inform learning and identity construction around teaching. The literature corpus also reveals identity tensions, multiple memberships, and engagement in boundary work and brokering across communities within the landscape of practice. Moreover, it illuminates faculty members’ exercise of agency and creativity in navigating economies of meaning on the matter of what constitutes teaching competence and desirable teacher identities.

Chapter 3: Research Methodology

The present inquiry aimed to explore how early career engineering faculty members construct an identity as teachers in a research-intensive space. I undertook a qualitative research study of which the principal component was a series of three interviews per participant, conducted during the course of an academic year (2017 to 2018). For additional background information, I collected curriculum vitae and teaching statements from each participant and in two cases, optional teaching-relevant artifacts. Further, I interviewed each faculty member's program chair to gain an understanding of the expectations, requirements, and professional supports located within their immediate professional context. In this chapter, I document the philosophy undergirding the research design and how I conducted the study. I have organized the chapter as follows: 1) perspectives guiding inquiry; 2) positionality statement; 3) description of the research design, data collection process, and data analysis procedures; 4) trustworthiness and limitations; 5) protocols employed to safeguard the rights of the study participants.

Perspectives Guiding the Inquiry

Qualitative approaches are suitable for exploratory inquiries in which researchers seek to illuminate complex issues in detail and for which we need “unencumbered” (Creswell, 2007, p. 40) access to participant voices. Further, qualitative approaches help us to understand “the contexts or settings in which participants in a study address a problem or issue” (p. 40).

Qualitative inquiry is well suited to a study of how engineering faculty build teacher identities in the early years of their careers as such approaches are predicated upon the notion that “meaning is socially constructed by individuals in interaction with their world” (Merriam, 2002, p. 3). This

aligns well with the focus of my inquiry on how the interactions of early career engineering faculty within and across contexts facilitate the construction of their teacher identities. The research question guiding the study is:

How do new engineering faculty in research-intensive universities build teacher identities in the early years of their careers, and in particular, what experiences and contexts shape their identities and practices as teachers?

I employed a narrative approach to data collection and analysis for my study, with the intent of developing a set of theoretical propositions related to the construction of teaching identity among early career faculty that could be tested in future research. The narrative approach focuses on how individuals make meaning of their ongoing individual and social experiences across time and space. It holds that individuals engage in a process of retelling stories over time and, as they do so, they are advancing their meaning-making process (Connelly & Clandinin, 1990). Narrative approaches are grounded in the idea that at any given time in the experiencing process or in the story-telling process, meanings may be multiple and complex (Elbaz-Luwisch, 2007). These conceptions underlying narrative approaches align well with a sociocultural exploration of professional identity development in general, and teaching identity development in particular because sociocultural frameworks view individuals as developing identities as they negotiate their “experience of self” (Wenger, 1998, p. 150) while negotiating the meanings of social practices within the social settings they inhabit (Wenger, 1998). Wenger’s communities of practice framework conceptualizes learning and identity construction as inextricably linked. Individuals engage in the practices of several communities of practice to different degrees across time and space. In this regard, they seek different levels of membership in these communities, and in only a limited number of communities do they intend to acquire full

membership (i.e., it attaining full membership in a large number of communities is an implausible proposition). Other memberships are more peripheral or represent visitations, for example, with the intent of drawing from expertise or the competence of other communities that may have relevance for their focal communities (the central community that is identity-defining). As individuals engage in the practices of communities, they negotiate meanings of what constitutes competent practice and choose to identify or align themselves with practices connected to the communities' enterprises. In the context of an engineering department, these might range from the use of lectures to the use of individual response systems, e.g., clickers. Through time and space, individuals navigate through landscapes of practice, engaging with different communities in diverse ways and to different degrees. Further, their negotiation of multiple kinds of membership is reflected in their histories of learning of various practices, which according to the individuals' identification and alignment (with these practices), represents their identity trajectories. An engineering faculty member may visit with an education faculty member in another discipline, perhaps a humanities discipline, to learn about practices that might help them facilitate ethics discussions in engineering courses. This visit represents a brokering of practices across boundaries and the engineering faculty member would be framed as having a peripheral trajectory in relation to the humanities community. Framed by communities of practice theory (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner, 2015), the professional identity construction of new engineering faculty would be influenced by the meanings they make of local and disciplinary social practices and how they experience themselves in connection to these meanings. New faculty may test possible meanings and refine their understandings of academic practices as they exist in their departments. They may try to

reshape the meanings they make of those practices or even attempt to change practices in ways that reflect and support their desired professional identities.

Narrative inquiry uses the metaphor of “landscape”(e.g., Connelly et al., 1997) to address the role of context in the ongoing professional (and other aspects of) life story. The landscape is comprised of “the social, cultural, political and historical – within which the knowledge of teaching originates, is shaped and is brought to use” (Elbaz-Luwisch, 2007, p. 366). Further, narrative inquiry represents “an exploration of the social, cultural and institutional narratives within which individuals’ experiences are constituted, shaped, expressed and enacted” (Clandinin & Rosiek, 2007, p. 42). In this regard, “these lived and told stories and the talk about the stories are one of the ways that we fill our world with meaning and enlist one another's assistance in building lives and communities” (Clandinin & Rosiek, 2007, p. 35). These elucidations on the nature of narrative inquiry, in terms of the importance of individuals’ life stories in social, cultural, and institutional context, further emphasize the alignment of this methodology with sociocultural framings of the construction of professional identity because they emphasize that individuals make meaning of their engagement across landscapes through the “telling” (p. 9) and “retelling” (p. 9) of stories.” From both a narrative and communities of practice standpoint, while meaning making is certainly influenced by sociocultural contexts (past, present, and imagined future), it is important to note that individuals have agency in how they shape their stories and identities. Further, this agency extends to how they select from, value, and prioritize different aspects of their experiences in shaping their professional identities (Clandinin & Rosiek, 2007; Wenger, 1998).

Social interaction is of critical importance to people’s evolving stories because while they are “individuals and need to be understood as such...they cannot be understood only as

individuals. They are always in relation to social context” (Clandinin & Connelly, 2000, p. 2). Human beings undergo experiences that have their genesis in other (past) experiences and these experiences lead to future experiences (Clandinin & Connelly, 2000). The central role of interaction in narrative inquiry further aligns the approach with sociocultural theories that focus on individuals in social contexts engaging with each other, and with context-related practices, in creating or establishing a professional identity as they engage in a “negotiated experience of self” (Wenger, 1998, p. 150).

Positionality Statement

In the qualitative research process, it is important to consider how one’s identities and critical past experiences have shaped how one approaches the research undertaking. My human development orientation to the world emerged early in my childhood. I was forever curious about human behavior. Having come from a family of many who lived lives dedicated to education and service, it was inevitable that I would later add my own contribution by pursuing the study of psychology and thereafter, counseling psychology. The most significant job I undertook, which I did much after completing my studies and having other less satisfying jobs under my belt, was that of a university based career counselor and student services practitioner – roles heavily focused on seeing the possibility and potential in others while being conscious of the short and long term individual realities facing them. These realities included personal timeline constraints, role in the family, geographic limitations, and financial resources.

In my professional capacity, I helped students tell their career and human development stories through their resumes and cover letters, often uncovering transferrable skills in the activities that they had dismissed. It was like assisting someone who was trying to find hidden pieces to a puzzle and put them together into a whole picture. I still cherish those interactions and

stories. Moreover, since leaving my job as a career counselor, I have seen and continue to see the stories further evolve online, whether on LinkedIn or other platforms that allow people to reach out to others and share their professional journeys. Apart from functioning in these ways in a professional capacity, I am that person who will learn a lot about relative strangers just by showing interest in their life experiences and being a good listener.

Thus, I came to the present inquiry with an open mind and open heart, with positive expectations of learning a great deal from my participants. I trusted that they would tell me their stories, albeit that others questioned what would happen if my participants did not have much to say or if they placed the period too soon and in a peremptory fashion. While it is always possible that study participants might at any point call an end to their participation in research – no longer wanting to tell their stories or believing that they have no *real* story to tell, I was of the firm belief that my participants had full and interesting stories to tell that would be nuanced and unique. Further, I trusted that having committed to the study, they would follow through and respond to my questions as best they could.

I maintained this idea notwithstanding the literature that conveys STEM faculty from a deficit perspective in the teaching domain. I held these positive expectations despite the many negative stories of STEM faculty instruction or student-faculty interactions I had heard directly from STEM students or others in the campus community where I worked for almost seven years. Although these stories reflected real experiences, there also emerged narratives of hope – stories of a few faculty members who went the extra mile; narratives of a few who cared about students and took every opportunity to learn more about teaching. Additionally, there were other STEM people I knew who loved knowledge broadly – with a voracious appetite for other interests – film, theatre, photography, music, sociology, politics, and human rights. Thus, much in my

personal life conspired for me to see beyond deficit narratives. I believe that my appreciation for the value of the individual story also helped me as I immersed myself in my data multiple times and engaged in the extensive data analytic process that would reveal early career engineering faculty as insightful, resourceful, dynamic, creative, and yet pragmatic human beings coming to know and coming to be in the area of teaching.

Some people might think that someone with a passion for human development might be inclined to see everyone through rose-colored glasses or only be inclined to elicit positive responses. However, I have been privy to some of the most challenging stories both in my professional and personal life and have had strangers tell me about the low points of their lives in ways that I did not expect. Indeed, I am sometimes surprised at the depth of the challenge or sense of failure or hurt that people share with me, although it seems that I easily create comfortable spaces for open sharing (sometimes intentionally and at other times, unwittingly). I trust that such sharing occurs because I have successfully communicated that I am approaching my engagement with their stories from a growth-oriented perspective. Thus, I view my passion for human development as an asset that helps to elicit the high and low points of experience. During the interview process, participants indeed responded to the question of what did *not* go well in their teaching and did not seem reticent to respond. Another feature of my positionality that could have been influential, however, is the fact that I was a graduate student asking professional development questions of early career faculty. Although we were from different academic fields – they, engineering and me, psychology and education – they may have viewed me as a learner as well as a researcher. In another regard, we were both novices in higher education teaching. In fact, during our conversations, participants appeared to be very much in learning mode regarding their teaching.

In relation to the process of data analysis, my passion for human development led me to such an appreciation for the nuances of each participant's individual story, that it was at first challenging to engage with the coded data to develop themes and categories common across participants. Indeed, the experience of dealing with fragmented bits of their stories felt uncomfortable at first. However, my reading and rereading of the codes as entered in my Excel sheet, and moving similar codes adjacent to each other, helped to ease my transition into a period of intensive analytic memoing which helped me to develop categories and themes. Further, I balanced this process with multiple readings of codes in the context of participants' transcripts and memoing about their individual stories so that individual narratives were kept adjacent to/and in dialogue with documentation of the codes, categories, themes, and memos reflecting what participants had in common.

A final aspect of my positionality upon which I engaged in much reflection concerning the present inquiry is that I am not a "STEM person." Thus, while I am interested in the academic and profession growth of STEM students and faculty, I have only vicariously experienced the triumphs and challenges of students, friends, acquaintances, and a sibling in STEM fields. Because I do not possess a STEM background (engineering in particular), I was concerned that I might not achieve as deep an understanding of my participants' professional identity journeys, given my lack of knowledge about engineering processes, instructional conventions, and their interrelationship. The latter could potentially preclude an outsider like me from recognizing moments meriting incisive follow-up questions. However, this concern was mitigated through the support of committee members who could provide clarification, insight, and necessary illumination where I lacked knowledge. There is too, the flipside of being an outsider as sometimes people feel freer to talk about not just the upsides (moments of flow and

connection with students) but the challenges and feelings of failure regarding their professional lives. My position as an outsider might have mitigated, for participants, a sense of embarrassment or even reticence to open up and tell their full stories.

Research Setting and Sample

Recruitment Rationale

I recruited participants from a single research-intensive university. I chose to focus on this category of institution because they are known to systemically emphasize research over teaching, which has implications for the extent to which faculty members invest in teaching (e.g., Serow et al., 1999; Walker et al., 2008). In research universities, rewards and recognition for teaching are typically and to a substantial degree less plentiful than those for research (e.g., Fairweather, 2005; Tierney & Bensimon, 1996). Scholars argue that this reward structure constrains the teaching investments made by faculty (e.g., Fairweather, 2005; Walczyk et al., 2007) even in the presence of interventions and programs designed to encourage a greater focus on teaching (e.g., Serow et al., 1999). Further, the majority of STEM faculty are educated in research universities (e.g., Pfund et al., 2012). Thus, understanding how professional identities are formed in these settings may offer insights into how STEM departments, faculty developers, and institutions at large can encourage greater attention to teaching among STEM faculty in research-intensive environments.

Securing Administrative Support and Recruitment Assistance for the Study

I reached out via email in mid-June 2017 to a senior administrator in the School of Engineering. The purpose of this communication was to gain support for the study and to secure his assistance with the recruitment of early career faculty members, which I defined as individuals in the first, second, or third year of their first tenure-track appointment. During this

meeting, I secured support for the study and eventually received a list of engineering faculty members hired in 2015, 2016, and 2017.

Research Participants

After I received a list of 39 hires, I excluded three engineering faculty who specialized in engineering education research and two who had previously served as assistant professors at another institution. I did this to reduce the level of specialized training in teaching and previous experiences of socialization as an early career tenure track faculty member. Further, I excluded two first-year faculty who were slated to arrive in the second term of the 2017-2018 academic year since the study was to extend over the academic year. These exclusions resulted in a pool of 32 potential participants from different engineering disciplines.

Embarking upon the recruitment process, I intended to employ a phased approach in which I would select four participants for each year level (first-year faculty, faculty on the cusp of the second year of their appointment, and faculty beginning the third year of their appointment) to develop a purposeful sample of 12 participants. Further, I hoped to recruit participants to balance the different race/ethnicities and genders, as some research indicates that women (e.g., Cox et al., 2010) and faculty of color (e.g., Umbach, 2006) may have different approaches to teaching than faculty who identify as White and male. Although I was not aiming for a representative sample, I sought a degree of demographic variation to provide the opportunity for the surfacing of such influences in participants' identity trajectories and preferred practices.

Recruitment Efforts and Yield

Initial recruitment email messages were sent on July 10, 2017, indicating the nature of the study, the expected time requirements, the proposed compensation of \$150 (with a \$50 gift card

being provided upon the completion of each of the three interviews constituting the study requirements), and tendering an invitation to have a preliminary conversation to further explain the study. Two reminder emails were sent out as necessary. By August 10, six participants had been recruited and after consultation with my dissertation chair, I opened recruitment to all 32 eligible participants regardless of year level, gender, and race/ethnicity. By the end of August, my participant yield reached a total of nine participants, and by the end of September, I achieved a yield of 11 participants. The sample included three year-one faculty members (all male faculty), five year-two faculty members (four men and one woman), and three year-three faculty members (two men and one woman). After the first set of interviews, a year one faculty member failed to respond to multiple invitations and reminders for the second interviews (through both email and physical mail) and was dropped from the study, resulting in a final sample of ten early career faculty members.

Data Sources

Protocol Development and Piloting

I began the development of interview protocols for the study in 2016 in the context of a qualitative research course. This allowed me to begin testing my protocols, by having expert consultation with the course instructor, the STEM education colleagues in my working group, and two pilot study participants (a lecturer with significant teaching assistant experience and a doctoral student in Chemistry) who were referred by one of my working group colleagues. I engaged in interviewing these participants with questions that focused both on the background to their teaching experience before they came to the institution and their teaching and related experience at the institution. I was readily able to build rapport with the participants. Further, the flow of the interview and response to questions proceeded well and it was clear that the

participants were invested in the process. Themes emerging from the piloting reflected the following: (a) recognition/value for their own need for learning in the area of teaching and pursuit of this knowledge; (b) student-centered teacher identities; (c) apprenticeship of observation of the faculty role and of teaching in particular; (d) experiences outside of the academy that were influential in teaching; (e) facilitating and constraining aspects of context; (f) exercise of personal agency; and (g) emotions and dispositions related to teaching.

In the second phase of piloting, I modified the phase 1 interview and drafted three follow-up interviews (one for the end of the first academic term, and one for the end of the second semester), which were reviewed by my dissertation committee. The core of this feedback resulted in a decision to reframe certain questions to encourage participants to provide well-elaborated stories. Further, we determined that three follow-up interviews might be a barrier to recruitment given faculty time demands. so Interviews 3 and 4 were combined into one interview.

I then engaged in further testing of my protocols with participants to whom I was directed by colleagues in my network. This yielded three informants who assisted me in pilot testing my revised protocols. Thus, in spring, 2017, I interviewed the first two participants – an experienced Math educator at the community college level and a post-doctoral fellow in Mathematics at a research-intensive university. I interviewed a third participant, an early career faculty member in Engineering at another institution on two occasions, once in early spring with the first protocol focused on his background leading up to undertaking his tenure-track faculty job and a second time in early summer, to explore his experiences as a faculty member since joining the institution. The post-doctoral fellow also reviewed the protocols for Interviews 2 and 3 (for follow-up interviews) and reported that she could readily respond to all of the teaching-relevant

questions. While the community college faculty member had promised to be available for a follow-up interview to test the second and third protocols, he did not respond to my attempts to recontact him. Finally, I engaged a highly experienced community college Mathematics professor with a Higher Education doctorate who reviewed all of the interview protocols. She asked me useful clarifying questions that helped her to assess the completeness of the protocol given my research question. Overall, this piloting phase helped to advance my thinking on the flexibility, dexterity, and agility that would be needed to reshape questions or probe in ways that were responsive to individual differences in the participants' ways of processing and responding to questions.

Sensitizing Concepts

The sensitizing concepts that helped me to construct my protocol came both from the communities of practice framework (Wenger, 1998) and the reading of higher education pedagogical research (e.g., Kember, 1997). Using the communities of practice framework (Wenger, 1998), I took a broad approach to identify key concepts. These included concepts such as interaction, engagement in practice, and observation. Interactions encompassed engagement with past professors, interactions with current colleagues, interactions with students, and other individuals that helped to shape participants' meanings around teaching. Further, direct engagement in teaching practice and the meanings faculty members made of this was critical to the inquiry. Further, past, present, and projected future were important to consider because identity is formed as the individual creates layers of participation over time that converge to create particular types of identities connected to one or more domains. From the higher education pedagogical literature, I considered conceptions of teaching (e.g., Kember, 1997; Pratt, 2002;

Prosser et al., 1994) and teacher efficacy e.g., DeChenne et al., 2012) as I constructed the protocol.

Data Collection

The main source of data for this study was the semi-structured interviews. Three interviews with each participant were completed throughout the study. To collect additional background and contextual information on the faculty participants' departmental contexts, I conducted a single 30-minute interview with each participant's department chair on role expectations of faculty members concerning research, teaching, and service and the kinds of support rendered to help them transition and function in these roles. All interviews were transcribed, de-identified, and stored on a university-approved online system under alphanumeric codes.

The goal of the interview process was to capture from past to present, the experiences of faculty that had been critical to their professional formation in terms of their knowledge, beliefs, conceptions, philosophies, values, and overall, their sense of self in connection to their professional work in general, with an emphasis on the teaching aspect of their work. Through the interview process, I also sought to understand how faculty engaged with experiences (past, present, and projected future experiences) and processed them in ways that influenced the construction of their teacher identities in the context of the larger identities as research-intensive engineering faculty members. While the guides presented in Appendices A, B and C represent an attempt to include interview questions relevant to faculty who are at different stages within the first three years of their academic appointments, the framing is ostensibly for faculty in the first year of their positions. Ultimately, the interview protocols were customized to suit faculty at different points in their professional appointments.

Before each participant interview, I requested from participants, copies of their curriculum vitae and teaching statements. During interviews, some opportunities organically arose in which artifacts related to the participants' journey as teachers were mentioned and offered but were not added to the data corpus as only two participants shared such information. These artifacts, in a small way, supported their telling of their professional identity stories.

The first interview, with a projected length of 90 minutes, was designed to uncover the participants' early understandings of the faculty role, the characteristics, and skills they assumed would be important to fulfilling teaching, research, and service roles, and the extent to which participants felt they possessed these characteristics. Key questions included those that focused on their observations of teaching while they were students, graduate teaching assistant experiences, teacher training, and conversations about teaching. The second interview, with a projected length of 60 minutes, was designed to focus on faculty members' experiences in their current academic position and how these experiences were shaping their professional identity. Interview 2 sessions were conducted at end of the fall semester or early in the subsequent semester, and asked faculty to reflect on their interactions across time that informed the shaping of their teacher identities and teaching practices. Interview 3 sessions were conducted at the end of the second semester or in the spring/summer holidays (according to participant availability). In addition to capturing faculty's ongoing teacher and identity construction journeys within their sociocultural environments, the third interview was designed to facilitate participants' reflection on their professional academic identity journey to determine how they have engaged with past, present, and projected (or imagined) future experiences. Interviews ranged in length from 60 to 115 minutes.

Before conducting Interviews 2 and 3 with each participant, I reviewed and coded, in a preliminary fashion, the data from the previous interviews. From these, I wrote interview summaries that helped me to customize the interview guides as needed and include relevant follow-up questions. This assisted me in asking questions that facilitated the continuity of participants' storytelling while allowing time and space for new subjects to emerge.

Across the 2017 to 2018 academic year, I conducted 30- to 40-minute interviews with the head of each participant's engineering departments to gain an understanding of the departmental employment context in terms of professional expectations in all aspects of the faculty role. The goal of these interviews was to assist my understanding of the "official" sociocultural context and help to illuminate my understanding of how faculty experienced that context (as they revealed this in the interview process). The responses to these interviews served as background/contextual information; I did not analyze these as part of the data corpus, although I occasionally referenced them to provide context for participants' comments.

Data Analysis

Clandinin and Connelly (2000) argue that stories are three-dimensional and involve "interaction, continuity, and situation" (as cited in Ollerenshaw & Creswell, 2002, p. 339). Table 3.1 shows Ollerenshaw and Creswell's (2002) adaptation of Connelly and Clandinin's model. This data collection and analytical framework align well with the communities of practice framing of learning and identity construction, as it emphasizes that these processes take place through ongoing participation, involving interaction, over time, within and across communities of practice and their resources (e.g., people, stories, tools, and artifacts). This three-dimensional structure offered by Clandinin and Connelly (2000) supports and reflects the need to examine the interaction of the individual (personal aspects) with the social world across both time (past,

present, and projected future) and place (sites of learning and identity construction across time). I employed this framework for both data collection and analysis.

Table 3.1: Depiction of the three-dimensional narrative structure guiding narrative analysis

<i>Interaction</i>		<i>Continuity</i>			<i>Situation/Place</i>
<i>Personal</i>	<i>Social</i>	<i>Past</i>	<i>Present</i>	<i>Future</i>	
Look inward to internal conditions, feelings, hopes, aesthetic reactions, moral dispositions	Look outward to existential conditions in the environment with other people and their intentions, purposes, assumptions, and points of view	Look backward to remembered experiences, feelings, and stories from earlier times	Look at current experiences, feelings, and stories relating to actions of an event	Look forward to implied and possible experiences and plot lines	Look at context, time, and place situated in a physical landscape or setting with topological and spatial boundaries with characters' intentions, purposes, and different points of view

Source: Adapted from Clandinin and Connelly (2000).

In examining this three-dimensional narrative structure in the context of my inquiry, I thought of past, present, and future (experiences) as a continuum that involves dynamic and mutually interacting representations in the minds of faculty as meaning-making individuals. Within each time horizon (past, present, future), I saw the personal (e.g., the faculty member's dispositions, hopes, and pre-existing beliefs) interacting with the social (e.g., the beliefs and points of view of other faculty, administrators, colleagues, family) within a place (such as a university department or other educational context that the participant views as bearing on education). I viewed present experiences as influencing how faculty make meaning of past experiences and how they perceived of themselves as professional academics in the past. Further, I also considered present experiences, which include the meanings made of lived present experiences in interaction with those made from past experiences) as influencing how participants make professional identity projections for the future. Finally, I also engaged with the idea that projected futures may influence individuals' negotiation of identity in the present and how they tell stories about their past negotiations of identity.

Qualitative research experts Ollerenshaw and Creswell (2002) describe the analytical approach advanced by Clandinin and Connelly as one that involves reading and rereading of texts (such as interview transcripts), and “considering interaction, continuity or temporality, and situation” (Ollerenshaw & Creswell, 2002, p. 342). Other knowledge landscapes may also interact with the professional, as Baker and Lattuca (2010) suggest in their work on the diversity of graduate students’ developmental networks and their effects on identity development, and as Wenger maintains (Wenger, 1998; Wenger-Trayner & Wenger-Trayner, 2015). For me, this meant re-entering the interview and data numerous times to examine how the personal and social interacted within situation and place across time towards the construction of participants’ professional identities. In interacting with the data, Clandinin and Connelly indicate that the researcher retreats for a moment from the transcript and asks about its contents, meaning, and social significance. Further, the researcher must identify themes, patterns, and tensions within and across the data. Clandinin and Connelly also speak to the need to renegotiate meaning with the participants and then return to the “field text” (Ollerenshaw & Creswell, 2002, p. 342). I engaged in this process through intensive analytic memoing across time, increasingly placing the findings into dialogue with theory.

Applying Analytical Processes of Grounded Theory

While I was guided by the foregoing general approaches espoused by Clandinin and Connelly, I also employed the analytical practices associated with grounded theory to support my goal of theory building about teaching identity development. Charmaz (1996) writes that grounded theory begins with “individual cases, incidents or experiences” (p. 28) from which the researcher develops “progressively more abstract conceptual categories to synthesize, to explain and to understand...data and to identify patterned relationships within it” (p. 28). Many of the

features of grounded theory methods apply to an exploratory inquiry such as the one I propose. In this regard, (a) data collection and analysis occur simultaneously; (b) analytic codes and categories are derived from the data rather than determined a priori; (c) mid-range theories are developed to explain processes; (d) analytic notes are employed in tandem with data coding before results are written; (e) sampling prioritizes the potential to assist theory building rather than seeking representativeness. Given the use of grounded theory analysis methods, I explored additional potentially relevant literature that could help to illuminate and explore the implications of my findings.

My initial coding and analytical work were influenced by sensitizing concepts in the literature such as teaching conceptions and beliefs (e.g., Kember, 1997; Wright, 2005) and teacher self-efficacy (e.g., DeChenne et al., 2012). I also utilized ideas from communities of practice and sociocultural approaches more broadly, such as sites of interaction and meaning-making and types of engagement in practice (e.g., Billett, 2001; Wenger, 1998). A copy of the codebook (table D.1) is found in Appendix D. However, as theory-building requires an analysis in which the data drive the coding process, I also employed an open-coding approach that relies on codes derived from the data (e.g., Saldana, 2013). This approach to coding facilitates the surfacing of participants' voices and enhances the authenticity and validity of the inquiry (Corbin & Strauss, 1990). I developed a codebook based on transcripts from two participants and refined it over time as needed. I also created a coding matrix in an Excel sheet that allowed me to compare participants across codes and to examine codes and rearrange them according to the similarity of their contents. The initial codes were indeed quite granular, such as teaching conceptions of self, teaching conceptions of the work, type of student taught. The sensitizing concepts also yielded productive codes. Codes such as teaching beliefs, teaching goals, teaching

philosophy, conceptions of teaching work, conceptions of teaching self, conceptions of exemplary teaching and self-efficacy for teaching, and teaching decisions were closely related. For example, examples of exemplary teaching contained practice components that faculty had begun to incorporate into their practice. Further, teaching goals were interlinked with the philosophies that faculty members articulated. These codes related heavily to the processes and products of meaning-making around teaching in terms of both identity and practice. Open codes that were particularly useful were those connected to early academic experiences (which I referred to as *early academic identity*) in conjunction with past learning experiences. Indeed, early student academic identities emerged as important for how faculty came to develop conceptions around teaching. I began writing reflective memos early in the data analytic process. Over time, memoing moved from the rudimentary listing of reflections and observations to analytic memos that included greater articulations of findings and involved connecting codes, refining categories, and developing themes. Additionally, memoing involved articulating the meanings I derived from going back and forth between repeated, in-depth engagement with theory and reading of codes in context.

In my findings present “shared themes” (Kramp, 2003, p. 119) that I identified across participants’ stories, while carefully describing their individual nuances. Key themes included learning through observation; learning through engagement practice; navigating the landscape of practice; learning through interaction with students; and identity trajectory types. To help the reader move from shared themes to individual nuances (Saldana, 2013), I engaged in the careful selection of quotes.

Trustworthiness of Research Process and Limitations

Credibility

While much of the present inquiry focused on elements of the participants' past, present, and, projected future experiences, some of the background information they provided was based on their memories of events several years in the past. Reliance on participant memory of past events (whether in the more recent or distant past) in a single time point of an interview sitting could potentially pose challenges to validity. The three-interview structure of the data collection helped offset this concern by affording the opportunity to conduct interviews that built on each other, allowing me to both gain new information about participants' experiences and meaning-making across time and ask clarifying questions. Prolonged engagement afforded throughout the year-long course of the study, allowed me to understand how faculty were processing some of their experiences of engagement in practice in real time. Further, conducting multiple interviews allowed me the opportunity to engage in member checking, such that I could verify the nature of particular experiences they shared and how they understood them. Central to this study was early career engineering faculty members' meaning making of their experiences rather than factual recall. Individuals' negotiation of meaning is central to the community of practice framework for identity construction as inextricably linked with learning (Wenger, 1998). Further, narrative methodologists Connelly and Clandinin (as cited in Clandinin, 2006), approach research from the perspective that:

People shape their daily lives by stories of who they and others are and as they interpret their past in terms of these stories. Story, in the current idiom, is a portal through which a person enters the world and by which their experience of the world is interpreted and made personally meaningful. (p. 45).

Additionally, I engaged in member checking with my participants. I shared those parts of my findings that included each participant's direct quotes or referenced their experiences and I asked them to provide feedback on the degree to which my articulation of the findings accurately represented their experiences. I also sought to assure that each was comfortable that references to their experiences were sufficiently masked. Further, I sought clarification on their desired personal pronouns (e.g., she/her, they/them) to use in my reporting. All participants responded and only two required two changes each; of the two, only one required two small wording deletions to assist in preserving his anonymity. Finally, my dissertation chair also served in the capacity of a peer debriefer. Throughout the data analysis and drafting of the findings chapters, we engaged in close dialogue on my analytic memos, drafts of findings, and discussed interpretations and insights that emerged in our conversations over the course of a year.

Limitations

Limitations of the study include the fact that I was able to recruit only three first-year faculty members (and was left with two after one of these dropped from the study). Thus, I was unable to build a large corpus of data on the first-year experience of early career engineering faculty and engage in a keener analysis of commonalities and variations in the identity trajectories of this group, as I initially desired. Further, I conducted my study at a single research institution. Although research institutions share similarities, especially around research priorities, not every research institution is the same. For example, there may be variations in how at the institutional and departmental levels, the work of teaching is promoted, recognized, valued, and supported in tangible ways.

Another limitation resides in the fact that I did not observe faculty or examine their syllabi or other instructional materials to corroborate their stories. I also relied on participants'

descriptions of the teaching supports that they relied on, such as participation in teaching workshops; I did not ask questions designed to elicit detailed accounts of participants' use of instructional supports available at their university or beyond. Rather, I relied on participants' descriptions, over time, about what shaped their teaching practices and, my analysis focused on the consistency and coherence of their narratives about how they learned about teaching through multiple, in-depth interviews.

Protection of Human Subjects and IRB Process

Institutional Review Board Approval

The study was reviewed by the IRB and given final approval on May 15th, 2017, under exemption 1.1.1 reflecting minimal risk, such that “the probability and magnitude of harm or discomfort anticipated in the proposed research are not greater, in and of themselves, than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests” (University of Michigan Human Subjects Regulatory Management). To assure confidentiality of the research data, I secured and stored participants' names and other identifying information separately from the research data. I de-identified and assigned alphanumeric codes to the audio files, interview transcriptions, and analytical memos and tables. For storage, I employed a University-approved, secure online storage facility.

To ensure informed consent in the recruitment process, I sought to include reasonable detail about the study and offered participants the opportunity to engage in either in-person meetings or telephone conversations that would allow them to clarify the nature of the research and the time commitments involved (see Appendix E). Further, before embarking upon data collection, I had each participant read and sign consent forms reflecting their understanding of the nature of their requested involvement, benefits of participation, potential risks or discomforts,

compensation, confidentiality and privacy protocols, storage of data, and IRB contact information (for any needed follow up questions on their rights as research participants).

Chapter 4: On the Cusp: Teaching and Learning Journey Before the Tenure Track

This chapter introduces the ten early career engineering faculty who participated in this study. At the start of the study, the faculty members were about to enter their first, second, or third year as tenure-track faculty members in various engineering disciplines. At this point, no participant had more than two years of teaching experience as a tenure-track faculty member. I introduce each participant, indicating the types of teaching experiences in which they engaged across time and exploring the conceptions of teaching they had built up to the point of entering their tenure-track faculty positions.

Not only had these faculty observed and later enacted some aspects of teaching they had made meaning of these experiences through reflection. The meanings they made of these experiences helped to shape their teaching conceptions and values. After sharing the participants' stories, I summarize where they stood concerning teaching before they took up their tenure-track faculty positions, identify common themes across participants, and connect these to key theoretical concepts that constitute the communities of practice theory (Wenger, 1998).

According to Wenger's (1998) communities of practice framework, learning, and identity construction are inextricably linked. The work of identity construction involves *making meaning* from experience, in effect, engaging in practice or learning as *doing*. Wenger (1998) also views learning as gradually achieving belongingness to a COP and becoming a particular kind of person in relation to it. In the present study, the focal community of practice for the participants is that of engineering faculty in a particular research-intensive institution. While engineering departments in research-intensive institutions share similarities, there are likely to be cultural

differences and nuances both at the level of department (discipline) and at the institutional level (Baker & Lattuca, 2010). In fact, scholars have argued that factors operating at the institutional level (conditions in the local context) mediate the impact of those associated with the discipline (Baker & Lattuca, 2010)

As we consider the sociocultural environments from which new faculty have come and those that they enter as they take up new tenure-track positions, it is also important to note that they are moving from the community of practice of doctoral students in engineering into the community of practice of research-intensive engineering faculty. While there is naturally an overlap between the practices of doctoral student communities and those of new research-intensive faculty in the corresponding discipline, the degrees of competence expected of faculty communities in terms of research, teaching, and service are at a higher level and have higher stakes attached to them as individuals are about to officially launch a trajectory towards tenure.

According to the communities of practice framework (Wenger, 1998), central to achieving belonging is legitimate peripheral participation, which occurs as individuals take part in the practices of a community in ways that approximate full engagement – preliminary to gaining full membership. As an engineering graduate student, one could be said to be engaging in a community of practice of engineering graduate students, while being a close neighbor within the landscape of practice, to the engineering faculty community of practice. To the degree that engineering graduate students have intentions of entering the faculty community of practice, the research, teaching, and service that they engage in as members of an engineering graduate student community of practice may simultaneously constitute legitimate peripheral participation for a trajectory into an engineering faculty community of practice. Further, a graduate student who may be keeping their career options open could be engaged in legitimate peripheral

participation both in relation to an engineering faculty community of practice and that of another engineering profession, for example, within industry.

Wenger (1998) seems to be uncertain as to whether observation constitutes a part of the picture of legitimate participation, which I challenge given that over time, pre-faculty (graduate students) learned a great deal about teaching through reflecting on their observations. Wenger states that “observation can be useful, but only as a prelude to legitimate engagement” (Wenger, 1998, p. 100) or engagement in legitimate peripheral participation. However, he also writes that people are allowed “various forms of casual but legitimate access to a practice without subjecting them to the demands of full membership” (Wenger, 1998, p. 117) and that this “kind of peripherality can include observation” (p. 117). Whether Wenger would view observation of teaching as legitimate peripheral participation – for example, if one were invited to observe another instructor for teacher professional development purposes or observed teaching as a student in a classroom – is thus unclear. However, given his concept of imagination, which includes visualizing oneself in practice, there seems within his work to be an admission that observation of practice, whatever the context, is highly instructive. Further, Wenger indicates that “it is through imagination that we see our own practices as continuing histories that reach far into the past, and it is through imagination that we conceive of new developments, explore alternatives, and envision possible futures” (p. 178). Thus, I argue that a new faculty member could be practicing in a way that represents replication, extension, modification, or refined iteration of teaching practices they observed while they were students. Participants in this study discussed similar observations as well as forms of legitimate peripheral participation (engagement in aspects of teaching) as preparation for their faculty roles.

I have clustered the participants according to the self-assessed level of preparedness for teaching they felt upon commencing their faculty positions, as expressed in our initial interviews. Notably, the number of teaching assignments participants in which participants had engaged before entering their tenure-track positions was unrelated to the level of preparedness they expressed. After introducing those participants who conveyed a greater level of concern regarding their preparation for teaching, I then present those who expressed a greater sense of preparedness. Table 4.1 shows the study participants at a glance: their years on the tenure track, the number, and level of courses taught while on the tenure track, the number and type of pre-faculty teaching experiences in which they engaged, and the level of preparedness recalled at the start of their faculty positions. Participants' self-assessed level of preparedness arose as a topic in my early conversations with them and during the process of initial data analysis, it served as a way to compare and contrast participants' experiences at the onset of the study.

Table 4.1: Participant Table

Participant (Pseudonym)	Years in Tenure Track Position (by end of interview period)	Number/Level of Courses Taught (by end of interviews)	Number/Type of Pre-Faculty Teaching Experiences	Narrative Around Preparedness for Teaching on Cusp of Teaching Position
1. Alex	3 years	1 undergraduate course taught 2 times.	Served as grader on 2 occasions; gave some lectures on her research to suitable classes.	Less prepared
2. Jordan	1 year	1 master's level course taught 1 time.	Served as a TA 4 times (3 times for graduate courses and 1 time for an upper-division	Less prepared

			undergraduate course		
3.	Cameron	2 years	1 graduate and 1 undergraduate course taught 2 times each.	Served as TA on 3 occasions for an undergraduate course.	Less prepared
4.	Ainsley	3 years	2 graduate courses (1 of these taught 2 times) and 1 undergraduate course taught 2 times.	Served as TA 3 times (1 time for 1 graduate-level project-based course; then 2 undergraduate laboratory courses).	Less prepared
5.	Harper	3 years	1 graduate course taught 3 times. 1 undergraduate course taught 1 time.	Served as TA for 1 undergraduate lab course.	Less prepared
6.	Grey	1 year	1 undergraduate course taught 1 time.	Served as TA 4 times for undergraduate courses.	More prepared
7.	Hayden	2 years	1 graduate course taught 2 times.	Served as TA 8 times (4 teaching assistantships as an undergraduate student; 4 teaching assistantships to undergraduate courses as a graduate student).	More prepared
8.	Parrish	2 years	1 graduate course taught 2 times.	Served as TA 2 times (1 teaching assistantship to an undergraduate course; 1 teaching assistantship to a master's level	More prepared

			course); also served 1 time as lecturer of record (while a doctoral student)	
9. Brighton	2 years	1 graduate course taught 1 time, 1 undergraduate course taught 1 time.	Served as a TA 3 times to undergraduate courses; also, post-PhD, served as lecturer to 1 undergraduate course 3 times.	More prepared
10. Morgan	2 years	2 project-based graduate courses (1 of these was taught 2 times).	Served as TA to 2 undergraduate labs and 2 mixed-level classes (including both undergraduate and graduate students.	More prepared

Faculty Who Narrated Less Preparedness for Teaching

This group includes five participants who questioned their preparedness for teaching (this does not necessarily map on to the number of prior teaching experiences they had acquired). The first two, Alex and Jordan, related their feelings regarding preparedness to teach to a lack of engagement in all the necessary components of teaching. Further, they noted that they had never before had responsibility for an entire course. A third participant, Cameron, questioned his preparedness based on gaps in his knowledge or sense of mastery of material for an undergraduate course he was expected to teach. Finally, Ainsley was concerned about his lack of preparedness to teach large numbers of students as his previous experience was with smaller

groups of students, while Harper was concerned that he had limited instructional experience and feedback thereon.

Introducing Alex and her Pre-faculty Experiences of Teaching and Learning

At the start of the study, Alex was in the third year of her faculty position. By this point, she had taught, as the instructor of record, the same undergraduate course twice, the first time during her first semester as a new faculty member. During doctoral training, she had twice served as a grader and had delivered guest lectures based on her research (part of the requirement for a fellowship program that prepares future faculty by orienting them to all aspects of the faculty role).

Alex had been highly motivated to undertake her undergraduate studies in an interdisciplinary field of engineering (involving engineering and another discipline that represents the problems it addresses), given the interest in the relationship between multiple disciplines she had developed in high school. However, she experienced frustration about the siloed ways in which the content knowledge within her program was presented. She felt as if “the material I learned in my courses was extremely disorganized...It wasn’t clear how the classes connected together or what they expected us to know before the class.” She shared that she had taken clusters of classes from the disciplines of which her interdisciplinary program was comprised and “they weren’t necessarily built on each other.” In addition, “it wasn’t always clear how they connected to each other either.” She further reflected that as a faculty member, she still had questions about how the undergraduate curriculum for her engineering discipline should be organized to better facilitate student learning. This stance of questioning positioned her well, potentially to engage in engineering education research or to collaborate with such researchers.

Alex shared that she began to observe teachers and develop ideas about good teaching in high school. She observed that good high school teachers were “on the side of organized, disciplined, very tough.” These teachers clearly set out the learning goals and the “material was clearly taught so you knew...exactly what you needed to do.” They were very transparent about what students needed to do to be successful and let them know that they could achieve such success if they worked hard. From this kind of instruction, Alex felt “like we've [she and her peers] learned something.” Alex compared her best experience as a student in college to this optimal experience in high school, as her best professors in college demonstrated similar approaches, so that in the end, students “learned a lot of existing material.” However, Alex found that these kinds of professors were in the minority. By contrast, most seemed to “hope you're not successful on the exam” and if most students achieve an A or B in their courses, “they feel like they're a bad teacher.”

Interestingly, Alex found that another kind of teacher – one opposite in many ways to her best teachers – also influenced her ideas about good teaching, at least to a degree. This kind of professor was quite “disorganized,” leading one not to “learn too much in the way of existing knowledge.” However, they offered interesting ideas that she would reflect upon as, “such a neat idea!” Alex saw value in combining the aspects of the “very best” teachers with the redeeming quality of the “disorganized” teachers – the ability to stimulate students’ thinking through including interesting or novel ideas that were not required for success in the course, as measured by tests. Further, she thought that her research mentors similarly influenced her thinking about teaching – at least to some degree. She remarked that while they were “probably not very good classroom teachers” and she did not think “they were as excited about organizing existing

material into something that could be easily taught,” they inspired her with their excitement over novel ideas, also influencing her to “include new ideas in teaching.”

Alex was glad to have had experiences as a teaching assistant while she was a doctoral student. However, “sadly”, these were limited to grader positions. When asked whether her experience in these positions had helped her to learn about teaching, even in a small way, she indicated that being a grader, although a limited teaching experience, had forced her to think about the nature of quantitative versus qualitative problems and reflect upon what constituted a good written response. Further, when asked whether she had held office hours to guide students on their written work, she reiterated that her role was “just grading” and moreover, “that was how the faculty member wanted it to be.” This was the same award-winning professor whom she had spent some time observing because she “wanted some kind of [teaching experience].” However, she seemed conflicted about his status, as she said, “You know, he – ironically...he won teaching awards.”

For Alex, the ways in which the award-winning professor showed himself to be a good teacher were highly reflective of her observations of good professors and high school teachers. She stated that this professor demonstrated a great deal of transparency in terms of making clear what students needed to do to attain success in the course. Further, the amount of homework he assigned to the students was well-calibrated – “he didn’t expect too much or overwork them” and she thought “the students in his class learned a lot.” However, there was an aspect to this professor’s presence that was a matter of curiosity to Alex. She remarked that he sometimes seemed “overconfident.” Yet, she subsequently considered that maybe “some students need that (i.e., this show of confidence by professors) to feel confident about what they’re learning sometimes,” suggesting that this kind of presence in the classroom might be productive in terms

of helping students trust the knowledge they were gaining. Notwithstanding this reflection, she remarked that she was unsure about how students would receive the same level of confidence expressed by a woman, stating, “I think it's something that is hard to figure out sometimes as a younger female teacher.”

Alex’s closest direct experience to that of teaching a course came through delivering guest lectures focused on her own research. These guest lectures constituted a portion of the requirements for the teaching aspect of a preparing future faculty type of program. She had been very anxious about delivering these lectures. However, she reported that the students’ reactions turned out far better than she had expected. In fact, some students told her through their evaluations that she did not need to be as nervous and afraid as she had felt about giving the lectures. She reflected;

Yeah, you know, I was terrified to give these guest lectures and I think that's also still my biggest fear of teaching is just, you know, getting up in front of a bunch of people and – but...I distinctly remember in those evaluations the students were so kind. They were like, ‘We loved your lectures, but you shouldn’t be afraid, just, you know, just, don't be afraid; don't be nervous; we really like the content.’ You know, I think the theme of most of them was they liked the content but [that I should] have more confidence.

As alluded to previously, while a doctoral student, Alex also participated in a program to prepare future faculty. She recalled that the main aspects of learning were generated from reflecting on the matter of what characterizes good teaching, which led her to consider the kinds of teaching that she had experienced as a student. The program also helped her to arrive at the realization that teaching was more than what one did in the classroom:

I think it also opened my eyes to like all the different nuances of teaching. You know it's not just – I mean there's a whole education program...devoted to research on teaching and I mean, how much there is to it.

On the cusp of entering her faculty position, however, Alex was concerned about her lack of teaching experience. She emphatically shared a felt sense of unpreparedness:

When you come in as a new faculty member and, you know, you're supposed to teach, it's crazy how little experience you actually have in teaching. I mean even though you've been a TA [teaching assistant], maybe you've given guest lectures, participated in a program about teaching like I did. I mean you've never – nothing prepares you for running – organizing your own course, with tests and homeworks, and deciding on content. I just feel like nothing that I had, really prepared me for that.

Through describing and reflecting upon her teaching and learning experiences and then declaring that she still felt unprepared, Alex conveyed both a sense of frustration with her lack of preparedness and a sense of respect for the kinds of capabilities that constitute the work of teaching. It seemed that she felt she could not confidently assert a teacher identity until she had mastered or at least experienced all of the elements that she perceived to be involved in independently managing a course, such as creating content and coming up with homework problems and tests.

Introducing Jordan and His Pre-faculty Experiences of Teaching and Learning

At the start of the study, Jordan was in the first year of his faculty position. He taught a master's level course that first fall semester but was on a break from teaching during the second semester. As a graduate student, he had served as a teaching assistant on four occasions – three times for graduate courses and once for an upper-division undergraduate course. Given his

experience, Jordan believed that there were certain core elements to the teaching of engineering. In this regard, he noted:

I think one of the teaching [methods] that I think everybody does is some kind of hands-on – I think in engineering, we do a lot of hands-on and I think here it's done a lot through homeworks. There's a lot of homeworks. It's done a lot through...I think homeworks and final projects are important for this. Having really a hands-on experience that's – that's important...I mean ultimately, you know, they're engineers we're training unless people... go into research – if they, you know, become practicing engineers, they will be building stuff, right.

While the foregoing might suggest that Jordan had purely a practical formula for teaching, he also placed great importance on the disposition of the teacher – not only the structural elements. His graduate research advisor was, for him, a model educator. Jordan spoke with appreciation for how welcoming his advisor had been in office hours. He described him as a very patient person who was always open to questions, even if it meant responding to those Jordan had previously asked but was revisiting because he needed further clarification. Jordan recalled that his advisor had taken a similar approach in the classroom– such that he opened class with check-in questions. Moreover, he found that his advisor was “incredible about explaining things” within the classroom as much as he demonstrated this during office hours.

Jordan further underlined the impression made on him by his advisor by emphasizing the degree of care with which he approached teaching: “he really, really cared a lot.” He further opined that “it's not all of [teaching], but it's a big part of being good teachers is caring and spending the time to prepare, and spending the time with your students, which is a little bit against the whole tenure process.” Because Jordan believed that it was important to genuinely

care about students, which meant spending the time necessary to prepare for teaching and meet with students, he was committed to making his availability after class and during office hours known. Jordan contrasted his experience with his advisor to that which he had with a different professor who had been very impatient and often seemed annoyed when Jordan posed questions in class. Jordan has been particularly frustrated with this professor's attitude as he had discovered that being able to ask questions was central to his own learning. He assumed, by extension, that other students were similarly frustrated. He expressed his frustration thus:

‘Why am I here if you’re not even going to answer my questions?’ I mean I might as well watch a video of the class, right? The reason I'm here in person is because I want to be able to ask you questions and this class needs to be interactive. If it's not interactive, we might as well watch a video.

Consequently, Jordan expressed the firm belief that it was important for faculty to teach interactively – for students to be able to freely ask questions as well as for faculty to pose questions to aid explanation on their part, and understanding on the part of the student. In this connection, he was felt strongly that faculty should not facilitate the review of material through restating or repeating information but by engaging students in a question-and-answer process through which effective review and clarification would be achieved. Further, he believed that instructors needed to be patient in providing students time to think about their responses to instructor-posed questions as well as demonstrating patience with those who were repeating questions they had already asked. For Jordan, a student asking a question he had previously answered, meant that the student needed further clarification; thus, professors should be positively disposed to providing clarifying responses.

As a teaching assistant during his doctoral studies, Jordan “lectured” to some degree, for example, introducing some new concepts in discussion section. However, he described his teaching experiences as including “very few real lectures.” He also assisted students with problem-solving – some of which was done through working out examples on the board. Further, he had helped to create exam and homework problems. However, he appeared to dismiss these capabilities and they seemed to be overshadowed by his concern regarding a lack of experience as an instructor of record who had been responsible for all elements of a course. Notwithstanding his self-perceived lack of preparation, he identified an area of learning acquired through his teaching experience: he had learned how difficult it was to create fair homework and examination problems. He had experienced that in creating problems, “very often you end up being too easy or too hard. And you have to correct [for this] when you grade them.” Notwithstanding his concerns about his self-perceived lack of teaching experience, he took some comfort that “at least my advisor thought that I was pretty good at giving presentations and he thought I would be a good teacher – he was pretty encouraging on that” although “he never told me explicitly what he liked.”

On the cusp of entering his faculty position, in addition to his misgivings about his lack of experience as a lecturer having familiarity with all aspects of teaching, he was “afraid that it’s going to take me a lot of time to teach.” Further, a “very big concern” he experienced during interviews for faculty positions was that he would be required to teach at disciplinary intersections, specifically, courses that he had never himself taken. Of all his concerns, this seemed the most dominant. The intense feelings he expressed about his level of experience and preparedness suggest that he did not underestimate the magnitude of the work of teaching. As was the case with Alex, it was apparent that he did not think he could confidently assert a teacher

identity until he had mastered all elements of teaching or perhaps until he had experienced being a lecturer of record for a course.

Introducing Cameron and His Pre-Faculty Experiences of Teaching and Learning

At the start of the study, Cameron was in the second year of his faculty position, having assumed the post in the fall of his first academic year at the institution. By the end of data collection, he had taught both a graduate and undergraduate course on two occasions each. His past teaching experience consisted of serving as a teaching assistant on three occasions while he was a master's student. In these positions, he had held office hours and was also a grader.

Cameron reported a mix of experiences that he underwent as an undergraduate student. He explained that many courses had not provided him with the information that would offer insight into the real-world application of concepts. It was this lack of connection between concept and application that had led to him becoming disaffected with college and had influenced his thoughts about leaving his studies prematurely. However, fortuitously, one day while watching a television documentary that focused on renewable energy, he was struck by the connections to what he was learning in college. This occurrence helped to illuminate for him how the academic knowledge he was gaining could be applied to solve "interesting problems." Further, he asserted that given what was missing (application) from how he was taught as a student, he determined that he would teach "in the way that I would have appreciated" rather than just doing the opposite of what bad instructors did. Further, because his most positive teaching/learning experiences were in a few courses that included projects, he expressed strong beliefs about the importance and value of these projects "that you claim as your own." He explained:

You choose the topic and then you could, over the whole semester, build upon that. And so I did that, you know, in a couple of classes where you're working in a team...each team member had maybe a different role. You'd have to write a proposal and it just felt more – when you're in the classroom, you're kind of – when you're learning stuff, you could see how that's related to that project...And there's just – you're not only learning what that material is, but you're learning how to write a budget or...all these other aspects. And so I think the project-based classes are neat.

The foregoing quote makes clear that Cameron placed a high value on project-based courses because of the ways in which he was able to apply the conceptual knowledge to a practical task or set of tasks. In effect, he valued the scaffolding of knowledge and skills gained in the class towards the execution of a project that was meaningful to him. Given this experience, it was not surprising that as we were discussing what Cameron had learned from teaching workshops offered by the teaching and learning center at his doctoral institution, he indicated that his major takeaway was an appreciation of the value of including in one's course, "a main project that they [students] build upon throughout the semester, so that as we learn new material" [the relevance to the project is made clear]. For Cameron, this contributed to "the idea of having context." For Cameron, then, projects constituted a significant means through which he (and other students) could experience authentic learning – making the learning of concepts meaningful through requiring students to apply them in real-world situations. From these positive encounters with project-based assignments, Cameron learned that the opportunity to apply knowledge gained to solving "real-world" tasks served a motivational function – at once an impetus for students to make sense of course content and a means by which they could do so. Thus, learners are not

learning the content just for the sake of building a store of information, but rather, for example, to carry out meaningful problem-solving work that mirrors that which is expected on the job.

Cameron found the teaching assistantships that he undertook while a master's student to be useful teaching-related experiences, although these had been limited to grading work and helping students with problem-solving during office hours. Matter-of-factly, he stated, "Pretty much as an engineer when you're a TA you're just grading, but we also held office hours." Having had to assist students with problem-solving, as a foundation for developing his approach to doing so, he engaged in reflection upon his own problem-solving strategies. He reported that this was the first time that he had found himself needing to reflect upon, "How did I figure it out? How did I learn it in undergrad? How can I explain to this person that they might understand it?" He further stated he had never been proficient at memorization but had always been "good with steps." Thus, he was able to reflect on his own problem-solving processes in detail and apply this approach to work out how best to guide and support students in their own efforts.

So I'd always try, if I was showing how to solve a problem, look, start here where we know –we know everything. We know where we're starting, we're on the same page. And then just go to the next step and just...try to break it up like that so it's just a logical sequence going from what we know, using, well, how do we get to the next step? What are our tools? We don't have an infinite number of tools. We have a finite number of things to select, so let's just think about it. Let's choose this one, this is why we choose it. And now we're at the next step. Now we're going to go from here...I think – that's how I think about solving problems. And so I know everyone's learning style is different, but I figure, you know, if I'm going to choose one – let me [choose one] that seems to work and make sense to me.

Cameron acknowledged that individual students learn differently. However, he viewed detailed dissection of and implementation of his own step-wise problem-solving strategies as a useful starting point for guiding students. He guided them in breaking down the problems logically, helped them establish the number of possible “tools” available for the task, and think critically about which ones to implement. He noted that as a teaching assistant it could be challenging to strategize an approach to teaching to the differing preparation levels with which students enter a course. He found that “you have the challenge of teaching – of trying to avoid having some students bored, but other students you don't want to be lost.” As he was sharing this, he also reflected on having been exposed to the attitudes of professors who were not particularly interested in focusing on students at the lower end of the “Gaussian profile” – an approach to which he was strongly opposed. He reflected that perhaps in his own work, he taught to those in the middle, but would always offer support to students who struggled: “Look, these are my office hours. I'm happy to work with you one-on-one. Send me an email. Stop by.” While Cameron seemed naturally inclined to be reflective, he also shared that being reflective about one's teaching was a process to which one should have an ongoing and intentional commitment so that one could improve.

Just reflecting on – consciously thinking about how the class went and what you could have done different, um, just because you don't want to get to...this stagnation point where all of a sudden you just keep doing things the way you've been doing them. And so just to reflect upon how – why you're doing what you're doing. And so that's something I try to remember, you know. I'm doing this. This is why I'm doing it.

Introducing Ainsley and His Pre-faculty Experiences of Teaching and Learning

Ainsley, at the start of the study, was entering the third year of his faculty position. He came from a family of teachers, including a mother who had been a K-12 teacher and a father who held a professorship that focused on teaching rather than research. Notwithstanding his familial connection to teaching, it was not a profession that Ainsley had initially planned to undertake. Prior to the start of his tenure track position, his teaching experience included that of a teaching assistant for a project-based master's course and two undergraduate laboratory courses. By the end of data collection, he had added to his teaching portfolio, two graduate courses (one of these taught on two occasions) and an undergraduate course (that he taught twice).

Ainsley had learned both from observing and having conversations with his graduate advisor, the importance of connecting with students and teaching them how to think about concepts. He found that his advisor demonstrated good story-telling skills in the classroom, and gave unexpected, compelling demonstrations that were powerful in establishing connections with students through engaging their interest. Further, he observed that his advisor “was also a great comedian,” “so funny” and “just so sarcastic sometimes.” He “just had this incredible personality.” In reflecting on whether he might be like his advisor, Ainsley said, “I can't be him, right? That's his personality.” He further emphasized that one could be “a great teacher without his personality.”

Ainsley reflected with much laughter upon a story his advisor had told him about the advisor's first teaching experience as a new assistant professor, lecturing under the watchful eye of a mentor. Ainsley's advisor had been feverishly filling the boards with text and derivations while speaking at a rather fast pace to the students. Ainsley recounted his advisor's description of this feverish delivery: “Boom! He starts going and writing and deriving everything – going

boom, boom, boom, and you could also see it this way and boom, boom, boom, and he just kept going and going and going.” Afterward, the mentor had strongly admonished Ainsley’s advisor not to do that again “and so he learned that it wasn't really like what you were teaching; it’s just connecting with the students, teaching them how to think about things.” Ainsley gleaned from this story, that “it's not subject material we’re teaching,” but rather, “you're using the topics as a vehicle to teach people how to think,” to “break things down.” Ainsley thought that through this process, students should learn how to teach themselves and respond confidently when handed a task. Further, not only should they learn to apply frameworks to their tasks but they should also eventually learn to create their own frameworks. The latter goal aligned with Ainsley’s notion that the teaching of engineering within the context of his present institution – a research-intensive institution – should be focused on creating leaders rather than employees (i.e., followers or tradesmen).

Ainsley had also observed the amount of time his advisor spent in the lab with students. His advisor would “literally...spend as much time as a teaching assistant, just working in the lab helping students out.” Ainsley contrasted his observations of his advisor to those of another professor who had been a “horrible” teacher of a course that Ainsley had ended up dropping from his schedule. When he later re-enrolled in that course, he found that the professor had improved his teaching significantly. Ainsley was certain that he had to have benefited from mentoring in the intervening period, given that mentoring for teaching was a part of the institutional culture. This, along with his own advisor’s example, seemed to play a role in his conclusion that while teaching is “definitely a talent” and “some people are more natural than others,” one could, and should get better with experience.

Ainsley also expressed strong feelings and ideas about the role and disposition of the student in teaching and learning. Alluding to the impact of institutional culture, Ainsley shared his view that students should be self-motivated and indicated that he was among the many self-motivated students at his undergraduate institution. Everyone had a lot of homework to do but never saw it as a reason to complain. Further, in this context, he and others took some courses out of curiosity even if they were “tangential to their interests.” Because this was an approach that he had embraced and valued as a student, he expected that all students should approach their academic work in this way, treating even “tangential” subjects as though they desired to be an expert in the associated domains. That said, it occurred to him that this expectation might be a product of his ego – perhaps he wanted the students to be like him. Somewhat aligned with his sense of initiative and personal leadership, he recalled that he had been allowed relative freedom to choose research directions as an undergraduate researcher. It is likely that these research experiences in tandem with those Ainsley recalled of being a self-motivated student, influenced his thoughts about the importance to the teaching and learning process, of students’ being self-motivated and curious.

Ainsley’s pre-faculty teaching experience involved providing guidance to students in a small, project-based graduate course and serving as a teaching assistant to two laboratory courses. It was with much enthusiasm that he recalled the rewards of teaching the project-based class.

You know I think the most rewarding thing is to be part of a eureka moment for them.

Those Eureka moments are just amazing. Like I get a rush, right, if I explain something and then their eyes light up and they're like there's just this huge realization like you

could see all the neurons just firing away and they're like – I'm like I reached something there. They've learned something they will never forget.

He also found that in project-based courses, teaching was more like mentoring, which he also found rewarding. However, he did not view this experience as preparation for teaching larger courses. He reflected:

I really liked the mentoring or maybe even the one-on-one aspects of teaching. I always was not sure even – even now sometimes I'm not so sure...of teaching many people at the same time – during a lecture for example. I think...now I'm starting to get the hang of it, right? But it was not something I was comfortable with. I just did not know. I could connect with one, two, or three people. Connecting with thirty-five people at the same time? [I] just did not know how to do it.

Thus, while Ainsley had entered his tenure-track faculty position, feeling confident in his facility with teaching small groups – a process akin to one-on-one mentoring, he acknowledged that it had been very challenging to figure out how to teach larger classes.

As a teaching assistant in lab courses, Ainsley liked to engage students in experiences that would help them make meaningful connections to the course content. From this experience, he learned that at times, he “would give the students too much science.” His goal had been to help the students gain a full appreciation of the details and the connections among phenomena or concepts, and to engage in some independent exploration of these. He had encountered “students that were like that” and “thought everyone should be like that.” In this regard, he reflected that “maybe it's natural or you want people that you work with that are like you, for example, or a version of you that's better or something like that.” Also, he liked the idea of being able to “learn stuff from them too.” However, he would come to realize that students had the right to make a

“conscious choice” about where to place their academic efforts. With this acknowledged, he felt that it was important for them to be honest with themselves about the possible outcomes of such decisions and not expect the highest grades if they had not put in the necessary work.

Introducing Harper and His Pre-faculty Experiences of Teaching and Learning

Harper, at the start of the study, was in the third year of his faculty position, having commenced in the winter of his first academic year at the institution. By end of data collection, he had taught a graduate course three times and his first undergraduate course. During his doctoral studies, Harper had served as a teaching assistant for a laboratory course for which the only practice with lecturing came through introducing and framing the laboratory work students were required to carry out. He observed that good teaching required good structuring and organization of material, good communication and example problems effectively worked out by the instructor, accompanied by lots of problems and homework for students to solve. From his experience as a learner, he asserted that “practice is what people need.” He maintained that:

Math is, you know, it's cliché, but you have to use it otherwise you'll lose it. In this case, it's not so much about the math but it *is* about writing the equations and understanding what they mean and what each term does or is relevant to. And then reading the *word* problems, like, "Do I conceptually understand what the problem is?" 'Cause If you don't understand the problem, you definitely can't get to the solution... 'cause I think if you spend a lot of time doing the problems, and you could actually do them, then I think you're actually getting the most out of the class.

Harper expressed that while personality might play a role in effective teaching, it was not necessarily pivotal. He described some of his professors as “very interesting characters” but also stated that these were not instructors of his “favorite classes.” Rather, he liked the classes that

“really kicked my butt – but not from a faculty member who had harsh demands.” Further, he recalled that “the teachers that I really liked, they were kind of dry but they were very much to the matter” – not providing much application. However, they “worked really hard on developing the course and communicating the information well.” It was “very methodical and well thought out and they did a lot of example problems effectively.” In turn, the students (including himself) were, “effectively weightlifting in class all the time and I felt like I was building real skills there.” In these classes, Harper felt that his “growth was accelerating” and he “liked that.” Of the faculty members he had observed, the most exemplary was “very polished.” Harper spoke about the aspects of their “polish” in this way:

...their notes were very polished; their chalkboard work was very polished; their homework problems were very polished...their [teaching assistants] came well prepared. I'm assuming she prepped them effectively...She worked from one chalkboard, lifted it up, went to the other one...Yeah, she had a whole system in place. She either thought it out well or she had made enough mistakes where she was able to fix it all or something.

While Harper seemed in awe of this level of competence, he believed that “polished” teaching came with practice. Further, he acknowledged that there was more to teaching than possessing content knowledge, “polished” communication skills, and good problems for students to work out. In this regard, he had begun to consider that rather than knowing “all the formulas,” it was perhaps more important to have students engage in “intuition-based thinking and hypothesis” [generation] – “I *do* know that these certain things or mechanisms do these [things], so I would expect this to happen.” These considerations had arisen from the ways in which his research advisor had challenged him to think, and had been “most valuable” to his learning. As a consequence, he thought this approach would likely also be helpful to his students.

Harper described his own teaching experience as fairly uneventful. He experienced the work as primarily that of “sheep-herding” although he had provided some lecture-like framing of laboratory tasks and had gained some experience in creating and grading problems. Further, he did not view his experience of guiding undergraduate research as bearing any relationship to classroom teaching. However, he talked about critical questions that had arisen for him as he reflected on “mentoring and teaching within the laboratory.” The questions included, “how do you instill in students a curiosity in the lab and how do you get them to use that to do certain measurements or whatever?” While these questions occurred in the context of mentoring undergraduate researchers, I reflected that potentially, as he continued to teach undergraduates over time, he might find himself asking similar questions of students in his classes.

Harper reported that he had not thought about the teaching aspect of a faculty position until he needed to prepare teaching statements for his job applications. During this process, he considered the competencies he had in his favor – the skills he already possessed that he could transfer to teaching. He knew that he possessed the necessary content knowledge and that he was capable of communicating it to an audience of people who were not experts in his area of research. In fact, he stated that if interviewers for faculty positions had asked him questions about his teaching competence, he could not have offered very much in response. He would have felt that he simply did not “know how I am as a teacher because I have so little experience and so little feedback.” Further, he would not have felt comfortable conveying to anyone, “I’m going to be a good teacher.” Rather, he would have discussed his “ability to communicate and get them to draw lines to my ability to teach.” He stated, “if you can relate these complex topics to people that are not in your field, then I think that does say a lot about your communication skills.”

Faculty Who Narrated More Preparedness for Teaching

This second group of five new professors presented as more prepared for teaching than the previously discussed participants. Grey felt that he had enough experience of observing what he liked and what he did not like (good and bad teaching) to navigate the work (role) and that securing feedback from his students would go a long way to make him an effective instructor. Hayden had experienced teaching both as an undergraduate and graduate student. His teaching assistantships as an undergraduate had constituted a “dramatic learning experience” and had provided good scaffolding for the teaching assignments he later undertook as a graduate student. Parrish had been able to crown his teaching assistantships with a position as lecturer of record that helped to fulfill the requirements for a teaching preparation program that he had sought out to further prepare himself for teaching in a faculty role. Similarly, Brighton had been motivated to seek out a lectureship that he undertook for three years while working in industry. Morgan felt confident about teaching courses that were based on her research and thought that she could prepare content and teach undergraduate courses that were sent her way even if such courses required her to include less familiar content.

Introducing Grey and His Pre-faculty Experiences of Teaching and Learning

At the start of data collection, Grey had just commenced the first year of his faculty career and had begun teaching an undergraduate course at the time of our first interview. For the second semester, he was on teaching relief. His pre-entry experience included four teaching assistantships, which he had chosen to undertake because he wanted to gain teaching experience. These assistantships involved grading homework and holding office hours.

Describing his life as a student, Grey spoke of having vigorously immersed himself in the academic community and deeply appreciating his learning experiences and the overall campus environment – classroom learning, office hours, undergraduate research, and caring advising and

mentorship at all levels of his journey through postsecondary education. While he framed his overall postsecondary education experience in a positive light, in addition to identifying effective teaching practices, he also addressed the problematic teaching practices that he had observed in some college professors, stating:

I like when teachers are engaged and I don't like when they're just blasting through PowerPoints. I like when they speak clearly. I like when they modulate their voice and don't speak monotone. I like when they speak loud enough. I like when they come to class on time. I like when they're organized. And I just thought I'm just going to do when I teach, everything I like and then I'm going to get feedback from students to see what they like and try and incorporate it. So trying to keep open classroom instruction – just do what you say and make the class have well-defined plans.

Grey seemed to appreciate a well-organized teacher that possessed a clear, well-paced, and stimulating articulation style. He determined that he would follow the approaches he liked and appreciated and get feedback from the students, which he would incorporate into his teaching. He also addressed the importance of providing a good balance between depth and breadth so that students would not only understand individual concepts but how they were connected. In this regard, he spoke about his appreciation for the instructors who helped him connect concepts across disciplines. While he was not sure exactly when he made the transition to being able to make such connections on his own, he found it liberating as he was able to depend less on memorization. He also described the opposite kinds of experiences in which there was an absence of connections to the real world.

When I took calculus, I didn't understand why I was taking calculus. I just thought, 'Yeah it's math and what's – what am I going to use this for?' But if someone said, 'Hey, you

have to learn calculus because in Engineering classes you use it because you need to describe flow in pipes and you need to understand how heat moves and this is all described by calculus,' then they'd be like, 'Oh, that's why you have to learn calculus.'

But they don't teach you that in math classes – why do you have to learn algebra?

Thus, Grey was determined to provide to his own students, insights as to how the knowledge they were acquiring was applied to describing and solving problems in Engineering.

A key disposition that Grey valued and benefited from in his tertiary education experience was that of caring. He described expressions of care rendered by individuals ranging from a STEM high school teacher to college professors to the graduate students supervising his undergraduate research, and graduate school advisors or mentors. Describing the academics who led the lab in which he engaged in undergraduate research, he reminisced, “they’re all so nice, and caring and diverse.” Also, of his faculty supervisor on another undergraduate research project, he remarked that he was “brilliant and he was very caring.” Then, referencing his doctoral journey, he noted that one of his committee members, a consummate professional academic, with whom he was still in contact, “practiced what he preaches” and was “very caring.” When I noted that “caring” came up quite often as a theme in his narration of his academic experiences, he reiterated how important it had been throughout his educational journey.

Yeah definitely... it is the office hours and that personal interaction after class – [it] is just when I felt like people were invested in me. I just wanted to do so much more to make them proud of my performance. I just wanted – it was really that I got to know all my professors in college from going to office hours.

This caring served a motivational function for Grey. In a sense, it created a sense of academic accountability beyond his accountability to himself – to prove that he could do well. He later affirmed, when speaking about bringing caring to the students in his own office hours as a teacher, that this is “what people [students] care about the most.”

Throughout his teaching assistantships, Grey enjoyed several confirmatory experiences. There were ways of being in teaching on which he received positive feedback, and which signaled to him that certain teaching practices and dispositions were useful and effective. He had received affirming feedback from students on responsiveness to their questions, for timeliness in providing answers/responses via email (if he could not have answered them on the spot), and for sending extra resources. He believed that “they felt like I cared about them” and that “I was in their corner and not out to get them.” He also mentioned that knowing the students’ names, and the fact that they knew that they could easily access him for help, likely contributed to their perceptions that they were cared for. It is apparent, then, that Grey’s own positive experiences of a caring academic community and his own students’ positive response to his similar offering of such caring to them, likely worked together to confirm for him that both access and caring were essential components of teaching.

On the cusp of entering his faculty position, Grey felt that the prospect of teaching a large gateway class was somewhat weighty. This was because, as an instructor in this context, one would be responsible for turning students on – or off – the discipline. Overall, however, Grey still felt a degree of confidence, asserting, “I mean it can be intimidating but I thought – I felt like I could do it. I never had doubts about teaching. I just thought that I’d been in classrooms for so long and I’ve seen teachers and I know what I like.” He further asserted:

I just know – the way I know I did a good job teaching is if the students do well in the class. And also based on their feedback. So I don't need anyone to tell me you should do this much.

In effect, Grey was explicitly stating that he was going to take the best of the teaching approaches that he had observed and experienced as a student (learner) and that the measure of his effectiveness would come from the students – their feedback and their performance in the course.

Introducing Hayden and His Pre-faculty Experiences of Teaching and Learning

Hayden, at the start of data collection, was in the second year of his faculty career. By the end of the interview period, he had twice taught a graduate-level course. His teaching background included four terms as an undergraduate-level teaching assistant and four terms as a teaching assistant for junior-level physics courses while he was a graduate student.

Hayden described an undergraduate career marked by immersing himself in the rich learning experiences of college:

Yeah, that was when I became extremely inspired by my teachers. Not to say that I had bad high school teachers but I didn't have – it wasn't like an exceptional school system... I had a few teachers here and there that were important to me. But when I got to college, I felt like the professors had an infinite depth of knowledge in the material they were teaching and I could just ask questions deeper and deeper and deeper.

Further, he noted that he stayed in academia not only because he was interested in continuing in research but because he was interested in education – “the interest in the transfer of knowledge that is combined with the projects.” In addition, he shared that while he could have found work

in other institutions apart from universities “that can be doing research at a very deep level...it won't have this – the energy of a campus.”

Hayden’s beliefs about good teaching and what constituted a good class focused on organization and resources. In his view, good classes were well organized. They had either “exceptional notes” or a textbook that had everything he needed so he could refer to it as a reference. He also emphasized the importance of “good problems” or “good questions” and placed a high value on “having that professor being available and ready to interact with students ‘cause otherwise...it’s [the learning experience] just a textbook.” Hayden viewed interactions with professors as opportunities “to probe” which was “very, very important.” Hayden’s liking for the traditional way of teaching a course was anchored in his memories of and appreciation for the vast body of content knowledge that professors needed to convey to undergraduates.

So, when I think of the classroom – the undergraduate classroom....I think of undergraduate courses – I think they’re more – these are courses that are taught for a long time; this basic knowledge has been around for a long time and will be around for a lot longer and you need to know it. I like the teacher on the stage presenting to me but having lots of available hours. But this is, I think, a very traditional way of viewing the classroom. But it's, you know, what I was used to and I liked it. It worked well.

Hayden spoke further on the value of and expressed deep appreciation for what he had learned as an undergraduate from conversations in office hours, particularly from a professor who had helped him develop a good workflow, decide on his major and, who, of critical importance, welcomed his questions and ideas – whether good or bad. Explaining this professor’s contribution to his learning, Hayden stated:

He had very long office hours and he created a comfortable space that I would bring questions outside of the class and ask him and he could usually show me why they were bad ideas and I loved that...Sometimes they were good ideas and I really liked being able to bounce ideas off – he was very patient.

Hayden also spoke of teaching assistants who had served as role models to him and sources of inspiration and motivation. Such had been his admiration for them that he was inspired to venture into teaching quite early – taking up positions as an undergraduate-level teaching assistant – something he did on four occasions. He placed great value on this aspect of his undergraduate journey, that for him constituted, a “dramatic learning experience.” Hayden found that the level of responsibility, which had been reposed upon him, to be in itself instructive. One of his most significant areas of reflection was on how important it was that no student felt left out. His depth of feeling on the issue is revealed in the following quote:

I would feel terrible if it was something that I had done that alienated a student or made them feel like they weren't comfortable to ask a question. And then the harder part is to figure out how – what is your responsibility level and what can you do to try and reach out to those students.

Through these early teaching assignments, Hayden realized, “there’s a lot of aspects to teaching.” In the instance of having to teach students who had to retake calculus 1, he learned about and reflected upon the psychological and motivational aspects of teaching. In this regard, he stated, “I couldn't understand the origin of the low motivation – I didn’t know – was it frustration? I didn't know what it was. And it wasn't all the students but way more than I'm used to.” Ultimately, he began to consider that these students’ low motivation combined with low frustration threshold might indicate different teaching-learning needs from those of students who

were higher achievers. It seemed to him that, to address the needs of struggling students, it might be better to take a more informal approach and let them know that all was not lost “if you tripped once.” He contrasted this with how one might approach teaching “a highly motivated group of science or math – engineers that want to learn how to do integrals.” In the latter situation, he thought that teaching would flow much more smoothly, stating, “it’s a lot easier ’cause you get on the board and you do your job and then they ask questions afterwards, you’re available, and I think things go fairly smoothly.” Either way, it became clear to him that to “connect with the student” was an important part of teaching.

Hayden reflected that it was valuable to have had his first teaching experience in calculus as it was essentially a pretty straightforward curriculum. There were a lot of problems with “lots of versions of the same kind” that students needed to solve. He described the flow of the process thus:

So I got to just get these students to be able to solve these problems and I don't really have to think big picture. I just go, ‘Today the goal is we're going to do triple integrals and like of in Cartesian coordinates, or whatever it is and it's ‘like I have an hour and I had – these are the things they got and they got to solve these problems. So you could be very sort of narrow...’

He compared instructing calculus (in his undergraduate years) to teaching physics classes (while pursuing doctoral studies) where questions you might get could be “very open-ended” and one could end up in some “very difficult problems – very difficult spaces.” In teaching the physics classes, he had to decide if he had time to address these questions in class or leave them for after-class discussion, “because you didn’t want to burn classroom time thinking about a problem.” Herein, he had begun to think about how best to use class time to benefit the majority of

students, while considering the individual interests of students who wanted to explore more complicated material.

Hayden shared that he had “first learned the importance of...just hanging around afterward and solving problems” while he was an undergraduate TA. This was something about which students had provided positive feedback and was “pretty easy” to him. He explained that students would often stay after class, and he would continue on the blackboard “until everyone was bored or tired.” It seems, then, that having enjoyed positive experiences of professors’ availability and provision of comfortable and accessible office hours as well as receiving positive feedback for being himself available to students as a TA, had concretized in Hayden’s mind that “availability” was an important aspect of teaching.

Hayden had entered his faculty position confident that the graduate course to which he was assigned, indeed was a good fit for him given his area of research expertise. Regarding undergraduate teaching in which he anticipated engaging in the near future, albeit that there was some distance between the projected scheduling of that course and the last time he had taught undergraduates, he asserted:

I'm very confident in my ability to read any book for any of the undergraduate courses and teach it. Absolutely! And then, it's just [that] am I confident to invent new material to integrate to make it a sort of transformative class to really go deeper – bring something new and exciting into it.

Introducing Parrish and His Pre-Faculty Experiences of Teaching and Learning

Parrish, at the time of data collection, was in the second year of his faculty position. By the end of the interviewing period, he had taught the same graduate class twice. His teaching

experience while he was a doctoral student included two teaching assistantships and an appointment as a lecturer of record. This lectureship was linked to a faculty preparation program.

As an undergraduate, Parrish had admired professors who were able to grasp students' attention by bringing enthusiasm to the course material. These were the teachers of the classes that he found most enjoyable. While he noted that sometimes "it was as much the material as the presentation of it," he also indicated that, "there have been completely irrelevant classes to my interests that I have found very interesting because of those things that are presented in a practical way that I can see why it's important." Hence, he undertook a similar commitment in his own teaching, to emphasize how concepts apply in the real world.

The most outstanding example of teaching Parrish had observed occurred in an advanced undergraduate class that built upon a foundational course in the same area. In effect, the advanced class built on the fundamentals such that it "was able to really go a whole other step further" so that Parrish (and other students) were able to see why certain processes were taking place and how they could apply material and concepts taught so far "in all these new, different ways." The instruction for this class had been carried out in multiple ways, which made a profound impression on Parrish, who noted:

There was not only verbal, but drawing figures, and explaining these ideas of why things are important and how to apply them and move them forward. So that was very – it was a class that left a mark on me because I just remember that being – a big component of it – was really being enthusiastic about this material, of why it matters, why it's important.

And the faculty was very enthusiastic about this, so it gets you excited about it.

Parrish's observations led him to embrace an approach to teaching that included:

all these things of application and being able to build a clear application and concept, at the same time focusing on the theory and the fundamentals of the class and the topic and trying to engage the students and having enthusiasm built into them and try to show that myself as well – trying to bring that to the classroom to be able to engage the students and help them – you know, use that as a technique to get them from A to B.

Parrish's first experience as a teaching assistant involved helping undergraduates with their senior capstone projects in which they needed to employ knowledge gained across related courses. His role had been primarily that of project supervisor, both helping students within the classroom and during office hours. Through this experience, he realized that he "enjoyed interacting with the students a lot." Also, in this experience of "working with them, being able to pass on my knowledge and understanding," he realized that he "didn't have to always be a hundred percent right." In this connection, he learned that "these students are very bright and they will catch onto things and make it right at the end of the day." It seems, then, that it was not only his enjoyment of interacting with the students but also in some sense viewing them as partners in the teaching-learning process that lent itself to a concretization of what I am calling a relationship-focused approach to teaching; in effect, a learning partnership. In this experience, it seemed that he came to embrace humility as a useful value in teaching and appreciate that students could contribute to the teaching process by raising questions that would lead to the necessary clarifications being made.

This relationship-focused approach to teaching was again made apparent when Parrish spoke of his second teaching assistantship, this time serving in the context of a masters-level course. In this situation, he found himself having to learn some of the course content at the same time as the master's students. While the experience had initially been stress-inducing, Parrish

reframed it such that he began to see the students as “equals” with whom he was engaged in co-learning. He recalled that students often came in large numbers to office hours because there was no discussion section structured into the course. This was where he was able to experiment with different ways of explaining the material. Further, by contrast to his experience in his first teaching assistantship, rather than providing explanations depending on individual projects (and the associated concepts and ideas), in this second teaching assistantship, he needed to explain the same concepts to many different students. He gained practice in providing additional examples to assist students’ comprehension, drawing a sketch differently, or even (because the class had a laboratory component) demonstrating ideas on the computer. From this experience, he learned:

Oh, if I explain this in four or five different ways, the student will pick it up. So, I could definitely see that if I was able to explain these concepts and ideas well, I could get the students to go from part A to part B where they actually understand it.

Notably, this ability to explain a concept in multiple ways was something that he had previously mentioned as something that he highly valued in the professor whom he viewed as most exemplary. In further reflecting on the value of his second teaching assistantship, Parrish noted:

you're trying to teach the whole class the same thing. And once you understand that this is a hard area for them to grasp and you prepare or essentially you are able to address it for one or two students, then the next ten that come to you, you can explain it much more concisely and better and they're able to grasp that concept quite easily. So, it was very rewarding to get – to go to those ten students and get them to go to that aha moment quickly and efficiently, essentially. So, that was a very useful thing that I'd say I got from this class – that this is a process that can be done well and quickly and efficiently and we can get all these students to really learn these great things very fast.

It is noteworthy that a strong focus on relating to students by being accessible to them and assisting their learning according to their individual differences did not preclude Parrish from thinking about the efficiency aspect of teaching, which is particularly important considering the research-related time demands faced by faculty in research-intensive institutions.

In his TA experiences across these two classes, Parrish encountered students who were taking longer to understand concepts. He stated that he maintained a positive view of these students and welcomed opportunities to work closely with them, explaining:

The troubled student for me at that point was the one that was just taking a little bit longer to understand the concept, which was often somebody that I would actually build a closer bond with and would actually spend more time working with. So, it was actually not a troubled student in the end. It was a student that I just got to know better in that way. But yeah, I would say those weren't often troubled students. They were actually very good students that were really trying to do well. So it was actually a pleasure to work with them.

The quote above reveals a nurturing approach towards students, which is consistent with Parrish's focus on the impact of his teaching approaches on student learning.

Parrish's participation in a teaching fellowship occasioned the need for a teaching position that exceeded the demands of a teaching assistantship. Fortunately, this coincided with his department's need for a lecturer of record for a course. Parrish found that the lead instructor (also his advisor) of the second course for which he was a teaching assistant served as a good model for the teaching of this course.

I modeled the way I taught that class in many ways based on that earlier – the second class that I had taught with my advisor who would have these weekly meetings with the

TAs. So I would have my weekly meetings with the TAs. He used to have the I-clickers in the classrooms – so having class participation, and so I incorporated that into the class I was teaching as well.

In further reflecting upon this lectureship, Parrish stated that he had taught the class “in a very traditional lecture style.” He regretted that he had not been able to go much beyond this approach although he had managed to facilitate some interaction among the students through using a student response system. He acknowledged that he had had a lot to master at the time: “part of it was I was just trying to figure out how do I make these notes, how do I fit this course material in such a short amount of time?” He reflected:

Yeah, the lectures unfortunately were just a very hard place to get interaction with the students. The best that I could do were the I-clickers [the student response system devices], right, where every student has ownership and you can put the results up and everybody's engaged but it's still in many ways a very one-way type of situation. And even in such a large class, you know, trying to solicit questions was difficult.

Parrish’s reflection on his teaching of this course and feelings of regret that he had not been able to facilitate more engagement in this class demonstrate that he placed a great deal of importance on the quality of his teaching and underlines his value for engagement of students – something he appreciated and benefitted from when he was himself a student. This is consistent with his appreciation of having a co-learning kind of relationship with students when he served as a teaching assistant.

Parrish’s takeaways from the training aspect of his fellowship were first, the perspective that teaching is “a nonlinear” process, and second, the reinforcement of the importance of reflection to teaching. For him, the “nonlinear” approach to teaching meant that as students differ

in learning needs and styles, particular configurations of resources may match some students better than others. On this basis, he as a teacher could better direct students to the teaching and learning resources that best suit their learning needs. Regarding the process of reflection, the focus was:

thinking about the organization of your board notes or organization of a class or organization of a syllabus – you know, all these tools that I kind of learned about have fit into this bigger picture of trying to build a class that can be effective and good.

While Parrish shared that he had in fact always been reflective, he thought that in the past he was “doing it much less effectively.” Post-training, he believed he had developed the ability to do “this type of reflecting much faster and much more efficiently and effectively.” Thus, “when I think about what I’m doing as an instructor, it just happens much faster.”

Introducing Brighton and His Pre-faculty Teaching and Learning Experiences

Brighton was at the start of the study, in the second year of his faculty position. By the end of the interview period, he had taught two courses – a graduate course and an upper-division undergraduate course. His past experience included three teaching assistantships and post-PhD, a lectureship that lasted three years. The thoughts that first came to mind for Brighton in thinking about good teaching were that it was characterized by “engaging interest” and “succinctly and clearly articulating and presenting the material.” These beliefs, which had first emerged through his experiences as a student, were supported by his own teaching experiences. Brighton’s reflections on his best classes as an undergraduate and graduate student revealed that across both levels of education, the professors he viewed as good instructors took a similar approach. In describing the best class and instructor he had taken as an undergraduate, he stated:

And probably the best class I ever had in undergraduate, the teacher wasn't that exciting, but just had these extremely organized and very clear notes with examples. And, yeah, just I learned quite a bit every class, and I almost didn't need to read the textbook...It was so – the notes were so coherent.

Following this description, Brighton stated that his exemplary professor in graduate school had followed the “same kind of line.” He was “a pretty low-key teacher” in terms of personality but “the notes were pretty articulate, and the material was just fascinating.” Further, he also described a professor for whom he worked as a teaching assistant. This professor exemplified organization and transparency about course content, difficulty level, and expectations of the students. Additionally, he had also engaged the students with “cool examples” and “brainteasers.” The overall impact of this professor's teaching, in Brighton's view, was that students developed “a more fundamental understanding.” Further, these were “all kind of little tricks that I've picked up to try to incorporate in my own teaching style.”

In discussing his work as a teaching assistant in graduate school, Brighton indicated that the “biggest trait” he had to learn was that of patience. He reflected that when one has “a more advanced grasp of the material,” it can be difficult to communicate with those who are less advanced. In seeking to remedy this situation, he found it necessary to “actually put yourself back in their shoes where it's their first exposure.” This was an area that he saw as a work in progress.

While working in industry after attaining his PhD, Brighton began to think about the professorate and decided to undertake a position as a lecturer for an undergraduate course at a university to build his teaching experience and “see if I liked it and, too, if I could handle it.” Brighton shared some valuable learning that he underwent during the time of his lectureship. He

learned that the problems he set were too difficult for his students. Based on this discovery, he was careful to work out problems ahead of time and give them to teaching assistants to test out. In this regard, he stated, “it had occurred to me that I needed some other metric aside from me because I could do all the exams very quickly since I wrote them, right?” However, he also needed feedback on how students had been experiencing the lectures and decided to intermittently survey them for feedback “to try to improve the style.” He also would “write notes after a lecture and see what I like about what I did; what I didn’t like about it.” When I asked him whether he had always been so reflective he responded, “Yeah, and probably to a fault.”

Regarding what the students had taught him about what they needed from him, he reflected that “there’s a personal level” to the work such that students “need support and positive reinforcement” and “you can’t beat them down too much.” Further, “they need the inspiration, they need the guidance in terms of intuition, and they need the reinforcement in terms of repetition.” He had “learned all those incrementally...how to fold those into my style.”

Brighton spoke emphatically about the importance of homework – a conviction that emerged from his own student/learner experiences. In explaining his strong feelings on this matter, he stated, “I’m not a good test taker. I need time to think through problems...so I always liked having homeworks because homeworks you spend hours on, and you really get a grasp of the material, and you can show what you know, right?” He further explained that “homework should be a learning experience to supplement lecture.” Thus in problem-solving examples during class, he would say,

Okay, well, here’s this result, and we are going to talk about physically what it means, and now you have an intuition about why it works, but in your homework, I’m going to ask you to actually derive it and go step-by-step.

In the foregoing statement, I noted an earnestness about making sure that there was a seamless link between what was presented in lecture and the set homework, both as a means of the teacher building upon conceptual lecture content as well as, on the part of the student, practicing the skill of derivation in an informed way. Thus, Brighton facilitated students' appreciation of the meaning of formulae in terms of the physical properties to which they were related in the real world. Brighton further explained what had sealed for him the importance of having students understand and have practice with "physical intuition." He revealed that it was partly the quality of undergraduate students he had mentored while in industry and his own experience of finding such a focus to be "most valuable in my career" (industry). While he believed in the practical value and utility of "physical intuition" to the burgeoning engineer, he also reflected upon the fact that his disciplinary background had helped to shape him towards taking a "theoretical" or "first principles" approach both to his teaching and research work.

Brighton reflected that towards the end of his time as a lecturer of record, "he began to get into a groove" and concluded that, "this is something I can do." He reflected that through this experience, he had "positive reinforcement too, in terms of...students giving me the impression that I could be an effective teacher." Thus, he entered his tenure track faculty position, with a good measure of encouragement on his capacity to be an impactful teacher.

Introducing Morgan and Her Pre-Faculty Teaching and Learning Experiences

Morgan, at the start of data collection, was in the second year of her faculty position. By the end of the data collection, she had taught three times – twice in one graduate course and once in the other. Her past experience included four teaching assistantships – leading two undergraduate labs and two courses that involved instruction in software, and facilitation of the

associated labs. The latter two courses included a mixture of graduate students and senior undergraduates.

Morgan had found, in general, that the professors she viewed as good instructors were often funny, interactive, asked questions, waited for answers, presented content material in interesting ways, and used non-hackneyed examples – “not the standard examples” which, she explained, were those that offered the benefit of connecting with students from different engineering disciplinary backgrounds. She saw her advisor as an exemplary teacher and it was her experience as a student in one of his classes that influenced her interest in having him as her research advisor. He offered multiple perspectives, provided intuition and his classes were interactive. Thus, Morgan believed in creating an interactive, interesting, and engaging class, providing relatable examples that helped to teach new concepts and “giving intuition on the concepts.” To do this, she used “directional questions” (i.e., guiding questions), not giving away the answers, but providing the students with room to think. She would have them freely generate and share their thoughts and perspectives on the problem at hand before indicating to them which answers were correct or incorrect. She believed that students should have a chance to generate responses themselves rather than the instructor providing them with answers. In this way, they would gain practice with critical thinking – engaging in thought processes that help them develop their intuition. Further, she committed herself to the task of creating interesting examples that reflected a range of disciplinary backgrounds so that she could effectively reach students who were pursuing studies in these engineering disciplines. Expanding upon this idea, she stated:

You can come up with much more interesting discipline-related examples. So because this concept is being presented in different engineering disciplines, you can use [an]

example that comes from that discipline, not that standard example that everybody uses when they are teaching that concept.

Concerning the relational aspect of teaching, she did not believe that as a professor, one needed to carry a “very serious” persona, as she had observed in many professors. She thought that such an approach created unnecessary barriers between teacher and student. She believed it was key for students to:

feel as though they can ask any questions they want to if they didn't understand something I just, you know, taught, they [should] feel free to ask questions; they don't think that I am judging them or somebody else – other students are judging them, you know, for the question they are asking.

While she considered that there could be a risk of students breaching the teacher-student boundary, she indicated that she had never had students who failed to respect the boundary.

Morgan had undergone some teacher training during her PhD program, but reflected that it had occurred too long ago for her to recall much of it. However, she had carried with her the idea of being interactive in her teaching which, notably, was in keeping with what she already thought was best based on her own experience observing professors over time. From training, she also recalled the suggestion of providing treats to students who had provided the correct answers to questions – an idea that did not find favor with her. This was one of the ideas that to her, was “just too much.” She asserted, “I am never going to do that.” She “felt like it was something that would happen in kindergarten.”

Morgan’s only concern about entering a faculty role was whether she was going to be asked to teach an undergraduate course outside of her expertise. However, she was quite matter-of-fact in her thoughts about how she would respond to such a request, “I mean I wouldn't look

forward to doing that, but if I have to teach a course, I just learn it, so that's not a big concern to me.”

Summary and Analysis

In building conceptions of the work of engineering instruction and constructing a teaching repertoire for themselves, participants found value in their store of observations of teaching as well as in their own experiences as teaching assistants. They had observed, experienced, and assessed the effectiveness of the teaching practices and dispositions of their past professors and drew on what they experienced as the best of these repertoires in constructing ways of doing teaching and ways of being teachers. In their own teaching experiences as teaching assistants and lecturers of record, they gained practice in and tested themselves in aspects of teaching work.

Pre-Faculty Years: Approximating Legitimate Peripheral Participation Through Observation

Before directly engaging in any aspect of teaching work, all faculty had experienced the teaching “repertoires” of many professors while they were students. In this context, while they were not yet practicing teachers, were not “mutually” engaged as equals with professors in figuring out the work of teaching, nor had any accountability at that level to a professional academic community or community of teachers, their observations afforded them opportunities to make meaning of the practices they were seeing and experiencing as students. As such, they had a window into practice, which has been characterized in the education literature as an “apprenticeship of observation” (Lortie, 1975; Mewborn & Tyminski, 2006). As students, they had observed, reflected upon, critiqued, and made judgments about the effectiveness and value of methods of teaching and teaching dispositions from their professors’ teaching repertoires. I think of these repertoires as instructional methods’ repertoires (e.g., lecture, use of examples, provision

of conceptual applications, use of conceptual questions) and dispositional or affective repertoires (e.g., caring, patient, welcoming, creating a comfortable office hour space, overconfident). The assessments that participants made based on their teaching observations were critical to informing their conceptions of teaching, how they would constitute their teaching work, and by extension, themselves as teachers. Additional and complementary to the observations that participants had made of professors they had experienced in the classroom, they engaged in similar teaching-relevant observations and reflections on their relationships with research advisors. The focus of these included mentoring practices (e.g., kinds of questions and ideas that research advisors posed that helped their learning) and dispositions or interactional styles (e.g., patient, welcoming, creating a comfortable space for testing ideas). In thinking about their own future work as faculty, participants reflected on the observed practices and dispositions as strengths to be emulated or flawed approaches to be avoided.

Pre-faculty Years: Legitimate Peripheral Participation

Experiences as teaching assistants and, in two cases, as instructors of record, allowed participants to personally test the value and effectiveness of previously observed methods of teaching and those that emerged through their own trial and error endeavors. This work, according to the communities of practice framework, constitutes legitimate peripheral participation. Participants were hired to do this teaching work to support more experienced members of the teaching community of practice and therefore, consistent with the requirements for legitimate peripheral participation, and were *mutually* engaged in the teaching enterprise and accountable to the community. While this teaching work varied in terms of both quantity of opportunity and the level of exposure to multiple components of teaching work, it was useful in providing a foundation for later practice as a teacher within a tenure-track faculty position.

Through engaging in teaching during their doctoral journeys, participants were able to practice teaching skills, reflect on their efficacy and success, concretize determinations about the approaches and dispositions that work in teaching, and make some commitments to the ways in which they would enact the teaching role in the future.

Identity Work: Bringing Together Observation and Legitimate Peripheral Participation

According to Wenger (1998), learning and identity building are inextricably linked. Learning is engaging in practice and making meaning of that practice in the process of becoming a member of a community (belonging) and becoming a particular kind of person in relation to/or in the context of that community (defining the nature of one's membership). However, before actual engagement, participants constructed conceptions of teaching from their observations of others' practices. This meaning-making process included identifying the kinds of practices that are important to teaching in engineering, both optimal practices and less than optimal teaching approaches and dispositions. Once participants began to engage in practice as teaching assistants, they began to draw upon "shared historical and social resources, frameworks, and perspectives" (Wenger, 1998, p. 5) of teaching practice, as demonstrated by their professors and mentors, and make their own contributions to practice.

As observers of teaching as undergraduates, while participants had not necessarily determined that they were on a trajectory towards becoming faculty and had not been engaged in the enterprise of teaching in engineering and were therefore not accountable to it, they had already begun to make meaning of practice. They were making assessments about both sound and poor teaching approaches. As doctoral students, both in research and teaching capacities, they were navigating membership both in the engineering doctoral student community of practice and approximating membership in the engineering faculty community of practice. As far

as teaching was concerned, they were directly involved in negotiating the meaning of practice and simultaneously negotiating their “experience of self” (Wenger, 1998, p. 150) in relation to it. This means that while figuring themselves out as teachers – taking up or modifying practices from the community, contributing new practices, and to some degree, creating personalized repertoires, participants had begun to engage in a process of identity construction, which according to the COP framework (Wenger, 1998) would be in continuous motion across the lifespan of their careers.

Chapter 5: Learning And Identity Construction In Community And Across Landscapes Of Practice

In the present chapter, I explore the resources, broadly conceived, for early career engineering faculty's construction of teacher identity as new faculty members, engaging in the work of teaching during years one to three of their faculty positions. In this process of engaging with their teaching work, they did so in the context of a locally negotiated community of practice of research-intensive engineering faculty members, complete with its own *histories of learning* (Wenger, 1998) as reflected in documents such as syllabi, stories available through community members, and other resources. Further, they were also accessing and engaging through *imagination* (Wenger, 1998) with the meanings they made from engagement in past communities – both as students and as graduate teaching assistants. In so doing, faculty were negotiating both how they would build their belongingness to their present focal community of engineering faculty members in a research-intensive environment, and thus, who they were becoming, as they engaged with the community and its learning and identity-informing resources.

Communities of practice theory frames individuals in relation to communities, as simultaneously engaging in practice, making meaning of practice, engaging in a trajectory into one community (or more) to achieve belongingness, and increasingly becoming a particular type of person in the context of and in relation to the community and its learning and identity-informing resources. These resources include stories, people (e.g., senior faculty), a variety of documents, tools, methods, artifacts, and other reifications (e.g., teaching-related products such as demonstrations). These reifications are conceived of as not only product but also, ongoing

processes, such as implementing teaching practices (i.e., we implement even habitual teaching practices in different ways each time we use them) and reconfiguring (i.e., intentionally doing things differently). As faculty engage with the discipline and field of engineering, as is the case with any professional domain, they need to engage with an array of experiences and perspectives from multiple communities. These include the communities of practice of their respective academic departments, engineering as practiced in industry, and engineering education specialists. Thus, they must be responsive to and navigate multiple dimensions of competence and practices (Wenger-Trayner & Wenger-Trayner, 2015). They must engage in productive relationships with community members to help to sustain and advance the collective enterprise; be accountable to the community's enterprise; and increasingly advance in "negotiability of the repertoire" (Wenger, 1998, p. 153), thereby interpreting and making use of the repertoires of competence in ways that allow them to create "meaningful moment (s) of service" (Wenger-Trayner & Wenger-Trayner, 2015, p. 23).

However, most professions, especially in the twenty-first century, cannot be seen as being possessed of such singularity, as to exist in a world where "claim(s) to competence" (Wenger-Trayner & Wenger-Trayner, p. 16) are narrowly circumscribed. As such, the traverse of individual trajectories towards identities that reflect competence must encounter other communities, and thus multiple "claims to competence" that exist in what Wenger refers to as the *landscape of practice*. Regarding research-intensive faculty members, one might consider other communities such as STEM or engineering education research or even the community of students itself albeit that, particularly the latter, should not be considered a monolith. As one engages with the landscape and one's memberships and or trajectories into communities representing distinct but related practices, the individual faces the work of modulating

identification and conveying their *knowledgeability* (Wenger-Trayner & Wenger-Trayner, 2015) across the practice landscape to best render “meaningful moment (s) of service” (Wenger-Trayner & Wenger-Trayner, 2015, p. 23). For the early career engineering faculty, “meaningful moment (s) of service” may be those rendered to a student community, to a department and its histories of learning, to a discipline (its past, present, and projected/imagined future), and so on.

According to the communities of practice framework (Wenger, 1998; Wenger-Trayner & Wenger-Trayner, 2015), engineering faculty may, to varying degrees, align their teaching practice to what they learned throughout their journeys within communities of practice and across the landscape of practices, such as those of research, teaching or work in industry. They may also engage in thinking and actions that reflect the desire to align with broader systems, such as those within the universities in which their departments are located. For example, a university may be engaged in a thrust towards more student-centered teaching or diversity and inclusion and social justice. Such institution-wide developments also become important considerations for faculty members as they build their professional academic practice as a whole or specifically in the areas of research, teaching, or service. As variable as the degrees of alignment to and identification with perceived core essential practices of a community may be, so too, may be the levels of criticality brought to the meaning made of certain practices. This meaning-making process may reveal the need for the tweaking or modification of teaching, or perhaps, some innovation. For example, a faculty member might preserve fidelity to core or typical practices, such as homework assignments, but be more thoughtful about the framing of the assignment prompts (e.g., to more authentically represent problems anticipated in the workplace or to be more gender-inclusive). Additionally, a faculty member might adhere firmly to a repertoire of what they made meaning of as core, traditional teaching practices that seem to

be dominant in their community of practice on a local (and even global) level. These practices might reflect, for example, “typical” teaching repertoires of STEM and/or engineering faculty, but individuals may interlace these practices with more novel approaches that are student-centered in nature. These might include active learning, whether research-based approaches or extemporaneously generated ideas that represent the faculty member’s own creative, innovative, and improvisational thinking). The latter would constitute going beyond mere engagement to bring into play a level of what Wenger (1998) refers to as imagination – standing back from one’s core community, surveying the landscape, so to speak, and considering other possibilities for practice. The use of imagination offers the opportunity to complexify the teacher identity of the faculty member as well as move the community of practice forward by enriching its history of learning and expanding the possibilities for the kinds of teacher identities to which faculty members on an *inbound trajectory* have access. However, imagination can be a double-edged sword in that an individual’s imagination may be limited, and as such, they may conceive of the community of practice (e.g., of research-intensive engineering faculty) on a global level, as a mere reflection of or continuous with their own locally negotiated community of practice of research-intensive engineering faculty. In this case, faculty might simply shore up their comfort level with existing “regimes of competence” (Wenger, 1998, p. 137) from which to form their practice repertoires and teacher identities.

The construction of identity is ongoing and is constituted of interactions between the individual and the collective within and across communities of practice. In some of these communities, one holds full membership or is on a trajectory to such. However, in relation to other communities, one may hold or seek peripheral membership and participation because limited engagement might be sufficient to fulfill one’s identity goals, for example,

complementing one's exercise of full membership in a more significant community. Past experiences and intentions for the future are incorporated in the negotiation of who one should be or how one should show up in the present. Identity is not only negotiated from moment to moment, but the negotiation process also transcends the moment as the individual engages with past experiences and meanings made thereof, as well as future projected identity-informing/supporting experiences, requirements, or demands. Further, individuals are negotiating meaning around identities across time – “paradigmatic trajectories” – “living testimonies of what is possible, expected, desirable” (Wenger, 1998, p. 156) – that reside within other community members including old-timers (i.e., senior faculty). Wenger notes:

As we encounter effects on the world and develop our relations with others, these layers build upon each other to produce our identity as a very complex interweaving of participative experience and reificative projections. Bringing the two together through negotiation of meaning, we construct who we are. (Wenger, 1998, p. 151)

In presenting the results of my study, framed by the communities of practice framework, I first discuss the messages the participating faculty members encountered within their academic departments regarding the place that teaching should take amongst faculty roles and responsibilities. Second, I address interactions that informed the participants' thinking about teaching practices and their reflections upon those that they implemented. I begin this section with a discussion of interactions with fellow faculty members, followed by interactions with students. Third, I address new faculty members' interactions with the landscape of practice both internal and external to the institution, and how they made meaning of the resources contained therein for achieving competence in teaching and constructing teacher identities.

Context and Conversation: Making Meaning of Departmental Messages About Teaching

Regarding the messaging that they received about teaching, most of the participants referred primarily to that which occurred within the School of Engineering, or within their respective departments. Before making their journeys into their departments, participants were certainly aware that that research was their central role and that they should focus more time and effort on this area than on teaching; this was reinforced in one way or another as they engaged in their work as new engineering faculty. In characterizing the teaching environments of their departments, some participants pointed to the knowledge of good teaching in the department and or/particular kinds of expertise resident within these disciplinary spaces, for example, knowledge for undergraduate teaching. Some participants spoke about directly benefitting from the sharing of syllabi, course notes, and course activities by faculty who previously taught a course to which they were now assigned. Much of the participants' exposure to colleagues' ways of being teachers occurred through informal conversations and stories shared or floated in the department. According to the communities of practice framework, the latter represent the histories of learning (Wenger, 1998) of the community, and constitute resources for learning and identity construction (Wenger, 1998).

Informal conversations were focused on such topics as homework and grading philosophies, and casual mentions of activities they were doing in their courses. The more formal teaching-related meetings within departments were primarily focused upon issues around curriculum content. Only one faculty member mentioned having experienced a talk about teaching approaches offered in a faculty meeting. Another spoke about contributing to an organized pedagogical endeavor involving the development of a new course, and four mentioned being a part of meetings that discussed the overall undergraduate or graduate curriculum. Formal

dialogue typically included discussions on the critical topics that students needed to learn within particular programs and the potential introduction of new courses.

Research is Your Priority and Teaching is Secondary

Participants registered the message that research should be their priority (which was not unexpected for most) and that they should focus more time and effort in this area than in teaching. Thus, the identities that faculty should prioritize as they navigated their community memberships as research-intensive engineering faculty members were clear. This would be a core foundational understanding of where the main focus of mutuality of engagement in the community of practice and accountability to the enterprise should lie. Year-three faculty member Harper stated that the message he received was that “we want you to do well in teaching, but you've got to do well in the research first.” Further, while teaching has to be good..., it shouldn't jeopardize research in any significant way.” Similarly, Cameron stated, “No, no, no, I was not hired to be an excellent undergraduate teacher... the focus is on doing research and...I think they want you to be a good teacher, but that's really not the focus.” Alex heard a similar message: “I mean I did get the message that [teaching is] important. I mean however, in the back of our minds, I think all of us know that we have to come up with research funding for our labs or we won't be here.” She further explained the meaning she had made of what the identity priorities of a faculty member in her department should entail.

I am not saying I think that's right or that I try to like just be an average teacher because of that...but I do think, you know when it comes down to it, you have to have the funding for your lab to keep being a research professor. And then I think it's a personal decision whether you're a great teacher, or you try to be a great teacher, or you just sort of check the box on it.

Alex's quote above not only conveys that research is a clear professional identity priority, but that there was a kind of mutual understanding that one did not need to feel a sense of accountability for making oneself "a great teacher." Rather, the additional effort to be excellent might be better seen as accountability to oneself. This is aligned with the notion of teaching as a private activity as compared to research, around which community engagement has been more typically a cultural fixture within research universities (e.g., Shulman, 1993), notwithstanding the ongoing calls for accountability in higher education (e.g., Huisman & Currie, 2004; Shulman, 1993), especially in STEM disciplines (e.g., Hora et al., 2017; Seymour & Hunter, 2019).

Somewhat connected with the emphasis on research, some faculty noted that their new colleagues were not interested in how they were going to teach but were instead interested in the research they would be conducting and the content or courses that they would develop and contribute to the curriculum. Brighton, who was in his second semester at the institution, noted that during his interview phase as a prospective faculty member, his colleagues had not demonstrated much interest in his teaching style. Rather, they demonstrated greater interest in the content he would teach, which boiled down to, "What can you cover, so I don't have to cover it?" Above all, he found that they were interested in the nature and direction of his research: "What's your research? How can we collaborate? Where's your funding come from?" Brighton added that these were "the three questions" he received from colleagues "all the time." Similarly, second-year faculty member Morgan noted that in her department, the early conversations about teaching were about what courses each person would teach; the methods or approaches she (or others) would use were not a topic of conversation or deliberation.

Inextricably linked to messages about their research priorities, were the messages that faculty received about how they should allot time to research versus teaching. Two first-year

faculty members spoke explicitly about how they would go about *saving time*. Jordan, who was teaching an interdisciplinary course for the first time, explained that a colleague had had a frank discussion with him about the importance of “doing a good job at low cost.” Thus, time constraints figured significantly among Jordan’s considerations in choosing to follow a previous faculty member’s syllabus for his master’s-level course and simply learn along the way, through experience, how he needed to improve. This conversation had informed him, as he illustrated to me on his whiteboard, that there is a point at which time spent on preparation for teaching yielded no significant improvement on its quality. Grey, referencing his learning about time usage at faculty orientation, indicated that he planned to consider this in his work as he, similarly to Jordan, had learned that there was a point beyond which additional hours of preparation put into teaching did not translate into significant enhancement to its quality.

Ainsley, third-year faculty, indicated that it had been “disconcerting” to him as new faculty, to be told that “teaching is not the priority” and that he should place most of his time and effort on research. In short, he should “just get through your first few years.” This approach worked in teaching his first course – a project-based graduate class, which he indicated that he was “winging...every week.” However, having not invested enough time in preparing for the undergraduate course that came the following semester led to evaluations that were “just horrible.” Ainsley explained that this outcome was a consequence of failing to “own” the class, by simply following the lectures from the previous course instructor. Thus, he made the determination, “Alright. I’m just spending this August (the summer immediately following the course), really just making – owning that class.”

Alex, also in her third year during the study, was also well aware of the messages about the need to closely monitor the time she was spending on teaching versus research. She shared

that she had thus far successfully navigated the time allotment implications of needing to prioritize research by confining her teaching to a single semester – where “I can focus and not feel guilty about focusing entirely on teaching, which is pretty much what I did.” Alex’s use of the word “guilty” concerning her teaching efforts and her strategy of keeping teaching siloed into one semester reflected the extent to which research constituted the preeminent professional competence demand to which she was accountable, and thus needed to be central to her identity trajectory. Several other participants also talked about the division of labor, reflecting upon the need to put more time than anticipated into teaching when they prepared their first courses. However, they managed this unexpected time demand by taking the long view – telling themselves that they would not have to take as much time to prepare for the next time they would teach the same course and or that this experience would contribute to the building of their teaching portfolios.

Experiencing the Assignment of Teaching Responsibilities Close to Core Identity

The general practice in this School of Engineering is to have faculty rank their areas of interest for teaching. However, this is in the context of the need of department heads to balance the interests of new faculty with the teaching needs of the department. This practice provided faculty with opportunities to ground themselves in the teaching of content that was a close match to their research strengths or domains of expertise (i.e., research identities) while meeting the teaching needs of the department. Most incoming faculty conveyed that their first teaching assignments were a good match, albeit that for one individual, teaching a large gateway course in his discipline felt somewhat intimidating, and was not his first choice. Also, for another participant, while the graduate course he was assigned was his best match, he experienced some worry about the assignment because he had never previously taught an interdisciplinary course.

Further, his identity as an interdisciplinary researcher and content expert was still in its early developmental stages. This was because he was still in the early phase of his trajectory into an interdisciplinary sub-community, albeit that he had experienced strong socialization in his core discipline (and previous departmental home as a doctoral student).

Year-three faculty member Alex, who at the outset of her tenure-track career was assigned an upper-division course in an interdisciplinary major, remarked that it seemed that her department “really needed someone to teach that course” as the subject matter did not fall within the research interests of her colleagues who did not like to teach it. Given the course’s connection to her research interests, Alex was “excited” about and “loved” the idea of teaching it – envisaging many possibilities for making it her own, for example, through drawing on aspects of her own research. Thus, she could add to the history of learning for the course in the department, while developing it in ways that reflected her scholarly identity.

Other participants shared in one way or another, positive experiences of the goodness of fit with their first assigned courses. For example, Morgan, concerning how her two graduate course assignments matched her research, stated:

I got to develop the courses that I like to teach, I developed them based on the set of skills I have, which I also use in my research, so they are very related. I'm not sure if everybody gets to have this, but I do.

Further, she expressed that she was not only teaching in her areas of research knowledge and expertise but noted that she was able to “include the topics in my courses that I'd love to learn myself – so it's all complementary.

Year-two faculty member Cameron found that both his graduate and undergraduate course assignments were very closely aligned with his area of research, notwithstanding his

initial anxieties around his preparation to teach the undergraduate course. He was concerned that his past engagements with the course both as a student and a teaching assistant were at this point, somewhat distant from him. Further, the course required the teaching of concepts that he had not been using in his own research. Also, as he reflected on his student experience in thinking about preparation for teaching it as an instructor of record, he recalled that some of the concepts had been particularly challenging. However, once he committed to putting in the necessary time into preparing his materials, he was glad of it and reflected that he would not need to invest as much time in the future. He knew he had to “come up to speed” and “spent a lot of time preparing them [his notes] knowing I'd be reusing them.”

Given that Ainsley's (year three faculty member) first assignments were graduate project-based courses, he was readily able to take full ownership of them. Not only was he teaching in his areas of research expertise but he was teaching in a setting similar to those in which he had previously had fruitful experiences – project-based classes, where he worked closely with students, facilitating them in bringing projects to fruition. This was much in contrast to his subsequent assignment – teaching an undergraduate class – far from his comfort zone, given that he had always loved the more “one-on-one” kinds of teaching that were akin to mentoring and coaching. He not only had had more experience in the latter kind of teaching but his teacher identity was also anchored therein. Moreover, he had no previous experience teaching large undergraduate classes, which was his greatest teaching concern on entering his department as a new faculty member. Ultimately, his first experiences with teaching undergraduates would lead him to undergo both identity and accountability tensions, which I reveal later in this chapter.

Experiencing Teaching Knowledge and Resources Resident Within the Department

Many participants conveyed something of the lay of the land regarding resources that were provided to or were available to assist them in getting started with teaching. This included the understanding that knowledge for particular subject areas, such as foundational undergraduate courses, was available within the department to draw upon and the actual experience of inheriting a course. For some, there was an awareness that there were, in the words of Hayden, “lots of secret sauces” or teaching approaches among the faculty. These experiences and interactions constituted learning and identity-informing resources relating to the teaching aspect of the faculty role. As such, faculty as they made meaning of practice, would make choices to identify or not with aspects of practice, opting for the degree of engagement and alignment that made sense to them in light of past identity-informing experiences and the practical realities of negotiating a teacher identity within a new context.

Negotiating Histories of Learning: Practice Repertoires. Most of the participants indicated having had access to some knowledge of how their course was taught in prior years or having some degree of access to pre-existing course materials for present and/or future undergraduate and some graduate courses. These resources included syllabi or lecture notes, some dialogue about the course, and casual conversations, or stories floated about the teaching (practice) preferences of particular faculty members. However, there was no indication that there were prescribed teaching methods. Instead, it was simply a matter of fact that faculty took different approaches to teaching. Alex expressed surprise both at the autonomy afforded to faculty to teach her upper-division course both in terms of content and teaching repertoire, revealed through the histories of learning conveyed to her, which illuminated how the course had been taught by different instructors. She remarked:

I was actually shocked when I started, how wide open it was for me to teach whatever I wanted, however I wanted. You know, I had a title of a course that I was teaching, and I had a textbook that people had used to teach it before, but the content that was taught in the way it was taught varied widely from faculty member to faculty member who had taught it before.

Similarly, Cameron reflected that while he viewed the standard way that faculty tended to teach was “lecture style – 50 to 100 students taking notes and you're up there showing some examples and going through material,” he was pleasantly surprised to learn, both during his postdoctoral period and his time at his current institution, that his senior colleagues had expanded their teaching repertoires to a greater degree than he had expected. He noted:

There's (sic) some amazing teachers here in engineering, and...my advisor – post-doc advisor – I think was an amazing teacher. And so they would do stuff like have oral exams...I know people in... [the School of] Engineering who teach these classes of 70 students and they give oral exams. It's like well clearly, it's possible, they're doing it and the students end up liking it. And so there's kind of, you know, that's one alternative approach.

Inasmuch as Cameron reflected that he still needed to go beyond the very occasional conversations with faculty to find out about their teaching through observing their classes, he was glad to know that there was potentially a more diverse repertoire to learn from than he had anticipated.

In similar vein, Hayden reflected that in his department there were “a lot of people who care about teaching” and were good at it, yet took different approaches to the work. For example, he shared about one who was a full proponent of the “sage on the stage” model and the other

who thought that teaching should be done fully in “active learning” mode. These represent what in communities of practice terms would be called “paradigmatic trajectories...living testimonies to what is possible, expected, desirable” (Wenger, 1998, p. 156). From these exposures, Hayden developed the view that “if you care about the course and you're engaging, you can probably win in any of these styles, especially...it's a small class.” This was his situation as he had only twelve students in his graduate course. Hayden would later question, in his final interview, whether his current classroom teaching would be effective with undergraduate students with different profiles – varying in terms of high school preparation, motivation and work ethic and “faith that they should do the work because they’re going to learn, and it’s meaningful.” These reflections were consistent with his concern that students did not feel out of place or left out – concerns that dated back to his period of service as an undergraduate teaching assistant.

Through informal interactions in their respective departments, year-two faculty Brighton and year-one faculty Grey were exposed to different homework philosophies that they found interesting but with which they did not agree. Brighton had had some interaction with colleagues who “threw out homework” and replaced it with sessions held every three or four classes where students would work on problems together. On this issue, he opined, “that’s not a good thing to do.” Rather, he viewed homework as important both because of his own experience as a student and his experience as a teacher. He explained that with “homeworks you spend hours on...you really get a grasp of the material, and you can show what you know.” The homework philosophy that Grey heard about involved assigning homework only on material that had not yet been covered, “so that the students have to always go above and beyond to learn the material to do it.” He also mentioned that “other people totally disagree with that.” He found that hearing these homework philosophies “made me kind of think about my own.” He explained, “I think that I

maybe give one problem on something that's stretching [the thinking of the students], but ultimately, I think the homework should be practice on [already taught] concepts.” Ultimately, both he and Brighton would filter out those ideas that seemed incongruous to them through their own critical reflection. They would instead rely on their own experiences (i.e., their own past histories of learning) and maintain their identification with their pre-existing homework conceptions and repertoires.

Negotiating Histories of Learning: Experiences of Inheriting a Course. Alex’s point of entry into the history of learning of her course in her first teaching assignment was disappointing. She had entered her tenure-track position with a doubtful teacher identity, keenly feeling the lack of adequate experience as a teaching assistant arising from insufficient opportunities for legitimate peripheral participation in teaching when she was a graduate student. Thus, she had looked forward to the prospect of having her first teaching experience as a new faculty member occur in a co-teaching context because she could learn from the teaching approaches of her senior colleagues. However, their approach to sharing the work did not facilitate the formative experiences she had expected. Rather, the co-instructors divided the course according to spans of weeks during which each faculty member would cover content that reflected a particular range of book chapters. Thus, everyone taught in their own silos and Alex did not have the opportunity to learn by observing her colleagues’ teaching. While somewhat discouraged that the hoped-for learning opportunity did not materialize, the following year, the course was fully hers. She recounted learning by trial and error about creating interdisciplinary content and authentic interdisciplinary problems and incorporating aspects of her research process into the course, thereby putting her stamp on it. Notwithstanding the lack of professional learning experiences afforded in the co-teaching situation, Alex found that she was initially

affected by the frequency and intensity with which the other faculty delivered homework and tests. She would come to examine these choices in light of her learning goals for her students – building their capacity to complete their term projects. Thus, she proposed to adjust the scheduling of homework and tests so that students would have more time to work on their projects. This decision regarding the privileging of hands-on projects was in keeping with what she experienced as most useful in her own history of learning as a student. This history of learning was reflective of an academic identity trajectory focused on learning by doing (i.e., engaging in practice) both in the context of undergraduate research and as a doctoral student and postdoctoral fellow.

Cameron's undergraduate class had its own history regarding both content and assessment methods. Further, it had a reputation as a class that students did not particularly like. Cameron was determined to recast the identity of the class as one that students could enjoy and see the value of, even if they were not intent on pursuing a directly related engineering career. Thus, he was demonstrating accountability to the students; he wanted them to enjoy the content and learn ways that the discipline could serve them, both in the moment academically, and career-wise in the future. Cameron's pedagogical approach for his section of this class included lectures delivered via tablet, always facing the students, in a highly energetic and enthusiastic way (a feature that he observed about himself and on which he received feedback from students); the inclusion of students' ideas about applications in the real world; and the use of demonstrations. This approach was distinct from his direct colleague's more traditional lecture method and it seemed that the only thing they had in common was that they were preparing students for the same homework and tests. However, by his third interview, having taught the

course twice, Cameron shared that he desired to make changes to the way the course was historically assessed to include a more project-based approach. He reflected:

I would like to move away from this model of the entire grade comes from three exams. That's how this undergrad class has always been taught and it makes sense because it's easy when you have sixty or seventy students. But I'd really like to come up with a – some people just don't take exams well, and I understand that. And so I would like to branch out, and just come up with other ways of assessing understanding of the material; you know, maybe make it more project-based for a class that's typically not project-based.

While he acknowledged the history of the course and had an understanding of the likely reasons for which it continued to be assessed using midterms and finals, it is noteworthy that central to Cameron's concern, was the knowledge that some students simply did not demonstrate their knowledge well on examinations. This concern was indeed consistent with his trajectory as a teacher who valued being inclusive and student-centered, dating back to his period of service as a teaching assistant. Further, his investment in the idea of project-based work derived from his own history of learning, which included rich, enjoyable, hands-on learning experiences in project-based undergraduate courses and from a teaching workshop series in which he participated as a doctoral student. This workshop advocated for project-based courses as well as for the scaffolding of other learning activities in ways that would help students execute their projects. These ideas had animated Cameron's interest and imagination.

Hayden had also received information on the history of the content of the graduate course to which he had been assigned. However, he had thoughts about content that varied from what had been done in the past. He did not want to be misperceived as the newcomer who “comes in

and just like trashes the old standard way of doing things” or “maybe 30% of the curriculum goes out the window.” Thus, he experienced the early period of his engagement with the course (planning stages) as “very nerve-wracking.” The following quotes reveal his challenges in balancing accountabilities and his understanding of the histories of learning associated with it within his department:

Because the field is – has a long history; it goes back to like the '30s but probably more like '40s, '50s. So, a lot of the textbooks and everything are written towards like what was being done in the '70s and '80s and they're not written to what's being done in the last five to ten years; they don't reflect the current state of the art.

However, his confidence would ultimately be shored up by the words of his program chair and those of his colleagues that encouraged him to include what he thought was important for students to learn based on his expertise. His road to this assurance was not entirely smooth, as, in the midst of his interactions with the chair, he had at first experienced conflicting messages. While the chair had at first said, “don’t rely too much on previous course notes; this should be what you think that students should know to be experts,” in another conversation, the chair expressed some thoughts – revealing an assumption that certain aspects of content would remain in the course – and this was content that Hayden had planned to omit. However, Hayden took the overall message, at least in principle, to be one signaling that he had full ownership of the course. While he “was still very nervous” about making changes, given the conflicting messages from his chair and his concerns about being the new person who seemed not to respect the course history, he decided:

Let's really just focus on what...is needed to understand the state-of-the-art tools and not focus on what was [in the past]. And something of course is being lost with that. I'm not

saying that the traditional way [s] the courses are taught – they're very useful, but...they're becoming...less common tools. So, yeah, so I've shifted it – shifted the course and, and what topics are chosen dramatically...that's why we don't follow a textbook – because a lot of the topics aren't in textbooks and we're working off journal articles...pulling lessons constructed from – from peer-reviewed publications...probably 30% of the content of the course is not in a textbook anywhere.

Having made these changes, in keeping with his sense of accountability to the discipline and the department's history of learning around the course, Hayden would eventually share his course outline “with two people [departmental colleagues] that I knew were familiar with it [the course] – two or three faculty members, right when I started...[and]...yeah, it was okay.”

Another issue in the mix of Hayden's considerations was that he was developing his course, in the broader context of other *locally negotiated communities of practice* – comparable departments in other institutions that offered the course as a two-semester series, rather than a single-semester course (as obtained at his current institution). Thus, in developing the course, he had to balance accountabilities to the history of the discipline, the present and future of the field, and the histories of learning in his department for the discipline. Further, he was negotiating accountability to the students as reflected in the quote below:

So then it's, you know, how do you balance...giving them like a strong theoretical foundation in the [discipline redacted] versus giving them the practical knowledge so that they go and they can use it in their – in their research, right? And so you have those trade-offs.

All told, Hayden conveyed a sense of scrupulous attention to his accountability to all who had a claim to defining competence in terms of what counted as a good course in this specialized aspect of his discipline.

Meaningful Moments of Identity Negotiation: Interacting with the Student Community

Given the reliance of engineering departments on student teaching evaluations as a critical reification that reflected teaching quality and thus competency, the student community can be seen as legitimately having a “claim” to defining what constitutes competence within the landscape of practice of research-intensive engineering faculty. In fact, when Grey was asserting his positive feelings about how his course was going, a more senior colleague challenged him, “Oh yeah, just wait until your teaching evaluations come; don't get ahead of yourself. Similar to the expressions of Grey's colleague, Ainsley, sharing his reflection on students' evaluations for his upper-division undergraduate course and the students' needs and preferences as conveyed therein, remarked, “you're a slave to reviews, right.” This was an especially poignant remark given that he was anticipating the mid-term review that would reveal his standing and progress as an assistant professor, and felt that it was imperative for him to garner “a bunch of fours and fives” on his evaluations to boost his profile.

Student feedback in its varying forms played a critical role in the early career engineering faculty's reflections and considerations about ways of *doing* teaching and *being* teachers. Students were a source of information about content, the impact or effectiveness of instructional methods as well as the presence and manner of their instructors. Faculty learned how students experienced them as teachers from students' formal evaluations, direct conversations with students, and observations of students' engagement in and response to teaching and learning activities. Further, in their classrooms, many faculty found themselves having to interact with and respond to student identities that they did not expect, based on their own experiences as

students and the attendant expectations for academic preparation and dispositions. The learning that faculty achieved through student identities placed into contention led them to have both more global considerations around teaching (e.g., the need to carry out a survey to learn about graduate students so that he could optimally meet their needs and histories of learning) and more granular changes (e.g., allowing for more interim feedback on group projects). While some of the changes faculty made or contemplated making to aspects of their teaching are reflected in the latter half of this section, others are illuminated in chapter 7, which addresses participants' teacher identity trajectories.

Identity Confirmations: Students' Confirmations on Being: Disposition, Presence, Manner

Disposition, presence, and manner were areas on which students weighed in through the teacher evaluations. Harper, Grey, Cameron, and Brighton all received feedback related to students' valuing and appreciation for the energy, passion, or enthusiasm they brought to the classroom, as they engaged with the course material. As faculty shared these observations, they also reflected on how these ways of being were reflected in their pedagogical choices. First-year faculty member, Grey, reported that at the end of his semester of teaching his lower-division undergraduate course, student evaluations revealed that they "really liked my energy and enthusiasm," which was only one of the student-centered ways of being that he believed converged to yield him stellar end-of-semester evaluations. Among his reflections on his ways of being a teacher that students seemed to value, he shared that he engaged them in "pair-and-share" activities, tended to "land at least a good joke here and there," often being "playful and walking up and down the aisle" and bringing in career panels to illuminate multiple trajectories into engineering careers.

Of his first experience with an undergraduate course, third-year faculty member, Harper, indicated that midterm reviews revealed that some students, “did comment on my energy being very high, which I think they mean that in a positive way” (laughingly). These kinds of comments resonated well with Harper’s earlier expressed the idea that critical to teaching (whether graduate or undergraduate students), was the act of “expressing your natural interest for the topic and trying to convey what's really interesting.” Further, his investment for his first undergraduate course would ultimately become that of:

Integrat[ing] different ways to show enthusiasm behind the...exciting topics in the material, not just do word of mouth or drawing equations on the board and highlighting some function. Now, we actually – now I mean – these are all things I've broken in class [referencing demonstrations] and...we also do the math part; we show some real applications.

This rendering of enthusiasm for the subject matter was much in contrast to what was effective for Harper as an undergraduate student in a physical sciences discipline, where he learned well with professors who “were kind of dry.” In fact, having reviewed a video of himself teaching a doctoral survey course in his department, he learned that following this “dry” manner of instruction was simply not a good fit for him. He contrasted his subsequent approach, properly aligned with his own disposition thus:

I like putting in – what I like to try to do now is I put in more ‘this is what this is relevant to now’ – like context, whereas in my classes it was, ‘this is how you solve the problems’...But then again, I was a [physical sciences] major at that time and now I'm in [name of engineering major redacted] and I think maybe it's different.

Harper was not only reflecting upon the contrast in teaching dispositions and approaches between himself and his former instructors, but was considering the potential impact of his engineering discipline, confirming who he preferred to be as a teacher. It seemed that he was considering how his past instructors' teaching approaches were perhaps constrained by pure science disciplinary norms and his own approaches were being liberated by teaching in engineering (a more applied field). Beyond being energized by his current discipline and its applications, Harper spoke of himself as someone who believed in scholarly rigor that meant relishing hard work, while also framing it as play. He was “an enabler of the breaking of things” but also promoted the “weight-lifting” involved in engaging deeply with problems. Further, exemplifying both work (teaching and research) and play, he chuckled as he shared that he “would like to think that my research side...bleeds into my teaching more in my undergraduate class now; I have a lot of fun just making up these gambles [spontaneous demonstrations] on the fly.”

Cameron, a second-year faculty member, said that “the midterm evaluations were pretty good” for the second iteration of his undergraduate course, and shared a bit of feedback, indicating that he was “the most exciting and enthusiastic professor they've ever had,” which was reflective of the tenor of students' feedback in general. However, once the students had taken some tests which they told him were “challenging,” Cameron became uncertain of whether the tide would be against him. However, he found that students' overall positive feelings about their experience of the course held. He happily shared with me:

Yeah, the final was Tuesday...I got an email from one student, just saying how she came into class expecting this to be a nightmare from stories from the past, and this was by far

her favorite class...I had several students just tell me how much they enjoyed the class.

And that felt really great!

Reflecting on what students appreciated about his style of engagement, Cameron highlighted the demonstrations that he presented frequently throughout the class, upon which students were required to carry out calculations. Further, he found that students appreciated how he engaged with them in one-on-one meetings to learn about them – especially about their academic career interests.

Students enjoyed coming in and – and just introducing themselves and talking a little bit.

You know, a student yesterday came in and he said he's interested in going into biomedical and I asked him about how [the course] is relevant to that and he got pretty excited about the conversation we had. So, um, I enjoyed that.

Acknowledging that students enjoyed the undergraduate course represented a full-circle moment for Cameron. One of his big goals for the course was that students would enjoy it rather than repeat the negative stories that seemed to mark the earlier history of the course.

Brighton, who was in his second year as a faculty member, but his first year of teaching (as he had assumed his position in the second semester of his first year as faculty), reported that student evaluations for his undergraduate course revealed many comments conveying that he was “positive and energetic,” with one student remarking, “I don't know how you can be so energetic at 8:30 in the morning.” Also salient for him was students’ indication that he “did a good job of explaining concepts in conceptual ways – really breaking it down into a physically intuitive way.” He explained: “I like that I got that feedback, 'cause I do spend a lot of time thinking about that.” These comments were in alignment with his stated commitment to providing the students with a strong grounding in “the fundamentals.”

Many participants were generally happy to receive feedback from students that they were either caring, available, and or responsive to questions. Second-year faculty member Morgan stated, “Having a student realize that you actually care about them and care about them learning, it's nice to see.” First-year faculty member, Grey, also noted that his students made mention of his caring in the end-of-course evaluations. He had experienced a similar kind of caring from his professors during his academic journey and believed it was important to demonstrate this to students and mentees in the classroom and lab. He shared, “They said they felt I cared and I was very much available answering questions on the message board – like always, always, always, clear directions.” He also noted that “the vibe in the class felt connected and people were comfortable, calling out and asking questions and they knew that I was okay – so it's okay to talk to each other.” This did not mean that students viewed the class as an easy one. Rather, Grey had put a lot of effort into encouraging and motivating them through setting “clear expectations,” letting them know that he was personally invested in their learning, and sharing his own challenges as a first-generation student. Thus, Grey sustained a core caring teacher identity that was earlier manifested in his ways of guiding and serving students as a teaching assistant.

Hayden, who was teaching his graduate course for the second time, recalled that “the evaluations were very good.” When asked about any standout comments, he instead referenced students’ continued interactions with him, stating:

So students from the last course come to me still and visit or ask questions. I try and make it very clear that any student that's taken my course I'll give extra time to – you know, I'll see any student. But if a student took the course, then I might spend more time helping them understand or interpret their data so that they can, you know, if they're working on something for their professor and they want to get a second opinion, I'll sit

down and actually dig into it a little bit with them. So some students have come back. I think they seem to appreciate it.

Hayden's open door to any student that had taken his course reflects the inclusive approach that he took to serving as a teaching assistant to undergraduates while he was both an undergraduate and graduate teaching assistant, as he shared about how he would stay around after class and continue to interact with students. It is also reflective of how, as a new instructor to a class of graduate students, he would stay late with them if they needed or wanted to work longer in the laboratory portion of the class.

Jordan, a first-year faculty member, had invested much effort in memorizing students' names in his class of around 25 students, having recognized that, "it shows them that we care," something of which he had come into fuller understanding at the orientation for new engineering faculty. A favorable report from his efforts came from a student indirectly through a faculty member, who said to him one day while they were on their way to a meeting, "Hey, my student told me that you know all the names in the class." Like, "yeah"...and he was like, "that's really impressive." Although Jordan minimized his effort by replying, "It's a small class. Twenty-five. If it's 200, sure," It is worth noting that it is in keeping with the view he expressed about good teaching in his first interview, during which he reflected that "a big part of being good teachers is caring." In addition to this manifestation of caring, Jordan shared that he had discovered that a student was falling behind because of personal issues and he had encouraged her to visit the campus counseling services. This student's situation was one upon which he engaged in substantial reflection, considering the cultural impact on her willingness to seek psychological assistance, and contemplating the possibility that he could have helped her earlier.

Negotiating the Constellation of Student Identities: Imagined and Projected Versus Real

Participants experienced tensions between the student identities they imagined they would encounter and those they actually encountered in their classrooms. These student identities and/or histories of learning came with needs that faculty had to consider as they were made manifest over time. Some faculty found themselves having to navigate the challenge of students' content expectations, leading to the necessity of figuring out the thorny issue of how best to address a class of students coming from different disciplinary backgrounds in engineering and with varying levels of foundational background for the course. The participants also contended with students' expectations and feelings regarding such things as workload, work difficulty as well as their learning preferences, such as having practice exams or having instructors refer more closely to texts.

When Harper reconfigured his doctoral class from a more basic required survey course to an elective that was unique to the department and that focused on a critical principle or concept around which his research was centered, he experienced a variety of challenges. One concern was that students from a particular disciplinary background understood and connected with the central principle far better than did others. In response to this concern, for future iterations of the course, Harper was in earnest to find the best ways to serve the research interests of the graduate students and proposed, in the immediate future, to administer a survey about their research interests and goals, as recommended by a colleague. However, he knew that this would not be a cure-all and shared:

What has me worried is that the student composition will fluctuate rapidly and dramatically...because I get students from chemistry, I get students from electrical

engineering, I get master's students, I get – I've had undergrads last semester, and graduate students all in the same class...everybody's obviously not on the same page.

Through the foregoing reflection, Harper revealed the need to balance accountabilities to his discipline and department and the students' learning and research identity trajectories as well.

Brighton similarly experienced challenges related to the difficulty level of his courses. In his undergraduate course, he assumed that students would have brought forward foundational knowledge from a previous course, but found he needed to be responsive to an unexpected gap. In his graduate course, he learned that most of the enrolled master's and doctoral students did not "have the preparation to take the course," and a significant minority of students moved from formal registration to auditing status. Laughingly, he told me that it seemed as if this group of students felt, "Oh well, this is too much work, but I like the lectures. I'm really enjoying the lectures, so can I audit it?" Reflecting upon students' lack of preparation for readily engaging with the course material, Brighton reasoned that:

I think probably I went in with expectations from my own grad experience and just, I forced them upon the class, right...specifically being, as I mentioned, for undergrads I don't expect you to do external research. But for grad students, the way I formulate problems is, 'Here's a prompt, here's the end. Get from A to B, right. So for a few of them, they really struggled with that, especially the ones coming out of undergrad like, 'How do I [do this]? I might have to go look in a textbook and pull out a new concept that you didn't go over in class.'

This quote conveys that Brighton was transferring knowledge about teaching from his own learning history as a student and superimposing his own academic identity on the students before him. Further, he reflected that he had "only taught undergrad courses before so my

expectation was that the [graduate] students should be capable of undertaking more complicated assignments and that probably wasn't a fair expectation." Thus, both his experiences as a graduate student in a similar course and his experiences in teaching an undergraduate course had an impact on his expectations of the level of work graduate students were capable of undertaking. To address this challenge, he "ended up having to reduce the level of the course to be more broad." While he said, "that was fine... people really liked it", he was clearly conflicted as he went on to say, "but it wasn't actually serving my students [doctoral mentees/advisees] as well as I wanted it to, since this is supposed to be a course in their field." To manage the tensions arising from contrasting student identities present in his course, he reconciled himself to a course identity and a *modulation* of teacher identity that both were, in his view, less than ideal as he was not fully able to put his researcher stamp on it such that it would optimally serve the doctoral researchers in his laboratory. Further, he reflected upon conversations with other faculty about the idea of having to drop the desired level of one's course, stating that his colleagues shared similar disappointments. Additionally, he noted, "it's not fair because each of us is an expert in our respective fields, so we just want to teach it to the level we're used to thinking about it" which suggests a deeply felt challenge to both his teaching and generally to his scholarly identity.

Of his first effort teaching an undergraduate course as a tenure track faculty member, Ainsley found, "people here complain a lot more if you give them a lot of work." He recalled students' line of argument as, "there are [only] so many credits, why are we doing [this]" and explained further: "They complain that the problem sets are a lot." Ainsley reasoned, "But this is like [a] senior-level undergrad class – I'm like sixteen hours...every other week is not a big deal right. It's just like seven or eight hours a week." He elaborated:

When I was in undergrad, all my classes took seven or eight hours – even when I was a freshman -- to do a problem set, right. It's just how long things take, right. And if you had a project they just took forever and you were just there night and day in the lab, whatever, and do the work. And that's what people did, right? People just relished that, you know. But not here. No. No.

Further, Ainsley had been educated in an academic culture in which it was not unusual for professors to assign large problem sets. Furthermore, students tended to respond positively to the workload. In fact, “people relished that.” Ainsley also reflected that the students in his undergraduate course were very grade-focused and they tended to view questions they got wrong as things the instructor failed to teach them. Another complaint, even in his second time teaching the undergraduate course was, “Oh, we get tests we’ve never seen before.” Ainsley told them this “could not be true if they have done the homework, as the problems look[ed] like the homework.” Ainsley shared, “I always think like the tests is [sic] really to test whether they really understand the concepts so they...need to see it outside of a problem that they've already worked on, but they don't see it my way.” Recalling that a respected colleague had advised him that students do not all have the same level of interest in the material, Ainsley described the approach of his senior peer thus: “he wants to make sure there's something for everybody and that not everyone in the class needs to be that serious about the thing they're learning in the sense that this is really what they want to do.” Ainsley reflected that this approach to learning represented a large contrast to his own approach to course-taking and learning as an undergraduate. His approach involved treating courses, even if not central to one’s core identity trajectory as if one wanted to be an expert in it. Thus, he felt, “If I take a physics class I'm going to take [it] as if I'm going to be a physicist. If I'm going to take an art class, I'm going to take it as

if I want to be an artist.” Thus, in approaching his teaching, he held the philosophy that if a student came into his class, he was going to provide an experience suitable for a student seeking to become an expert in the subject.

Ultimately, Ainsley decided to create a final exam in which more than three-quarters of the test would be comprised of what he viewed as “easy problems,” because they were similar to past homework, and the remaining percentage of the test content would be what he would consider to be “the real test.” The latter group of problems would reveal “the students that really understand” and “maybe I’ll recruit them [for my lab] or whatever.” This was not an easy compromise for Ainsley to make and he stated, “I’m like this is not how I want to teach” but he also considering that he needed to be mindful of the power of student evaluations. Ainsley would not only adjust the course assessment but would respond to students’ comments about course organization, something that he initially had pushed against as he made meaning of the evaluations from his first cohort of undergraduate students. Expressing his frustration, he stated:

They want to know what's going to happen next. They don't like the uncertainties in class. They want to know exactly what's expected...In a sense the fact they need that, I think a little bit bothers me in the sense that they're not preparing themselves for the real world where...the world is uncertain. And so they're optimizers; they're optimizing their time; they're optimizing their effort – things like that.

Ultimately, Ainsley would respond in the following way:

I took topics out and I added one, and I restructured it so that the flow matched basically the activities, and everything was geared towards the final project. So basically...in the final project, they used everything they learned the first 10 weeks. [Interviewer: Okay, so like scaffolding, you carefully attempted to ...]. Yeah, I scaffolded the final project and the

labs basically are pieces of the final project. So when they get to it, it's still a lot of work but they're prepared for it. Yeah. I basically scaffolded it. That's a good one. That's an education term (chuckling).

Although Ainsley did not relish the idea of students needing “to have a class where they can really kind of get all the parameters up front” (reflective of their concerns around course organization), his greater concern seemed to be students’ complaints about the amount of homework and the kinds of questions that appeared on the exam and the need to strategically balance the kinds of questions he set. His sense of resignation to a compromise with student needs seemed a painful one as he stated:

Instead of trying to get the best out of everybody, you just have to...accept the fact that there is a lot of people that just don't want to give the best of themselves and that's their loss. And it's too hard to draw that out of 30 people – even though you want to and you feel like that's your mission. And the people that are willing could partake and there's something for everybody, then.

Morgan also reflected on negotiating different student needs. The first time she taught a graduate-level course, she was surprised that the students she encountered were not as independent as she had expected. In explaining the nature of her surprise and concern, she stated:

Well, basically, just, you know, owning what they were doing – not coming to me for the instructions on every little detail – just showing some initiative on their own. I mean the program I was in when I was doing my PhD, it wasn't like that; the students were much more independent...not just me, but in general the students were more independent.

She then noted that her own graduate school was not as highly ranked as her employing institution, “so I was expecting to see more independence [among the graduate students]. But it

wasn't the case...So yeah...in my second year I did meet students who were more on the independent side [but] in the first year, not so much.”

Morgan’s assumptions appeared to be rooted in her doctoral journey, during which her research advisor fostered and supported a spirit of independence and freedom that she thoroughly enjoyed and through which she thrived. However, teaching her first cohort of graduate students as a new faculty member, she found herself having to be responsive to students who varied from her ideal picture of a doctoral student and her own identity as a teacher and mentor of doctoral students:

Well I mean if they required more meetings, I just met with them more often and I gave them more detailed instructions as they required it. I still – when I meet a student for the first time, I still try to stay back, give them some space and see what they can accomplish on their own because I don't want to get too involved if it's not necessary. But then if they show me that they need more, I don't know, guidance or instructions, then I meet with them more often or give them more detailed instructions on what to do.

Morgan tried to balance challenge with support, such that while sometimes needing to provide more guidance than she had planned, she still created space to foster her doctoral students’ independence by letting them show what they could do on their own before providing help.

The foregoing faculty stories reflect tensions among the participants’ expected, projected, and preferred student identities and the need to be responsive to the students who presented in their classrooms. For Brighton and Harper, it was challenging to create graduate courses that allowed them to optimally represent their areas of disciplinary and research expertise. Ultimately, they arrived at the realization that they would have to reconfigure their teaching approaches to address the multiple academic identities (or histories of learning) and needs of the

students in front of them and that they could not exactly teach the course or the students they had imagined. These tensions were not simply those regarding how to enact the designing and teaching of courses, but also who to be as a teacher, given the identity constraints of the students and what acceptable compromises they as faculty could negotiate given their multiple accountabilities. Ainsley and Morgan, too, experienced tensions between projected, expected, and preferred student identities and the reality of differing student identities that presented in the classroom. For Ainsley, tensions arose around course organization, amount of homework, and exam content, and constituted resistance to the multiple ways in which he was living out his teacher identity in the undergraduate classroom context. Morgan's identity work was a question of modulating the expression of her teacher and mentor identity according to the presented student identity. In each case, participants worked to resolve these tensions, irrespective of the ideal teacher identities and student identities they had envisaged they would encounter in engineering classrooms in a research-intensive engineering school.

Moments of Learning and Identity Negotiation Across the Professional Landscape

In the context of their new tenure track faculty positions, many faculty members in the present study discussed ways in which they accessed the landscape of practice to expand their teaching knowledge (including conceptions and/or approaches) or reflected upon ways in which they might in future, engage with these resources and the conceptions and approaches contained therein. Some faculty's engagement with the landscape took place within the departmental setting through interactions with colleagues working in STEM or engineering education fields, while some faculty accessed such knowledge through colleagues external to the institution, professional associations, and in a few cases, through independent reading. For example, to help him plan his undergraduate course, Harper called upon a departmental colleague who was

knowledgeable in science education, which would ultimately fuel his interest in creating demonstrations for use in his course. Further, in keeping with his playful personality, he would create demos “on the fly” as well. However, consistent with his disposition to combine work and play, he made sure to engage students with solving problems relating to these demonstrations. In the succeeding paragraphs, I describe other examples of such engagements across the practice landscape, attempting to lift up the meanings that these new faculty made of interacting with individuals in the landscape of practice, both locally situated (at the institution) and globally (beyond the institution).

Hayden’s engagement with colleagues who were knowledgeable about research-based teaching practices was easily made possible, as these individuals were also in his friendship circle and had also been doctoral colleagues. Although he was uncertain of the place of active learning methods in his future, he was happy to report that he had access to these individuals who were truly knowledgeable about the research behind the practices. Further, he could “imagine a future that blends – that blends or has, you know, both traditional teaching and active learning.” In saying so, he reflected that “projects obviously lend themselves to active learning,” acknowledging that perhaps he was already engaging in practices that facilitated active learning. Interestingly, in describing his teaching approach, he described his graduate course as being composed of traditional lectures and a lab that was “not traditional at all...very hands-on” with results being “not always predictable.” In the lab section of the course, he was facilitating active learning in an almost organic way, “walking around...creat[ing] dialogue amongst the students,” and facilitating them in the mutual sharing of their knowledge and competencies. He noted that he paid careful attention in these moments to assure that an accurate picture emerged without “overcorrecting” the students. Further, he shared how he was able to take advantage of

unexpected and accidental occurrences to facilitate student learning. In this regard, he talked about how he guided students through using a piece of “broken” equipment, to engage in a process of, what I refer to as *mental recalibration and estimation*. He described the situation in the following way:

But the way in which the detector was broken was perfect because...the experiment we did allowed us to identify that it was broken, which it probably was not known to be broken for many years because no one had done this careful measurement. And then... that became a nice piece of the lab...identifying the manner in which it's broken – how we know that, and we could still use the data to complete the experiment, despite it being broken, but we had to account for this certain missing – missing piece.

The contrasting portion of the course, the “traditional lecture,” he described thus:

[I’m] on a blackboard probably two-thirds of the time and jumping between that and PowerPoint slides. And so the PowerPoint slides are sort of a break to...writing on the board and the rigorous...equations...and then PowerPoints give you [the student] better visual representation and a chance to take a break from writing and see current work.

Like – like I can show state-of-the-art manuscripts and techniques and things like that.

As he described both settings of teaching comprising this course, he would go on to explain that the lab setting in juxtaposition to the lecture portion of the class:

becomes this very open...comfortable workspace where people can learn from each other. So the lab offers [this]...But then I get to have the traditional, you know, staying awake through writing kind of lecture.

Although we did not explore it in our interviews, given Hayden’s capacity to identify and facilitate moments of learning in the laboratory, it was hard to imagine that these modes of

facilitation would not also appear in his lecturing style, although he presented the two styles as representing distinct approaches.

Like, Hayden, Alex also had colleagues who held the promise of providing answers to questions about teaching that she was still trying to solve. These were colleagues who originated from her life in her postdoctoral community, and with whom she now shared co-membership as early career engineering faculty, albeit now located in different locally negotiated communities. Alex was ongoingly working on the challenge of “trying to pick the right topics that combine those” (two disciplines reflecting her interdisciplinary field). This, along with endeavoring to create and specify intentionally interdisciplinary problems appropriately, was an area of intense trial and error work. Thankfully, she had employed one of her doctoral advisees as a teaching assistant and the latter had helped her in the process of specifying problems. However, “something that gives [her] hope is that other people are trying” to create textbooks that effectively marry the two disciplines. She had already reviewed two textbooks and was “super excited” at the prospect of them being published. She further reiterated her investment by saying, “you know, the textbook, obviously, I have...a selfish interest in that textbook being successful.” In addition to engaging with her author colleagues, Alex reached into the landscape of communities on campus – collaborating with engineering research faculty and other interested parties (doctoral students and faculty) who were developing active learning models that held promise for curricular integration. Alex’s motivation to see curricular integration in her discipline was strong and seemed to reflect accountabilities to her past undergraduate student self, her current students (and their emerging disciplinary identities), and equally, to the discipline itself. So while she did not view herself as an engineering education researcher, she

was committed to participating in research-based efforts and to integrating them into her teaching.

Parrish, during the summer between his first and second year as tenure-track faculty, attended a teaching workshop sponsored by his disciplinary association. Information about this opportunity had been shared by departmental colleagues from whom he had gleaned some good ideas and positive testimonies of the workshop. Parrish felt that the discussions of some basic teaching ideas, such as board organization, with these colleagues, had provided him with a primer for what he would learn from the workshop. His uptake from the workshop included the setting of objectives and alignment of course activities with objectives, resources, and so on. While he did not address this connection specifically, it seemed that his learning about nonlinearity from his previous teacher training, undertaken while a doctoral student, would have also served as a good primer for the component of the disciplinary workshop that addressed the idea of aligning resources to objectives and course activities. Having discussed the workshop and his training experience while a doctoral student, he was reminded that he should perhaps revisit the material to remind himself of aspects of the knowledge and ideas and determine how he could use them going forward. He also indicated that while he had worked on the alignment aspect as gleaned from the workshop, time constraints had caused him to fall off in fully enacting this principle. However, he indicated that he was committed to staying on course with this kind of alignment in the future.

Both Harper and Cameron reported that they had the opportunity to engage with information coming from more distally (disciplinarily) located units in the campus landscape. Harper had done so indirectly through a colleague, who shared with him a writing activity that had its origin in the campus' writing center and was originally intended for undergraduates. In

his spirit of experimentation, Harper employed this exercise focused on scientific communication in his graduate class without altering it and found that it was not completely suited to the students' level. When reflecting with me, upon whether he might tweak it for subsequent use in the graduate course, it quickly came to his mind that he might consider making it an activity that involved the graduate students in developing their oral communication skills rather than their writing skills. Cameron's experience involved connecting with one of the art departments on campus to create an interactive and embodied demo that was so successful and generative of student engagement that he planned to "scale it up" for the benefit of future students. While he had always wanted to attempt a similar activity, he had never had the opportunity, until a unit that encourages the inclusion of arts in engineering created a bridge to the art department within the campus landscape.

Chapter Summary

This chapter focused on new engineering faculty's engagement in teaching practice in the early years of their tenure track faculty positions. I examined how participants' learning about teaching and construction of a teacher identity were both informed through engagement within and across communities of practice, the meanings they made of such engagement, and their choices to identify with or align with certain teaching conceptions and approaches. As new faculty began to engage in the work of teaching, they interacted with engineering faculty, some with adjacent and related in the institutional landscape of practice, such as the communities of STEM education experts, those in other academic units, and students. The landscape of practice outside of the institution also provided sites of interaction, meaning making, and identification through collegial interactions of various kinds within and outside of professional associations. These encounters and interactions served as resources through which new faculty would learn

more about teaching and about themselves as teachers through creating moments of identity facilitation or ease, tension, and identity confirmation. Moments of tension included those experienced with aspects of the community's histories of learning around the teaching of particular courses; reconciling the need to put some initial time investment in teaching while adhering to the community imperative of prioritizing research; encounters with teaching approaches that challenged existing conceptions; and encounters with student identities or needs that ran counter to expectation and challenged them to make adjustments to their teaching approaches. Moments of identity ease and/or confirmation included being assigned to courses connected to one's research interests; in some cases, the revealing of multiple identity possibilities, as faculty learned that within their communities, there was some diversity in the teaching approaches existing among more senior faculty in the community (old-timers); and positive student feedback.

Participants' identity construction was informed by their learning – the meanings they made over time through their participation in and reification of practice (i.e., their teaching conceptions and teaching toolkits). Such learning occurred within and across communities and from past to present. My participants' evolving teacher identities reflect their “negotiated experience of self” (Wenger, 1998, p. 150), developed in relation to the meanings they made of various aspects of practice (e.g., teaching approaches, tools) and the degree to which they chose to identify with the latter over time. In negotiating identity in the context of practice, participants differently navigated both moments of ease or facilitation and moments of tension. Further, these new engineering faculty, in varying ways, also proposed investments of resources – time and effort – for future engagement in practice.

Chapter 6: Identity Trajectories: Threads Through Space And Time

In the present chapter, I characterize participants' identity trajectories in terms of locations (spaces), junctures (times), and significant meaning making relating to their identities as teachers. Further, I seek to demonstrate how faculty proposed to continue their becoming work as teachers based on the foundation of their meaning making (learning) over time. The nature of individual variation across the ten participants presented a challenge, as I sought to cluster participants into groups representing identity trajectory types. The challenge of creating such clusters is that of retaining the nuances in individual participants' sociocultural engagement, meaning making, and identity construction. My analysis suggests that participants shared an overarching trajectory reflecting *a learning and developmental approach to teaching*, that could be divided into two major trajectory sub-types characterized by dispositions and commitments that seemed to guide their approaches to teaching. The first sub-type includes faculty whose identity trajectories reflected leading with care and concern for students, while the second includes faculty who were leading with scholarly commitments and values that served the discipline. My proposal of these identity trajectory sub-types is not meant to contend that faculty in each group did not display features of the other. Rather, I sought to illustrate what emerged as participants' dominant narratives of their experiences and meaning making related to teaching, had profound consequences for the shaping of their teacher identities. Over time, these through-lines in participants' professional journeys seemed to constitute a teacher identity core, which can be considered a central lens for their meaning-making and identity construction in their ongoing work of building teacher identities. I close this chapter with a discussion of what a grasp

of these identity sub-trajectories might contribute to our understanding of the teaching experiences of early career faculty.

Common Threads in Participants' Identity Trajectories

Before describing the two identity sub-trajectories, it is important to note the overarching trajectory that represents participants' commonalities. Participants in both sub-groups believed that teaching was important, and all aspired to improve in this capacity over time (they had, after all, volunteered for the study). Further, they were all demonstrably reflective people and believed in the continuous improvement of teaching. In this regard, they each talked about teaching in language that reflected their view that their relationship with the work involved ongoing learning and development, identifying areas that they had already worked on, that constituted a work in progress, or a project for the future. In effect, they all demonstrated a *learning and developmental orientation* to constructing a teacher identity and conveyed that they all desired to offer what Wenger-Trayner and Wenger-Trayner (2015) term “meaningful moment [s] of service” (p. 23) in this domain. Further, they shared the belief that they served students by being in good relationship with the subject matter they were teaching. This involved bringing to the teaching enterprise, interest, passion, and enthusiasm for the content. Further, this included having relatable examples, applications, and stories that helped to illuminate the subject matter. Harper explained this as, “expressing your natural interest for the topic and trying to convey what's really interesting.” Similarly, Parrish expressed this approach to the enterprise as:

having enthusiasm built into them [the students]...to show that myself as well – trying to bring that to the classroom to be able to engage the students and help them....use that as a technique to get from that A to B.

Intersecting with this enthusiasm, passion, and interest, was a commitment to engaging students around applications of concepts. This work included such activities as demonstrating how concepts and processes were reflected in the structures and functions of familiar, frequently-used objects; how concepts and processes were involved in product design; how concepts were implicated or manifested in research processes and products; offering personally experienced industry examples; presenting problems in industry-based context; and interacting with students around meaningful project-based work.

The value that these participants placed on teaching and their earnestness in accountability to the work beyond reflection on practice was conveyed through such activities as reaching out to students, requesting direct verbal feedback on their instruction, seeking the teaching center's assistance in gleaning or interpreting student feedback, and creating their own surveys. Further, in one way or another, they engaged with others about various aspects of teaching, mostly through informal interactions with colleagues inside and outside of the institution and in most cases, through midsemester consultations with education development personnel from the teaching and learning center. These shared features of their trajectories are indicative of an investment in teaching that may not be reflective of the average research faculty member. However, the latter findings are not entirely unexpected given that these ten faculty members self-selected into a study that required them to think about their teaching and engage in a more than superficial dialogue about this aspect of their overall professional role.

The Trajectory Sub-types

In analyzing the participants' profound "experiences of meaning," (Wenger, 1998, p. 52), their conceptions, and their "investment (s) of self" (Wenger, 1998, p. 192), I identified two trajectory sub-types among my participants. I refer to the first of these sub-trajectories as *leading*

with care for students, thus making the discipline and field welcoming for students. The second sub-trajectory I term leading with *disciplinary commitments* – leading with a focus on the discipline (scholarly approaches, values, and mindsets), thus preparing the students to be ideal contributors to the discipline and field. These groupings do not represent two mutually exclusive clusters of experiences across teaching journeys. Further, although each participant seemed to be driven or guided by one of these two patterns, this does not signify that features of the second theme were absent from their commitments and values around teaching. In the succeeding paragraphs, I unveil the nature of these two trajectory sub-types. In so doing, I seek to characterize participants' experiences, the meanings they made of these experiences, and, ultimately, their negotiation of identity as they traversed the landscape of practice across time and space to constitute meaningful identities as teachers and to project future identity work. Leading with care for students were Grey, Cameron, Jordan, Parrish, and Hayden. Leading with a focus on the disciplinary commitments and values or concerns for creating scholarly engineers or engineering leaders were Brighton, Harper, Morgan, and Ainsley. Alex seemed to bridge both categories; therefore, I address her identity trajectory separately.

Journeys to Care-Centered Teacher Identities: Experiences of Meaning

Faculty who led with care for students tended to talk about experiences of serving the students, getting to know the students, having a working alliance with students, creating good conditions for student learning and participation, and in some instances, the value and importance of meaningfully and/or proactively connecting with students who struggle, academically or personally. In short, this group demonstrated emphatic concern with ensuring that all students felt included and had comfortable conditions that would facilitate their participation in the teaching and learning process. While the experiences of Grey, Cameron,

Jordan, Hayden, and Parrish have their own nuances, their stories demonstrate profound *experiences of meaning* with respect to their journey towards a caring orientation to students. Although they clearly enjoyed enough success as undergraduates to attain entrance into doctoral programs, they all conveyed powerful stories that revealed a trajectory towards caring, that I am choosing to term *vulnerability*. These narratives had to do with encounters with (to varying degrees) being on the outside of favorable learning conditions, learning experiences, or noticing that others in their environments were under potential threat of exclusion. These contrasted, for some participants, with experiences that reflected the opposite – spaces of welcome, inclusion, and hospitable conditions for learning. Parrish’s journey to leading with care revealed a vulnerability in different ways that were connected to being optimally knowledgeable to serve the students in his discussion sections as a teaching assistant. In this regard, his response reflected the stance of a co-learner who respected the intelligence that students brought to the learning process.

Grey’s path in high school was not one in which a college education was assured as a natural progression. Grey had only come to the consciousness of himself as a science person because of a caring teacher who engaged with him meaningfully when he was retaking a high school science course. In recounting his vulnerability and the impact of this high school teacher, he shared,

She said that I was doing a good job and really believed in me...having someone telling me that I'm doing a good job in a topic that's considered challenging, it really motivated me. And then once I started actually trying, things started to come quite naturally. So that – maybe it was just that personal touch was missing or the lack of really someone telling me this is important or if you do this, this can really help your life.

Grey's stories of positive faculty-student interactions, starting as an undergraduate who was "inevitably quite behind" in his freshman year and continuing across his journey to and through graduate school, were marked by references to "caring" interactions that provided a supportive environment for his learning. Given that he was "so lucky that" he "got the mentors I did at the times I did," and realizing that "it could have been completely different," given that his brother did not share this journey, he was compelled to provide high quality learning experiences for others. Thus, as a graduate student, given the trust of his advisor, he took on five undergraduate mentees and one high school mentee. He shared:

I was so close to just not going to college, I was so close to not getting involved in research. And every step of the way I was just always just lucky because someone said "yes" to me. So I don't think – I'm not going to – it's so hard to turn down these people because it's like this could be a life-changing event.

Further, he thought, "I'm going to have people enter my field and maybe they're going to stay in it and this is how you make the science family." In this context, he seemed to be profoundly moved;

Working with those people just made me think, "Wow when I was 17, you should have seen what I was doing. So I felt very inspired by working with these young people. And I think I feed off that...when someone depends on me, I bring a higher level of performance...I feed off being around people, seeing them get it, seeing them understand something complicated, and then start to make some of their own contributions. It's very fulfilling.

While serving as a teaching assistant, Grey also conveyed a similar level of responsibility, noting that students appreciated his availability, responsiveness to questions, and

the fact that he “would also go above and beyond to send resources to them.” He asserted that “they felt like I cared about them; they felt like I was there in their corner and wasn't out to get them.” Grey’s trajectory, marked by critical meaningful experiences around caring – both as a recipient and as a provider of care, would continue to represent this principle and its practice in his work as an early career engineering professor.

Cameron shared that his first two years of college were “tough,” although he had been motivated to pursue engineering because he had been good at STEM courses in high school. He felt uninspired and unmotivated in his classes until he had an out-of-classroom encounter with a science documentary that made him think, “all this complicated stuff I’m learning...I can actually use to solve interesting problems.” These uninspiring experiences had been furnished by professors who exemplified highly transmission-focused approaches to teaching, “telling you information and you're taking it in and maybe you ask questions once in a while.” By contrast, he would later experience “decent professors” who provided examples of how students could apply the knowledge they were gaining and “you’d feel a kind of passion motivated in the classroom.” However, his richest learning experiences were in classes where professors required semester-long projects that asked students to go beyond learning and using engineering knowledge and involved other skills, such as proposal development and budget-writing. He appreciated that he “could directly see how that would be useful in industry,” if he “went that direction.” He found that this “was nice but...kind of rare to have.” Reflecting upon how his past experiences motivated his present approaches, he asserted that he was determined to “teach in the way I would have appreciated.”

In his experience as a teaching assistant, Cameron was struck by the range of preparedness levels among students. “There were some students who knew calculus because they

had taken calculus” and “could pick up things quick.” However, there were also “some students who just didn't know anything it seemed.” He found that some professors seemed to have the attitude that, “these people are lost; there’s nothing I can do to save them.” He indicated that he had “a hard time” with this perspective and approach and let the students know, “Look, these are my office hours. I'm happy to work with you one-on-one.” In his office hours, he worked with students methodically and patiently in breaking down problems, together assessing and trying together the “tools” with which to solve the problems at hand.

It was startling to learn that Cameron could have been lost to academia, having experienced *vulnerability* as a student for whom a deeper connection to the material was necessary in order to become an engaged learner and successful engineering student. This undergraduate experience and that of coming into contact with some professors’ seemingly unconcerned reactions to struggling students during his life as a TA in graduate school seemed to have been critical to his keeping an open door for students, as well as an open heart.

Jordan’s experiences of meaning around the importance of caring in the work of a good teacher included those had with an advisor/teacher who modeled patience in research and teaching interactions, in comparison to those had with a teacher who was impatient and intolerant of questions. As a student, Jordan was frustrated by the latter approach because he learned best through questions and being able to revisit them as necessary. His internal response to his impatient instructor was, “The reason I'm here in person is because I want to be able to ask you questions and this class needs to be interactive; if it’s not interactive, we might as well watch a video.” By contrast, his doctoral advisor was a positive example, both in class and during office hours. He would start the class with an invitation for questions about the previous day’s material and wait “thirty seconds” before moving on. Further, during office hours, his “advisor

was incredible about explaining things and about being very patient, and there are some things he explained to me like five, six, seven times.”

Jordan seemed to have undergone a deeply meaningful experience around teaching as caring, facilitated by encountering the contrast between these dispositions and approaches – the care manifested by his advisor both in the classroom and outside of the classroom in juxtaposition with those of the “impatient” professor. These experiences of vulnerability both to a lack of care as well as to manifestations of care (i.e., being open and responsive to care) served as a foundation that he would build upon as a new faculty member. Jordan manifested his interest in and focus on care through the student issues to which he gave attention during new faculty orientation, and those that he handled as they arose through direct experiences and interactions with students in his first course.

Hayden had performed well in high school, attaining a high GPA and good scores on standardized tests. However, he also explained that his high school was not situated in “an exceptional school system.” Further, he did not have much guidance about being a college student compared to his peers, as he later learned. Hayden “had a little bit of catching up to do” in his first semester as “just coming out of high school...I wasn’t as strong as my peers.” Standing in the gap, so to speak, a significant figure in his college trajectory was a professor who advised him and set him on a firm path to solidifying his undergraduate major. This professor also helped Hayden to clean up his “disorganized” algebra problem-solving and made room for him to talk about science. This professor was particularly patient with Hayden’s trying to test his scientific ideas. He had “very long office hours and he created a comfortable space that I would bring questions outside of the class and ask him and he could usually show me why they were bad ideas and I loved that.”

Hayden also directly engaged in experiences as an undergraduate instructional aide (IA) in which he had a personal and direct encounter with the importance and significance of leading with care as an instructor. Further, he stated that “going into it” (the teaching enterprise as an IA), he did not think he had “a full appreciation of” the scope of his responsibility” with respect to the careful attention some students needed. However, encountering students somewhat on the margins of STEM in contrast to students who were more prepared, constituted “a dramatic learning experience.” Hayden came to understand the importance of interacting with students in ways that were motivating and eschewing ways of interacting with them that might have a demotivating impact. On this matter, Hayden reflected, “I would feel terrible if it was something that I had done that alienated a student or made them feel like they weren't comfortable to ask a question.” Further, he would learn the value of availability after class, “just hanging around afterwards and solving problems.” He explained:

I definitely got positive feedback from being available and that was pretty easy to me. I just – students would linger after class and I would kind of just continue on the blackboard ‘til everyone was bored or tired. There were a few poor students that just felt like they could never miss out on any of it (chuckling).

Although Hayden was clearly an able student in his high school, upon entering college, he recognized his knowledge gaps. While he had benefited from the care from a professor/advisor, the naming of his experiences as an undergraduate-level T.A. as a “dramatic learning experience” had implications for his sub-trajectory of leading with care. He further explained:

It felt like maybe a more casual, informal approach worked better...maybe it's not a big deal if you bomb this problem set...you can – we can get past – don't get too caught up

just because you know you tripped once, right? And more – maybe [I] more felt more psychology was – was an important part of the delivery – to connect.

Hayden’s experience of *vulnerability* as a not entirely college-ready student, though a high-performing student (as manifested by high school GPA and standardized test scores) is a noteworthy part of his trajectory. However, having support and guidance from a faculty member who made him comfortable enough to move from receiving academic guidance to discussing science no matter how weak or strong his ideas were, equally convey a sense of vulnerability through responsiveness to care. The power of this care in grounding himself as a science person was apparent to me – feeling *a freeness of being* in exploring science as he discussed science with a professor/advisor early in his undergraduate career. This seemed to provide him with a sound foundation to more directly enter into and learn from experiences around what it meant to be a caring teacher, as he interacted with students who were on STEM identity trajectories ranging from deeply vulnerable to robust.

Parrish, unlike the others in this group, did not speak either on any areas of vulnerability that he had experienced as an undergraduate student (learner) or specific demonstrations of care directly received from faculty members during this early period of his postsecondary career. So what did he convey that informs us about his pathway to caring for students? He developed a relational style with his first teaching assistantship – coming alongside students in a project-based capstone class where he was a “guide on the side,” assisting students with their projects. He later served as a teaching assistant to a master’s course in which he experienced the discomfort of having gaps in areas of content knowledge. With his undergraduate course, he also experienced some vulnerability, “like everyone goes through – “you want to be perfect,” although “there will be that one or two things that you are either unsure about or you make a

mistake on.” Regarding vulnerability experienced during his service as teaching assistant to the master’s course, the challenge Parrish faced was that of a large knowledge gap because “a good chunk of the course material” were “things that I had to learn before I could basically help the students.” Concerning the undergraduates, Parrish trusted the aptitude of the students such that if he made any errors, the students would notice them, and between them, the error would be resolved. It seemed as if he were treating the students as co-learners, which connects with how he would later manage the anxiety of his knowledge gap vulnerability while serving as a teaching assistant to the master’s students. In this connection, he described the meaning of the experience as that of seeing himself, “being more of a guide on the side versus the sage on the stage because there was [sic] some of these topics that I wasn't all that certain on as well” and was “learning them at the same time.” He mitigated his anxiety in this context by thinking of the master’s students as “in many ways, equals.” Thus, “it didn't feel quite as much of a high stakes scenario” as had his teaching assistantship with the undergraduates.

Parrish’s most compelling story about the relational side of teaching that illuminates the concept of leading with care, arose in our conversation about his experiences, as a teaching assistant, with students who struggled with academic content material. He shared his view that “the troubled student” in this context was:

one that was just taking a little bit longer to understand the concept, which was often somebody that I would actually build a closer bond with and would actually spend more time working with. So, it was actually not a troubled student in the end; it was a student that I just got to know better in that way...They were actually very good students that were really trying to do well. So it was actually a pleasure to work with them.

Having later undertaken formal teacher training workshops as a doctoral student, Parrish's understanding of educational theory and approach of care for students became intertwined. Although already reflective, and having served as teaching assistant with a lead instructor (for a master's course) who was very improvement-focused, he further deepened his reflection skills and came to speak the language of nonlinearity, which he explained in this way:

Every student grasps things in a different way, at a different time...from a different method. But I've realized that I really need to be able to give the students, essentially different resources to get the same outcome.

This idea of nonlinearity and being able to facilitate the abovementioned learning context for students would continue to be central to his teaching work as new faculty, along with additional concepts and ideas that he would learn from further pedagogical training that he undertook after his first year of teaching as a new faculty member.

Manifestations of Care: Expressions and Demonstrations as New Faculty

Grey, in anticipating teaching in the context of his new department, had stated emphatically, underlining his highly relational orientation that,

I just thought I'm just going to do when I teach, everything I like and then I'm going to get feedback from students to see what they like and try and incorporate it. So trying to keep open classroom instruction – just do what you say and make the class have well-defined plans.

In this relational orientation, he planned to privilege student feedback and have “well-defined plans” while keeping an “open” approach to teaching, reflecting a focus on creating a comfortable space for learning. He also showed sensitivity to students as individuals, indicating

that this was similar to what he did in the research context where he employed a “custom mentoring approach.” In this regard, he stated,

So you have to just treat people on a case-by-case basis...but also give people room to grow, because, you know, just how people start is not necessarily how they will [continue] maybe after some experience people can really blossom.

Through this statement, Grey mirrors his own academic trajectory as a student, which was one of *blossoming* with the help of caring interactions from significant figures – an experience that he demonstrated a deep commitment to facilitating for his students.

Grey’s teaching in his first course as new faculty was characterized by a clear focus on connecting and relationship building. He was transparent with students about his first-generation status so that “people kind of connect with you.” Further, he was highly responsive to student questions and despite the large class size, he did not stay podium-bound in the lecture hall. Rather, he engaged the students by “being playful” – running up and down the aisle,” and “land [ing] at least a good joke here and there.” Further, he also facilitated their engagement with each other by having them do think-pair-share and participating in homework groups. Moreover, he discussed study approaches with them and shared openly with them about the nature of the problem-solving they would be doing in his course and how it differed from what they likely encountered in high school. In the latter respect, he let them know, “they’re not even problems that you might solve on half a sheet of paper anymore; they might become a page long.” Further, realizing that students had been judging themselves harshly and quitting homework problems because they seemed to be taking too long, he simply lengthened the estimated time frames and let students know that given the nature of the problems, one could expect them to take more time. Also, concerning the framing exams, he provided some helpful guidelines, for example,

indicating, “the last problem might be the longest” and other ways of helping them see ways in which they could productively structure their test-taking experience. Grey was indeed emphatic about the need to come to the work of teaching from a place of empathy and perspective-taking.

You always must speak to your target audience. And you have to teach them. They're anxious. They're these kids – these young students are very anxious about everything. And they need to be – you need to kind of give them work in a way that, I don't know, makes it not seem overwhelming.

This did not mean, however, that he intended to coddle them either, as he shared:

I think what's core is that you have to make them become free thinkers. They have to be able to become problem-solvers on their own so they have to be able to struggle through problems that are hard that might be long.

To further motivate students towards his engineering discipline, Grey also implemented panel discussions, featuring professors and other engineering professionals that represented different domains of engineering and possible academic and/or career trajectories. His goal was not only to demonstrate the diversity of engineering careers that students could consider, but also the winding paths that some people had taken to arrive at their careers. All of his efforts were reflective of his goal that students are not weeded out of the discipline. His mission was to convey, “Yeah, it could be hard, it could take some time to adjust, but you can do it.” When he realized that he had reached out to a struggling student too late, it bothered him and he apologized to the student. Further, he committed himself to more proactively identify struggling students much sooner in his future teaching endeavors, although at that moment, he was not yet sure how best to achieve this in the context of a large lecture course. However, he was determined to find a way to do so.

Cameron’s approach to teaching, given the teaching quality gaps in his experience as an undergraduate student, was to “teach in the way I would have appreciated.” Further, having heard as a graduate student, the exclusionary views expressed by faculty who took a dim view of undergraduates who seemed underprepared, he was determined to create a welcoming space for all students. As faculty, he demonstrated this commitment in multiple ways. He described asking his students’ opinions about how they were experiencing his teaching approaches – “What do you think about this?” Because I’m new, it’s hard to tell how things are going.” He also noticed that there were ways in which he interacted with students and research mentees in similar ways to his manner with his own children, through “encouraging” and “complimenting” them on their efforts.

Cameron also talked about having listened to the undergraduates’ stories about approaches that other faculty members took that were helpful to their learning. Further, he asked students to set up times in which to meet him so he could learn about their interests and career goals. Additionally, he was transparent with them about his course, letting them know his awareness of its checkered history – that he knew students typically did not like it – but he had made it a goal to facilitate such an experience that they would both enjoy and learn from the class. He recognized that he needed to be transparent not only about how a course such as his could seem on the surface to be irrelevant to students’ career goals but also about how the material and the learning experience could serve their interests. In one example, he shared how in a one-on-one meeting with a student intent upon another engineering discipline about how course concepts were relevant to his disciplinary/career direction, the student “got pretty excited.” This was truly gratifying to Cameron.

Cameron also shared with me a sense of gratification for the benefit of having many of his undergraduates share with him, a topical interest in a particular scientific problem – a common interest that he could leverage to their mutual benefit in the teaching and learning process. Further, he also invited the students’ collaboration in the teaching and learning process. In this regard, he had them send emails or otherwise contribute content that demonstrated how course concepts were applied in the real world. Further, he used another part of his identity as someone interested in rhythmic movement, to engage the students in embodied demonstrations, illuminating course concepts.

For the future, he proposed to scale up the demonstration aspect of the course, given the impact on both student enjoyment and learning. Further, albeit that he was only one of two instructors for a course that shared common homework and examination problems, he was thinking about changing the assessment structure of the course. Illuminating this, he stated that,

I would like to move away from this model of the entire grade comes from three exams. That's how this undergrad class has always been taught and it makes sense because it's easy when you have sixty or seventy students. But I'd really like to come up with – you know, some people just don't do – take exams well, and I understand that. And so I would – I would, like to branch out, and just come up with other ways of assessing, um, understanding of the material; you know, maybe make it more project-based.

We also discussed the breadth of out-of-classroom access to students that he hoped to provide as he continued his faculty career. He reflected, “sometimes I'm like, you know, that's a time sink and that might mean less time with my graduate students or writing papers.” However, he was resolved to “try it until it doesn't work [timewise]; so I'll offer it and then if it becomes unsustainable then I'll try to figure something else out.” He then went on to share that, “there

were...maybe two or three students that we would just meet one-on-one, and it was fine and it was enjoyable.”

Cameron’s approach to teaching as a new faculty member is reflective of a trajectory of care that seemed to have its genesis in his experience of vulnerability as a student as well as having a meaningful experience of the vulnerability of a subsection of students he encountered as a teaching assistant while in graduate school. As illustrated in the foregoing paragraphs, students’ needs would continue to be at the center of his work as a teacher in the context of his position as an early career faculty member.

Jordan would manifest his care through taking seriously his learning from new faculty orientation – especially that which came through the voices of underrepresented minority students who had urged the importance of manifestations of care such as learning students’ names and having longer wait times for responses to in-class questions so that one could better facilitate students’ participation. He would ultimately master the names of all students in his course and implement wait times. Further, he would employ some bridging techniques that he learned at orientation. These included connecting the previous session’s material to that of the current session through asking questions that would reveal students’ grasp of the concepts while serving as a review, rather than simply providing a prosaic recap. Further, although he had been following a pre-existing syllabus given that he felt himself to be a novice and had been warned about being time-efficient around teaching, he was immediately responsive to students’ expressed need for a stronger foundation on concepts that would better facilitate their learning for content coming later in the course. Additionally, he was very committed to answering students’ out-of-classroom questions in such a way that all students benefited and was happy to employ a technology that allowed him to do this effectively and efficiently.

Jordan would also find himself engaging in deeper avenues of care. During his first semester of teaching, he would identify a master's student who needed psychological support and would spend much time reflecting on whether he had assisted her enough. In this regard, he raised the issue that within certain cultures, the idea of seeking psychological support was not necessarily well received. Further, he would also reflect copiously on a student who failed the course because she did not meet the requirements that would have secured her a passing grade. He engaged in deep self-examination to make sure that he was not bringing any gender biases to the situation, as it was a woman who had failed the course. This intense concern was in keeping with the matters that he had paid careful attention to during new faculty orientation.

Beyond sharing his trajectory of demonstrated care, Jordan spoke explicitly on the matter of care as a philosophy, sharing that it was important to him to convey care in ways that were accessible to students. He felt that, while for example, one could learn some basic information about students from their class profiles, professors should make time to meet students by having them introduce themselves within the class so that students could directly experience the professors' interest in who they were.

Jordan's pathway to caring seemed to emanate from a profoundly meaningful experiences of care about and patience with his learning needs, manifested by one faculty member/advisor by comparison to another who demonstrated the opposite trend. As a new faculty member, Jordan would also be deeply affected by the component of orientation that centered on the experience and needs of underrepresented students. In his teaching work, then, although in the beginning, he was following a pre-existing course template, he would emphasize caring for students and make adjustments in both the content and manner of his instruction, with positive impact as demonstrated by student feedback.

Hayden shared his approach to teaching his graduate course as one that encompassed contrasting approaches – traditional lecture in the “lecture” portion and for the labs, an approach that was “not traditional at all,” but very “hands-on.” Overall, though, he sought to make the students in his course, “comfortable that they can ask any question they want whether it relates to this lab or...something that has to do with the course or an idea that they have.” The latter was reminiscent of his experience as an undergraduate, of being able to talk science freely with a professor without being concerned about how good or bad his ideas were. Further, his concern for creating a “comfortable” environment for students to ask questions was also reflective of how he sought to engage students when he was an undergraduate instructional aide, and later, a graduate teaching assistant. In teaching his first course as a new faculty member, he employed organically emerging moments, whether making a lesson around a broken piece of equipment, through facilitating meaningful questions about the impact of its use, or facilitating the students in sharing their strengths and skillsets to support each other’s learning. In the latter case, he shared:

I just can listen and – and then make sure everything's reasonably accurate without over-correcting...so then that becomes this very open – ideally a very open, comfortable workspace where people can learn from each other.

Although Hayden viewed the classroom component of his course as “traditional” lecture, his description of it suggested that he was thoughtful about making it interesting. While there was lots of “board work” with “rigorous equations,” these were interspersed with illustrative PowerPoints or research manuscripts that employed the concepts being addressed. Further, Hayden was happily responsive to students’ questions, such as “has anyone tried,” or “what if” inquiries that took him off the planned path for the day. For him, these were “really great”

occurrences that “happened all the time.” So it was often the case that “the first ten or fifteen minutes of class would not be any of the notes I intended, it would just be figures from manuscripts related to the brief discussion I had answering a student's question.” In this way, there seemed to be an inherent partnership, even during lecture – a co-constructing of the teaching and learning experience between himself as a teacher and the students.

For Hayden, availability to answer questions outside of the classroom continued to be important to his practice and identity trajectory as a teacher, as he had “first learned the importance” of it when he was an undergraduate teaching assistant. Hayden framed this availability as “just hanging around afterwards and solving problems.” He continued this focus as new faculty. He stayed late with the students of his graduate course who wanted to continue to work in the lab. By creating this accessibility to additional work time and resources, he let them know that they did not have to “rush to the finish line.” In this way, students who were differently prepared for the course had favorable conditions in which to make progress. He asserted that it was not necessary to tell students that these were his intentions, but rather to demonstrate it “through helpfulness.” In this regard, he indicated, “I don't even want to call attention to it...students can finish when they finish.” This theme of availability and helpfulness was also manifested in Hayden's stated commitment to support students after the course was complete, somewhat in the manner of, *once my student, always my student*:

I think one thing that I make explicit about that is – is that...like use me as a resource, you know...you can walk into my office after the course is over and ask me any question...I don't know if they realize it, but that's a pretty valuable thing – like you can get sort of free expert advice at any time.

Hayden's view, as expressed in the foregoing quote, was consistent with ideas about service, oriented around the theme of broadened access to science for all people on local and global levels. In discussing the local level, he referenced having grown up in an urban center similar to one in his current state (of residence) and recognizing the connections between the two locations regarding issues of equal educational provisions and access. He stated emphatically that he would "very much like to engage those underserved communities," and beyond the desire to do so, he indicated that given his comfort level traversing similar communities in his past home state, he felt at ease with the idea of doing the same in his present home state.

Reflecting upon what he had learned from his teaching experiences at the institution so far, Hayden stated:

So the thing that has my mind now is, um, really what the difference is between – it seems like what I'm doing works really well for highly motivated, really intelligent graduate students at the [current university]. I really wonder where this breaks down. This statement is reminiscent of the fact that he had had a "dramatic learning experience" as an undergraduate level instructional aide, where he learned that there were different psychological and teaching and learning needs that existed between students who had previously failed a course and were struggling to find their way in calculus and "a highly motivated group of science or math – engineers that want to learn how to do integrals."

He further engaged the comparison, and in so doing, lifted up the strengths of the students in his graduate course, who had created the environment for a certain ease in teaching, rather than emphasizing what he had contributed to their brilliance. In this regard, he stated:

I mean...these students are good enough and...they put enough faith that they should do the work because they're going to learn and it's meaningful. But if they didn't have that trust or faith or work ethic, you'd have to have a very different approach to teaching. Additionally, he contemplated, "there may be a difference with undergraduates but if you start thinking more broadly, you know, about like [quality of] high school education, especially, then it gets very, very tricky. So, I don't know if I – I guess that's where my mind is...is how do you adapt?" Hayden was very much aware of the variability in educational quality in urban centers such as the one in which he grew up, as he stated that, "the access to education was not equivalent throughout the city." He seemed very committed to working through this issue in terms of the implications it might have for how he would teach a forthcoming undergraduate class.

Hayden's trajectory to care, then, was rooted in realizations not only about his own vulnerability, but the greater vulnerability of students he taught as an undergraduate teaching assistant. A central theme in his work with students across time and space became that of being as available as possible, even beyond their time in his course.

Parrish's engagement with formal pedagogical knowledge started when he took a set of teaching workshops as part of a teaching fellowship program. He would later build upon this with engagement in a disciplinary-based pedagogical workshop of which some of his departmental colleagues (in his new institution) had spoken highly. Among the ideas to which he was exposed in the doctoral teaching program was the idea of nonlinearity (the need to emphasize different configurations of learning resources to students, given their different learning needs). He added to this knowledge through faculty teacher training offered by his disciplinary association, as he engaged with the idea of setting objectives and creating alignment

among course components. These were areas that were most salient for Parrish in terms of their applicability to his teaching and complemented his disposition towards leading with care as a teacher. In fact, he talked about both principles as important ones to carry with him across his teaching journey and noted that while he had not been completely faithful to his goal of optimally aligning all course components with course objectives, it was his goal to improve on this going forward. Further, he planned to revisit his workshop notes before planning his next set of classes. Concerning challenges that he had experienced with some students' engagement in his graduate course, he reflected, "maybe I was a guide on the side better for others than I was for some." Further, he began to reflect upon how in the future, he might engage with students in more transparent ways about the importance and place of the homework problems in their learning. This was based on his observation that some students had complained about the homework load while others had found it central to their learning. Further, he noted that students who came to office hours and those who worked in groups would likely have had a more positive experience of attempting and solving homework problems than those who did not engage in these practices.

Leading with care seemed to be governed by a desire for students to feel welcome in engineering and while such an approach was much more in the foreground for the subgroup of faculty described in this section [than those who lead with disciplinary concerns?], their care was yet in the interest of students developing scholarly approaches to engineering. All faculty members in this group articulated ways in which they desired students to have meaningful scholarly experiences of the material of their respective engineering disciplines and engineering overall and, at times, STEM more broadly. For example, Grey spoke about wanting his students to "learn how to learn...so they can go off and teach themselves" and make connections among

concepts. Cameron spoke of helping to illuminate for students how they would now be “applying some of those challenging calculus things...to solve problems,” some of which he had them apply to intriguing and highly engaging demos. Hayden had his students venture educated guesses on problems to prime them for what he was going to teach later and he was delighted to see them progress with skill and elegance at this task over time, displaying “very rich ornate guesses and beautiful thought processes.”

Table 6.1

Leading with Care: Meaningful Experiences

Participant	Pre-faculty Meaningful Experiences	Early Career Faculty Meaningful Experiences
Grey	<ul style="list-style-type: none"> ▪ Experienced STEM and academic doubt in high school. ▪ Realized that he was behind his peers academically during his first year in college. ▪ Received caring and belief in his potential from high school STEM teacher as a senior in high school. ▪ Received multiple demonstrations of caring from professors, advisors, research mentors (professors and graduate students), as an undergraduate student. ▪ Experienced care as a doctoral student from faculty mentors. ▪ Was profoundly affected by the educational and research opportunities afforded to him (especially since going to college was not a foregone conclusion given his family background) ▪ Directed care towards undergraduate researchers and took on six mentees (one of whom was a gifted high school 	<ul style="list-style-type: none"> ▪ Demonstrated transparency with students. ▪ Attended carefully to the balance between support and challenge. ▪ Created a comfortable atmosphere for interactions and questions in lecture (engaging with humor, questions, moving around the class and connecting with students, framing homework). ▪ Was transparent about what the course would require. Continued to be responsive to students’ questions. ▪ Considered the psychology of the students – that they were anxious beginners in the discipline – by adjusting completion time estimates for homework, helping them think of ways strategic ways to approach homework and tests, and discussing effective study skills. ▪ Provided career development opportunities via career panels,

	<p>student) and felt motivated to “make a science family.”</p> <ul style="list-style-type: none"> ▪ Was moved and impressed by mentees’ interest, investment, and intelligence. ▪ Received appreciation from students for whom he served as a teaching assistant for his demonstrations of care (e.g., they could depend on him, he was available, responsive to questions, and willing to go “above and beyond”). 	<p>hoping that this would help students envision themselves continuing in the discipline/field.</p> <ul style="list-style-type: none"> ▪ Expressed concern for a struggling student and apologized to him for not reaching out earlier. ▪ Began to reflect on the ways in which he might more proactively identify struggling students in the future.
Cameron	<ul style="list-style-type: none"> ▪ Had experienced disconnection with college (courses) because of lectures with lack of real-world connections or application – a demotivating experience. ▪ Experienced a few rare professors who were more engaging. ▪ As a teaching assistant encountered students who had preparation gaps whom some professors viewed as “lost,” and seemed unwilling to try to reach; this did not sit well with him. ▪ Responded to these students with care and invited them to meet for one-on-one help. ▪ Provided thoughtful stepwise problem-solving guidance. 	<ul style="list-style-type: none"> ▪ Endeavored to teach students in ways he would have appreciated as an undergraduate. ▪ Invited students to one-on-one conversations to get to know them and their career interests. ▪ Was transparent with his students about his newness to teaching. ▪ Invited students’ direct feedback and suggestions. ▪ Acknowledged to the students the history of the course as one that many people did not like or enjoy and shared his plans to shape the course differently with the goal that they would both learn and enjoy the material. ▪ Delighted in finding common scientific interests with the students which helped him engage them. ▪ Invited students to find and share examples of the real-world application of course concepts, i.e., search various news sources or other media to email him so that he could use them to benefit the whole class.

Jordan

- Experienced challenges with a professor who lacked patience, which contrasted with the care with which his advisor taught, mentored, and explained. His mentor would explain concepts as many times as was necessary and did not respond negatively when asked for clarification.
- Demonstrated interest in students' career directions and how, even though they were unlikely to enter his field, they might transfer and apply the learning to their desired fields.
- Sought ways to heighten engagement of students, including demonstrations in which students collaboratively and with his guidance, bodily and kinesthetically created demonstrations.
- Paid great attention to and was very impressed and affected by the student panel portion of faculty orientation. (The students addressed ways in which professors could be inclusive by learning their names, offering longer wait times to enable them to answer questions and thus be better able to participate in their classes).
- Assisted a student in difficulty and directed her to psychological support.
- Spent time thinking about how cultural differences can be a barrier to student help-seeking and reflected on whether he could have offered more assistance than he had.
- After realizing that one of his students could not pass his course and in effect failed, he reflected on whether he had been fair to her although he knew she had been graded correctly. He displayed scrupulous attention to any possibility of gender bias.

Hayden

- Attended a high school that was not of the highest quality.
- Knew he was not as well prepared as some of his college peers although he had performed well in standardized tests and in terms of high school GPA.
- Experienced the welcoming disposition of a professor who helped him with his workflow and helped him decide on his major.
- Felt well received by the professor who created a welcoming space for questions that went beyond advising to the exploration of scientific ideas that Hayden felt comfortable to test out with him no matter how good or bad they were.
- As an undergraduate teaching assistant, had a "dramatic learning experience" that made clear the difference between the learning needs of students who were retaking calculus and those in another class who were better prepared.
- Was gripped by the concern that no one was left out of the learning experience
- Practiced availability across his teaching assistantships.
- Stayed in the lab after the end of class to provide time for students who needed more time to work; created this space and opportunity without drawing too much attention to it (preferring to demonstrate helpfulness rather than drawing attention to himself or the students needing help).
- Leveraged students' respective skills to facilitate mutual teaching in the lab.
- Sought to affirm what was right in students' problem-solving discussions, rather than first pointing out what was wrong.
- Avoided overcorrecting students.
- Reflected on the undergraduate classes he would teach in the future, considering that he might not be able to teach them in the same way he would highly motivated graduate students, and also given his knowledge about the differences that exist in the levels of high school preparation (a situation that he knew firsthand from his experience growing up in an urban center).

Parrish

- Experienced concerns as a teaching assistant to undergraduates that he might not have all the answers.
- Experienced discomfort of his knowledge gaps as a teaching assistant for a graduate class.
- Managed these experiences of concern by viewing the students as learning partners.
- Continued to hold to and act on the idea that students have different learning styles and may need different configurations of resources to support their learning.
- Experienced deep concern when a midterm evaluation revealed some students were not grasping concepts and

- Viewed students who struggled with some concepts not in a deficit way, but as bright students who needed extra help.
 - Experienced strong resonance with teacher training (through a future faculty fellowship), in the aspect that focused on individual student needs and how across a diverse group of students, there might be needs for different configurations of resources (this he referred to as the nonlinearity principle).
- readily implemented their suggestions, referring to it as one of the “more instrumental” things that happened to shift his approach to teaching.
 - Reflected that he might have been a better “guide on the side” for some students than others.
 - Sought going forward to enhance transparency regarding the purposes of different components of the class and their role in helping students learn.
-

Summary of Leading with Care

Faculty who led with care for students demonstrated and emphasized the importance of serving the students. They concerned themselves with getting to know and understand the students, responding to differences among students, in some measure, co-constructing the learning experience with students, and in other ways creating good conditions for students’ engagement in learning. They were open in reflecting upon the need to include students and leave no student struggling. These concerns and values seemed to be anchored in deep “experiences of meaning” (Wenger, 1998, p. 52) regarding vulnerability and caring encountered throughout their journeys across time and space in the academic landscape. The stories of these journeys were potent and palpable and conveyed a depth of feeling that demonstrated the importance of sharing these accounts at some length.

Journeys to Leading with Disciplinary Commitments

Faculty who led with disciplinary commitments were guided by concerns about grounding students in the discipline or necessary habits of mind, perspectives, values, and

attitudes they associated with meaningful engagement with the discipline. These included independent thinking, intuition-based thinking and risk-taking; valuing the science behind engineering; and being oriented towards leadership goals in the field and discipline. These perspectives, habits of mind, and values seem to reflect what I have decided to call *the scholarly engineer*.

Some critical experiences brought Brighton, Harper, Ainsley, and Morgan to a strong focus on fostering students' development of sound disciplinary foundations and values. For Brighton, it was his grounding in a heavily theoretical field, but equally the way that this approach served him in the world of work, and also served the bright undergraduates that he mentored in the context of that work. For Harper, the profound "experience of meaning" (Wenger, 1998, p. 52) was engaging with challenging questions posed by his doctoral advisor, which required him to exercise "intuition-based thinking and hypothesis," an experience he found highly valuable to his learning.

For Ainsley, it was his approach and that of his undergraduate colleagues to engaging with all courses as if they wanted to become experts in them, and thus seeking a firm grounding, gained through a strong work ethic. Moreover, for Ainsley, it was the compelling nature of the science behind the engineering – the fascinating nature of even small details that evoked a curiosity that he associated with an ideal engineering student. Also highly influential to Ainsley's academic identity, were his experiences at his previous undergraduate and graduate institution, where instructors took a more fundamental conceptual approach to teaching rather than employing modes that Ainsley viewed as advancing "a trade school mentality" or that of "training employees," which he was concerned about as he saw it evidenced in his present institution.

For Morgan, independence and risk-taking were important values that she wanted to see in her master's students. This was reflective of the spirit of independence that she had experienced among her doctoral student peer group and of course in herself – a spirit fostered by an advisor who, before playing that role in her academic identity development, had been a teacher that excited her about what would become a core area of her research. Given her experience with him as a teacher and advisor, a primary instructional goal of Morgan's was to encourage intuition-based thinking by creating a classroom environment in which students could exercise it. In her view, this approach “engraved” what was taught in the classroom into students' memories. She had learned from her advisor that:

just writing down a bunch of equations on the board, it's not going to help anyone, but giving students, especially in engineering, intuition about what these equations mean [is more productive]. You know, of course, the math is there and you can read the math and you can have an understanding, but that intuition makes all the difference.

Thus, Morgan seemed to be highly invested in seeing her students take the kind of initiative and leadership in their work that she was afforded in her own learning and research experiences with her advisor. This was by contrast to experiences that she had had in which professors had failed to give students time to work through problems, allowing them to surface and enjoy the deployment of their intuitions.

Making Students Ideal for the Discipline: Expressions and Demonstrations

Critical to both Brighton's and Morgan's approaches was the focus on the development of intuition, for example in Brighton's case, gaining increasing capacity and dexterity with assessing the impact of particular physical conditions on mechanical structures. In discussing the importance of intuition and a focus on the fundamentals, Brighton shared how he developed

homework which became a high point and central feature of his senior-level undergraduate course. In this work, he required students to “calculate from first principles why the efficiency [of an engine] is the way it is.” He described this as a powerful and transformative experience for students and noted with some animation that some students had engaged in “reverse-engineering” as they problem-solved.

In keeping with his fundamental and scholarly bent, given his assessment of the success of the homework, Brighton was intent upon scaling up this project in future iterations of the course, to have students work on group inquiry projects and demonstrate their knowledge through creating posters that would become a part of the department, and in a sense, a part of what Wenger would term, its history of learning. A part of Brighton’s future also lay in providing strength to a particular curricular track in his program, one that he saw himself well equipped to accomplish in concert with another faculty member, raising “the quality of the department” and providing undergraduates with enhanced specialized options.

While Brighton was strongly focused on disciplinary integrity, he had many thoughts reflecting his responsiveness to students. For example, although having access to practice exams had been a foreign concept in his academic environment as an undergraduate, he was quite willing to make these available to future cohorts of the class. Further, he was determined that he was “going to get better” about figuring out the derivations that students most needed and be able to “spend a little more time talking about the applications as they apply to concepts and...start doing more engaging [of the students]” On the matter of responding to student concerns, he laughingly had also shared that there were certain course aspects that were inherently boring and sometimes he even bored himself. He hoped to find a way to solve this problem in the future. Also, having contemplated that some students did not seem entirely comfortable having had to

rely almost entirely on his notes for content knowledge (without a textbook for reference), he was considering finding a text that best aligned with his teaching approaches.

Given Morgan's convictions about focusing on intuition, she employed an approach that had proved very fruitful for her and, in her view, for the students. She used what she termed "directional questions" and created a space in which students could test their intuitions. For her, facilitating students' building of intuition seemed to come with a bit of play. Further, her description of her mode of question facilitation conveyed a sense of collaboration and engagement of the students in the teaching and learning process. She provided the following example:

there are some students who are very sharp, they have the background, they know what the answer is although it is counterintuitive, so they say it. But I pretend as if, I mean, I try not to show any emotion (chuckling) about whether it is correct or not, to allow other people to, you know, let me know what they think...sometimes I take the students to the wrong direction, make sure that everybody agrees with the wrong conclusion (laughingly) and then let them know that it's wrong and then why it is wrong. So I think it helps them remember.

While Morgan had expected her students to be more independent, she did not ignore those who were less inclined to fit this pattern. She began to provide more support when necessary and took their suggestions to heart, implementing them in her next offering of a project-based course.

Also, she spoke confidently about her ability to read the room so to speak, and notice cues about students' grasp of the material, arousing her concern that they understood the material before moving on. Beyond reading the room, she would also engage in active check-ins to support the work of comprehension. Morgan expected to teach an undergraduate class in her immediate

future and while she had not yet done a lot of planning, she intended to “ask for materials” from those who had previously taught the course and make changes she determined to be necessary. Thus far, whenever she came across “a video or a picture or something” that she thought could “can help motivate a specific problem,” she saved it. While she was planning to take a teacher training workshop hosted by a disciplinary association in the summer, given the impetus by some colleagues’ positive expressions about it, she demonstrated skepticism about how much new content she would learn. She thought she might get some information to improve her teaching, but asserted, “I don't think it's going to be seven days’ worth of information.” Perhaps this was because her past encounters with treatments of active learning, first as a graduate teaching assistant in preparatory workshops and second, as a faculty member listening to the presentation of an education developer, were not presented in compelling ways. From her description of the latter session, it seemed as if she had come away learning only about categories of methods that she could try, without meaningful connections on how these would be more efficacious than her existing practices. Further, it seemed as if Morgan was extremely comfortable with her own intuitions about what worked in teaching and brought a high level of independence to her work as she had done in her research journey. Morgan’s teaching situation included a high degree of alignment between her graduate courses and the content areas of her research as well as the project-based and research nature of the courses. Thus, she may not have seen the immediate and direct value of the pedagogical training to how she presently conceived of the teaching enterprise given the research-oriented nature of the courses she had taught thus far.

Given his focus on *fundamental concepts* as opposed to *fundamental topics*, Ainsley’s commitment was to teach conceptually, eschewing textbooks that were topically (rather than conceptually) organized, and privileging problems that allowed him to test the undergraduates’

depth of conceptual understanding, and as such, he framed them [the problems] so they could experience the concept “outside of a problem that they've already worked on.” Indeed, he was later compelled to respond to a variety of student academic identities that did not fit the ideal image he held. Thus, he decided to include in his tests, primarily problems that students would find more familiar along with a smaller number of problems that had more novel features. While this change effort represented a clash of values for him, he tried to reframe it, noting that he could use the higher-level questions to discover prospective undergraduate research recruits. Further, he was responsive to the students’ need to have “all the parameters up front” although he questioned how well it would serve them in dynamic workplaces. In any event, he *did* respond by creating a careful scaffolding of content and problem sets in such a way that they fed well into their term projects.

His high scholarly ideals and expectations for a solid work ethic among students could make Ainsley seem to be a “task master,” he valued working closely with students as evidenced by the fondness with which he described the experience of working with them in the more personal context of project-based courses. In this context, he was able to co-construct ideas with students. Further, he spoke with much satisfaction of his graduate students’ discovery of themselves in relation to the discipline, for example, surprising themselves by what they were able to achieve in their projects. Also, he shared that he had learned from some alumni about the value of his course to their preparedness and success in the workplace. Ainsley shared this story with a laugh, in such a way that it seemed a point of delight and amusement. Moreover, when expressing his thoughts about what was of critical importance in teaching in large lectures, he emphasized the centrality of connecting with the audience, reading their faces, telling powerful stories including those from the workplace, and providing visualizations that helped to illustrate

concepts. Further, he viewed the student audience as helping to inform and shape the trajectory of the lecture. Ainsley's relational side is also revealed through his sharing of relevant stories about his work life with both graduate and undergraduate students.

In connection to his interest in exploring different ways of engaging students in large courses, Ainsley found a collegial space within his institution that allowed him to engage in discussions about engineering education that addressed his need for ways in which to reach diverse students in such contexts. He was able to observe colleagues' teaching in action and reflect critically on their repertoires. Further, he became invested in the idea of framing education research questions relating to solving the problem of providing meaningful learning experiences in a large course context for clusters of students who have similarities in their learning styles. Moreover, regarding his firm belief in organizing curriculum in conceptual ways, he described his plan to co-write a conceptually structured textbook with colleagues who are "really strong" in "different parts of the field." It was indeed heartening to hear him wish aloud that he could, "focus on research, focus on teaching" and "not constantly trying to raise money."

For Harper, what did his focus on intuition, deeper understandings of "the science." and leadership mean for his focus as a teacher? It meant challenging his students in his graduate course with problems in which they could see the weakness in problem-solving when some fundamental scientific concepts – principles and properties – are not considered. It also meant framing problems for the undergraduates in ways that illuminated both the importance of a focus on engineering leadership, and fundamental understandings that undergirded the development of intuition. In expanding upon this approach, Harper explained:

I mean, I think if you're a [name of institution] engineer, that says something, right...People say this guy's from [name of institution]. It's a top engineering school. This

guy's going to be good – or girl...I think those people often take leadership and management positions. And so I think in those roles, it's not only important to think like dollars and cents, and stuff, but you also need to think...you have to have some general intuition for the various technical things that you're also managing.

In this way, he skillfully and playfully (as he laughed about it) made evident to the students that developing intuition – understanding why things work and under what conditions and so on – is fundamental to that of being a scholarly engineering leader. This is consistent with his integration of work and play, which he displayed through his use of metaphors relating homework problem-solving to weight-lifting and developing skills “off-court.” His combination of work and play was also reflected in his extemporaneous and high energy development and use of demonstrations in his undergraduate course, facilitating “the breaking of things,” with math applied, and through an area of service he has developed. Through the latter, he had been seeking to benefit high school teachers and students by developing activities around which students can ask and seek to answer some fundamental questions relating to the discipline. For the future, he planned to continue to engage the undergraduates with the demonstrations and student response systems. In this connection, he stated:

I think I'll try to create a few other demos, to increase the demo density, but I'm going to keep the flash card. I'm going to keep the few slides to introduce the concept and then ...example and...question format...They liked the demos and they liked the excitement...And they learned a lot. I think I'll just turn that up.

Moving forward, regarding the graduate course, Harper was concerned about better addressing the needs of students on different academic, research, and career trajectories. While he intended to carry out a survey, as suggested by one of his colleagues, which he hoped would help inform

him on how he could best meet their needs, I could tell that this issue presented somewhat of a wicked problem that would be a perennial one:

What has me worried is that the student composition will fluctuate rapidly and dramatically, and I don't know how I'm going to handle that yet. Because I get students from chemistry, I get students from electrical engineering, I get master's students, I get – I've had undergrads last semester, and graduate students all in the same class. Everybody isn't – everybody's obviously not on the same page.

Notwithstanding the seemingly intractable nature of this problem, Harper was in earnest to better serve the students through better meeting their research needs. Further, the play element and enthusiasm that he brought to his teaching, particularly of the undergraduates was an important point of mutual identification. In these ways, although leading with disciplinary concerns, Harper demonstrated care for students.

Table 6.2
Leading with Disciplinary Concerns or Commitments

Participant	Pre-faculty Meaningful Experiences	Early Career Faculty Meaningful Experiences
Brighton	<ul style="list-style-type: none"> ▪ Underwent profound experiences working on homework problems that ultimately provided him with a strong foundation in his discipline. ▪ Possessed physics background that permeated his teaching and research; he thus maintained a strong focus on the fundamentals, which he called “first principles.” ▪ Experienced in the workplace (industry) how an emphasis on the fundamentals served not only himself but the 	<ul style="list-style-type: none"> ▪ Sought to provide to students learning experiences centered on applying first principles, so that they know physically why things work in ways that allow them to be empowered problem-solvers. ▪ Created a set of problem-solving exercises around an engine model that highly engaged students in applying first principles. ▪ Demonstrated excitement about the future development of the above exercise as he planned to transform it into a more scholarly group exercise,

	undergraduate students who were undertaking internships.	yielding posters that could become part of students' contribution to the department.
Harper	<ul style="list-style-type: none"> ▪ Learned about the importance of "intuition-based thinking and hypothesis" through the questions that his graduate advisor posed to him. ▪ Held a strong work ethic and appreciation for deep learning acquired by taking on challenging homework problems. 	<ul style="list-style-type: none"> ▪ Created problems that helped his graduate students grasp the need to understand elements of science behind the engineering so that they were clear on its importance. (Some of them had raised questions that challenged the need for this.) ▪ Expressed pleasure about the growth of his students around intuition as they started posing tricky <i>what-if</i> questions regarding the impact of changing certain dimensions of a problem. ▪ Sought to motivate his undergraduates' engagement in problem-solving by framing problems, referencing them as coming from a leading institution, and taking up leading positions in a company.
Ainsley	<ul style="list-style-type: none"> ▪ Possessed a spirit of independent inquiry, starting from high school research experiences. ▪ Experienced university cultures from undergraduate to graduate level in which a strong work ethic and relishing of problem-solving was evident. ▪ Engaged all courses, even those "tangential" to his main interests as if he wanted to become an expert, an approach in which he perceived he was not alone, given the culture of his institution. ▪ Also in this environment, he experienced an understanding that topics should serve 	<ul style="list-style-type: none"> ▪ Expressed some frustration with students who want "all the parameters up front" which, for him, was not a good way to become leaders in engineering. ▪ Experienced concern that students seemed opposed to engaging with novel problems and were keen to see test problems that mapped closely on to those given for homework. However, he decided to make a compromise in how he structured his tests, creating a balance between more familiar and novel problems. He framed the latter as being of potential value to help him recruit undergraduate

conceptual understanding which is primary, versus the idea of simply building topical knowledge.

researchers; however, his tensions around this issue were incompletely resolved.

Morgan

- Experienced the need to have space to think and answer questions rather than having professors tell you the answers too quickly in class.
 - Experienced having her exploratory and independent approach to learning and inquiry supported and further fostered by her research advisor.
 - Perceived peers in graduate school as similarly independent.
 - Gleaned from the professor who became her graduate advisor the importance of intuition through taking a course with him in which he taught in ways that elevated the importance of intuition.
- Frustrated with the lack of appropriate textbooks that were conceptually organized; thus he was motivated to co-write one with key experts in different aspects of his field.
 - Used directional questions rather than giving answers, thus facilitating students' development of problem-solving and intuiting skills.
 - Emphasized the importance of having the intuition behind the problem.
 - Fostered independence in students who were doing projects (not giving help until it was absolutely necessary).

Summary: Leading with Disciplinary Commitments

Faculty who led with disciplinary commitments expressed strong feelings about grounding students in the disciplinary values and habits of mind, which they viewed as consistent with meaningful engagement with the discipline. These included independent thinking; intuition-based thinking and risk-taking; valuing the science behind the engineering; and being oriented towards leadership goals in the field/discipline. Thus students would be

prepared to serve their respective disciplines and fields well. These faculty seemed to come to these conceptions and ideas through profound “experiences of meaning” (Wenger, 1998, p. 52) about characteristics that allowed them to be good disciplinarians. This group did not reveal any experiences of *vulnerability* that perhaps might have led them on similar trajectories to the faculty who led with care.

Special Case of Alex: A More Complex Identity Trajectory?

Alex’s undergraduate career had been marked by the experience of feeling like the material she learned in classes “was very disorganized and difficult” and classes “weren’t necessarily built on each other.” Further, she felt that she was not “a good student in the classroom; rather, the learning she experienced in research contexts helped her to believe that she could yet “be [a] good” student. Thus, she had gained a profoundly meaningful experience around the learning difficulties students might experience when faced with a poorly scaffolded or minimally integrated curriculum. Further, she had learned through her own experience, how students who learned best through hands-on, authentic inquiry could experience themselves as outside the boundary of what constitutes a “good very good student in the classroom.”

Alex, who was teaching in an interdisciplinary field, seemed to be taking on identity work for herself as a teacher in that field and as a student (given her fraught experience as an undergraduate) invoked through imagination (in the Wengerian sense), and mirrored by the undergraduate students in her upper-division course (and undergraduates in the discipline more broadly, at least as she imagined their likely experience). Moreover, she seemed to be on a trajectory that reflected taking on identity work in the interest of the larger discipline in terms of advancing the structuring of curriculum content and teaching in her discipline. She was invested in and gained much satisfaction from her work on integrating content across disciplines and

representing such integration through the problems that she developed and tested both in the context of her course and with the vetting of her graduate student assistant, a collaboration she highly valued. Further, she was much invested in an engineering education community, whose work not only promised enhanced integration of content for her own course but across the curriculum of the wider program.

All the work Alex was doing to improve her course and improve the teaching offered in her discipline more broadly had its genesis in her experience as a student who faced an incoherent and fragmented organization of courses in this discipline – a less than optimal context in which to learn. She was invested in her students having a more engaging experience through tackling meaningful problems and through trying techniques that she had developed and applied in her own research. Further, she desired that students “enjoy” their learning experience and it saddened and discouraged her that a “vocal” minority of students in the second iteration of her course seemed not to enjoy the content as much. This was a group that had colored her impression of how the class went the second time around when she had full responsibility for it. Recounting the situation, she explained:

it was funny ‘cause in my mind, I felt like the students were unhappy, but I think maybe it was a few vocal students who jarred me, who were very like self-confident and almost a little bit arrogant.

However, the evaluations turned out more positively than had she expected and there was some meaningful improvement feedback that she could use for the next iteration of the course, which she “really appreciated.” However, the comments from the “vocal” students, made her concerned about, “What could I do differently to make them enjoy it, ‘cause I enjoy it so much?” Thus, Alex committed herself to continued consultation with the teaching center. She reflected:

I mean the most important thing to me is I don't want to become someone who has a chip on their shoulder and is negative at all. That's the most important. Um, I think it makes me think...involving the [teaching center] in evaluations is important because they really – I think can strip out the negativity and then give you the productive feedback. And so I think that's something I always think about moving forward – like to some extent you – you have to not let every student sort of jar you and your, you know, what...decisions you're going to make about your teaching. But then you also have to be open to the student feedback 'cause that's the only way you'll get better.

An additional opportunity for improving her teaching (about which she was excited) involved the prospect of co-teaching with a colleague who “loves the class” he had taught “all on his own” in the past. Further, Alex had heard that the students “like it, too.” Both of these factors were motivating for Alex and were influential in making her “open” to and excited about the prospect of what she could learn, especially as past co-teachers did not seem to like their shared course and given Alex's concern that all students enjoy their learning experience.

While Alex could be viewed as leading with concerns about disciplinary integration and integrity, this seemed to emanate from a profound and seemingly painful experience of the disorganization of the discipline as a student and her identification with current undergraduates, whom she was determined should have a better experience, both in her course and within the broader program. In this sense, she seemed to be equally leading with disciplinary concerns as well as care for the students.

What do We Learn from the Idea of Identity Trajectories?

This analysis has revealed how engineering faculty members' identity trajectories were rooted in experiences of meaning-making that had consequences for their teacher identities as

new faculty, whether in terms of leading with care or leading with disciplinary commitments. These experiences included those relating to their own formation of student identity and those relating to their subsequent construction of a teacher identity. Even when participants had observed their own professors, they did not simply translate these observations into ideas of ideal teaching practices and ideal teachers. Rather, they made critical evaluations of their observations that helped to shape these conceptions. Further, many of them also developed images of preferable or ideal student identities that they would bring with them into their new faculty positions – perhaps with a less critical approach than they had applied to their observations of teaching.

My analysis revealed participants' internalized images, metaphors, and scripts, reflecting ways of being students and teachers (from both observation and their own experiences) that reflect their engagement in academic communities and the attendant identity construction that took place at particular points in navigating locations in the academic landscape of practice. These include, for example, the undergraduate classroom, graduate teaching assistantships, and encounters with STEM or engineering education research. These images, metaphors, and scripts include those of good teacher – good teaching, good teacher, poor teaching, poor teacher, ideal student, and less than ideal student. For example, regarding good teaching, some faculty were relatively more attuned to the disciplinary moorings with which they were being equipped, while others' *experiences of meaning*, while not unconcerned with disciplinary grounding, were palpably more focused on connecting with students.

The COP framework articulates identity as a trajectory that reflects individuals' journeying within as well as traveling across communities. In this regard, Wenger holds that an identity trajectory:

incorporates the past and the future into the experience of the present. Over time it accumulates memories, competencies, key formative events, stories, and relationships to people and places. It also provides directions, aspirations, and projected images of oneself that guide the shaping of the trajectory going forward. (Wenger, 2010, p. 185)

This articulation emphasizes the importance of personal histories and narratives to the constructions of identity in the present and into the future. Through personal histories of negotiating and identifying or aligning with particular meanings across time and space, new faculty engaged in identity-constructive work as teachers. Their trajectories up to the present provide indications of how they are likely to continue their teaching work, such that while gathering new knowledge and reconstituting their identities, there is likely to be a through-line that reflects a certain consistency (enduring beliefs and values) within the dynamic nature of identity. This suggests that the faculty in my study who lead with care are likely to articulate and leverage their other commitments such as those associated with disciplinary values, through the lens of care. For those who lead with disciplinary commitments, it suggests that the relational and caring aspects that are a part of their identity trajectory are likely to be manifested in ways that will help gear students to serve the discipline.

Identity trajectories, when self-studied or collaboratively explored, may reveal experiences and their related meanings that inform conceptions of being a teacher. Meaning-making involves the cognitive, behavioral, and affective, and perhaps the spiritual. Such self-reflection or self-examination regarding identity trajectories or personal histories of learning can help faculty to see how their interpretations of experiences, in turn, help to motivate other experiences, meaning-making, conceptions, commitments, and actions. Also, reflection on trajectories can be a useful point of departure to stimulate the imagination. Imagination, which

encompasses thought experiments (e.g., visualizing oneself as connected to other practices and professionals, whether more or less distal in the landscape of practice) allows faculty to consider alternate identities of themselves both as faculty in the present and the future. This is to say that if faculty can meaningfully encounter colleagues' stories reflecting differing student and, subsequently developed teacher identity trajectories, and how these connect to shape their present teacher identities, they may find features that could enhance the construction of their own personal teacher identities. For example, the stories from faculty that indicate the transformative power of care in their experiences both as students and as teaching assistants, and in the present as faculty, may lead colleagues whose constructed identities give less emphasis to care to apprehend its potential value in their own teaching lives and selves. Stories from faculty whose identities prioritize disciplinary commitments, given that participants leveraged these in ways that showed concern for students, might be particularly informative to colleagues who think that such a pattern of engagement inevitably leads to the sacrificing of academic rigor.

Sharing identity stories might thus allow early career faculty to experience previously unconsidered identity considerations and accountabilities that could potentially lead them to increase or enhance "meaningful moments of service" (Wenger-Trayner & Wenger-Trayner, 2015, p. 23) to students representing a broader range of student (STEM academic) identities. Harper, for example, ended up considering both broader student and teacher identities, albeit that he had experienced a history of learning in which he learned well through traditional lecture, through engaging both with students and a colleague. Regarding undergraduate teaching, meeting a departmental member, who had experience with and an identity invested in STEM Education, was a pivotal experience for him. This was so, especially given that Harper had come to the teaching of an undergraduate course having had no previous experience, except lab

supervision. Although he had gleaned but a fraction of this person's individual history of learning, this encounter was of significant value to Harper's learning and identity construction as a teacher. He learned about the value of classroom demonstrations to the student learning experience from this colleague. Further, he confirmed just how meaningful these were for students as he happily observed the resulting level of engagement, excitement, and learning. Further, discovering the value of demonstrations to the teaching and learning process, created more excitement for him as they connected to his own ethic of *work as play* and *work hard, play hard*, and emerging sense of teaching as related to research. The latter for Harper, in teaching his undergraduate course, was bound up in the experimentation and risk-taking involved in extemporaneously creating demos.

Trajectories, as unveiled in stories, are important. Through stories, on both a methodological and practical level, we gain insight into what might be pivotal experiences, to probe, reflect upon, imagine different configurations of contexts, different configurations of trajectory, differently configured conceptual and practical toolkits, and so on. Individual engineering faculty members' reflection upon their histories of learning as individuals, and what these reveal about the histories of learning of the communities they have inhabited, visited, or sojourned within, can help to feed thought experiments and perspective-taking that serves the consideration of both alternative student and faculty identities.

The theorizing of Nolen et al. (2011), based on their review of the literature reveals the motivational power of broadening what constitutes a trajectory towards competence in mathematics learners for K-12 students. In this context, the learning environment was structured to provide resources and space for students to use their agency to explore and negotiate identities of meaningful participation and competence as mathematics learners, as opposed to proffering a

singular possible identity trajectory. In applying this principle to faculty, I reflected that if faculty have access to a multiplicity of teacher identity trajectory stories reflecting different roads to “identities of competence” in teaching, motivation for the commitment of time and effort on improvement and innovation in teaching might be a likely outcome. Further, being invited to examine multiple identity trajectories to competence in teaching, could serve as a primer for new faculty members’ consideration of what trajectories to competent participation might look like for engineering students. In this sense, competent participation would be represented by an expansion and diversification of modes of engaging in the teaching and learning process. The desired outcome is that there would be a positive effect both in terms of enriched engineering teacher identity trajectories (for faculty) as well as enriched engineering student identity trajectories, fostered by the use of highly engaging, student-centered approaches.

Chapter 7: Discussion

A plethora of contextual factors has affected the preparation of STEM faculty for teaching and their development of teacher identities (e.g., Brownell & Tanner, 2012; Indorf et al., 2021; Stains et al., 2018). In many universities, these factors include departmental and institutional expectations for the prioritization of research that are also reflected in the tangible rewards for research productivity that make concrete the privileging of the research role over teaching (e.g., AAU, 2017; Indorf et al., 2021; Miller et al., 2017), disciplinary norms that have an impact on the use of active learning instructional approaches (e.g., Hiller & Nelson Laird, 2021; Lindblom-Ylance et al., 2006; Momsen et al., 2013; Neumann et al., 2002), and real or perceived constraints around the need for content coverage (e.g., Nelson & Brennan, 2021; Petersen et al., 2020). These long-standing issues and emerging research on the interactive effects of combinations of barriers (e.g., time) and supports (e.g., supportive colleagues) (e.g., Shadle et al., 2017; Sturtevant & Wheeler, 2019) suggest the need to explore in detailed ways the processes by which STEM faculty learn about teaching and what their teaching experiences mean for their construction of professional identities as teachers.

While K-12 education research has led the way in studies of teacher identity (e.g., Beauchamp & Thomas, 2009; Beijaard et al., 2004), there is an emerging body of research in higher education that has begun to explore teacher identity. Some of this research explores teacher identity in the context of professional academic identity more generally (e.g., Kosnik et al., 2013), while other studies have paid special attention to teacher identity (e.g., Blanton & Stylianou, 2009). This body of research reveals the multiplicity existing within and across

faculty professional identities; the inevitability of tensions among individuals' existing identities; the possibility of tension between their current and aspirational identities; and tensions between the identities they hold and those they may encounter in their communities of practice (e.g., Blanton & Stylianou, 2009; Jawitz, 2009a). Further, a cluster of these studies suggests that identity work occurs not only during faculty members' early years in their academic careers, but also throughout their career lifespan (e.g., McCune, 2019; Viskovic, 2006). Another subset of these studies reveals that these identity-related tensions appear to be more evident under institutional policies that shift the structure and requirements of academic work roles and communities (e.g., Clegg, 2008; Skelton, 2012b). These studies explore both the constraints that faculty perceive and the agentic moves that they make as they build, maintain, or strategically reframe their academic identities (e.g., Levin & Hernandez, 2014). However, these demonstrations of agency do not obviate the necessity of departmental and institutional supports that may promote progressive, student-centered teacher identities (e.g., Sturtevant & Wheeler, 2019).

In the present inquiry, I focused on early career faculty in engineering in a single research institution to illuminate how they made meaning of their teaching experiences and how their teaching identity might be shaped by their interactions across multiple sociocultural contexts, and how these identities might shape teaching practices. I posited that potential interactions might include those with colleagues inside and outside of participants' departments and institutions and encompass social interactions with students, which might all be consequential for the faculty members' learning and identity construction as teachers. The theoretical framing for my study recognizes the role that social interactions play in learning and identity development and guided my examination of how such social interactions in local contexts might influence

faculty members' teaching conceptions and approaches. Specifically, I explored the research question:

How do new engineering faculty in research-intensive universities build teacher identities in the early years of their careers, and in particular, what experiences and contexts shape their identities and practices as teachers?

The results of this research led to findings that both support and extend current understandings of the teaching and identity construction experiences of early career faculty as well as to the development of a set of inductively derived theoretical propositions that could guide future studies of teaching identity construction among early career academics in engineering.

Theoretical Framing and Methods

To frame the present inquiry, I employed the sociocultural lens of communities of practice (Wenger, 1998, 2010; Wenger-Trayner & Wenger-Trayner, 2015) that acknowledges that postsecondary faculty members' professional identities develop within social contexts such as programs, departments, and institutions, as well as the international disciplinary community. The theory conceptualizes learning as a process of meaning-making and identity construction as a process of identifying and/or aligning with particular meanings that are experienced in a given domain (such as the field of engineering). Further, learning and identity construction are assumed to be inextricably linked and to occur in different communities of practice across time and space. In this learning process, individuals develop different levels of relationship or membership (belongingness) to different communities. While there are many communities with which a person might engage, Wenger's theory assumes a focal community (or if more, a restricted number of focal communities). In the context of my study, I assumed that participants'

core communities were their engineering departments, sited in a school of engineering in their research-intensive institution.

Sociocultural conceptualizations of identity have been favored by many of the inquiries into professional academic identity (Bathmaker & Avis, 2005; Jawitz, 2007; Martensson et al., 2011). These approaches emphasize the impact of interactions in sociocultural contexts as central to learning and the construction of identity in particular domains of practice. Such studies focus on patterns of relations existing within and affecting the nature of practice; the evolving meanings that members make of practice and ways in which individuals navigate becoming members of the communities to which these configurations of practice are central (e.g., Billett, 2008; Wenger, 1998). Given that the goal of my study was to illuminate how interactions within the context and resources of a research-intensive university helped to shape teacher identity, I chose to employ a sociocultural framework. I focused on identity because research suggests that an individual's teacher identity has implications for their teaching approaches and commitments to improvement (e.g., Brogt, 2007; Martensson et al., 2011; Oleson & Hora, 2014).

I took a narrative approach to data collection that facilitates a focus on how individuals make meaning of their ongoing individual and social experiences across time and space. This approach assumes that individuals engage in a process of retelling stories over time and, as they do so, they are advancing the meaning making process (Connelly & Clandinin, 1990). Narrative approaches are grounded in the notion that at any given time in the experiencing process or in the story-telling process, meanings may be multiple and complex (Elbaz-Luwisch, 2007). These conceptions that underly narrative approaches align well with a sociocultural framing and exploration of professional identity construction in general and teaching identity construction in particular because sociocultural frameworks view individuals as developing identities as they

negotiate their “experience of self” (Wenger, 1998, p. 150) through their meaning making about the practices they encounter in the social settings they inhabit.

I approached this inquiry with a view of faculty as active meaning-makers. I expected that while engaging in the work of teaching, they would test possible meanings and refine their understandings of teaching practices that had currency in their department; this process would contribute to their emerging identities of competence in teaching. Further, I expected that these new engineering faculty might ultimately try to reshape the meanings and articulations of those practices in ways that supported their personal understandings of what constituted an identity of competence or knowledgeability, given their negotiation of academic and teacher identities across time and space in the landscape of practice. My focus on participant narratives finds affordance in the shared notion between narrative inquiry and studies of communities of practice that identity is produced while navigating a particular landscape. As Clandinin and Rosiek (2007) have indicated, narrative inquiry represents “an exploration of the social, cultural and institutional narratives within which individuals’ experiences are constituted, shaped, expressed and enacted” (p. 42). Indeed, my study revealed that participants’ meaning making about their social, cultural, and institutional interactions served as identity-informing resources.

My use of a semi-structured, multiple-interview protocol allowed individuals to tell their stories over time and to revisit and clarify them as well. The use of multiple interviews not only surfaced new content or evolutions in participants’ thinking, but also helped to further illuminate significant themes as experiences reflecting these themes occurred over time. I coded the transcript corpus, intending to develop categories and themes related to teaching practice and identity construction while consistently revisiting these in the context of each individuals’ corpus

of transcripts. I used intense analytical memo-ing to develop and interpret the categories and themes to construct the findings presented in the previous chapters.

Summary of Results and Propositions for Future Research

The results of the present inquiry bring to light in-depth stories that run counter to the “narrative of constraint” (Terosky et al., 2014, p. 58) that depicts faculty as reticent to invest the time and effort needed to be highly effective teachers (e.g., Seymour & Hunter, 2019). My participants’ stories revealed their desire to learn about teaching and improve it, notwithstanding personal and professional constraints. These narratives reveal faculty who were willing to be experimental, who found joy in the work of teaching, who wanted students to both learn and enjoy studying the discipline of engineering, and who hoped their students would become empowered learners and even leaders in their respective engineering fields. In the following sections, I review the findings that led to a set of empirically grounded propositions to guide future research and link them to the results of prior studies.

The Formative Role of Early Learning and Teaching Experiences

In the first chapter of results, I demonstrated that in constructing conceptions of the work of teaching in engineering and developing a repertoire of teaching approaches, new engineering faculty found value in their store of observations that they acquired and processed when they were students as well as in their own experiences as graduate teaching assistants. They had observed, experienced, and assessed the effectiveness of the teaching practices and dispositions of their past professors and drew on what they experienced as the best of these repertoires, referencing how they facilitated their own learning and/or that of other students. In this way, they were beginning to construct ideas about the ways of doing teaching and ways of being teachers. However, this was not a case of simply teaching as they were taught, which Oleson and Hora

(2014) identify as an “oft-cited truism” (p. 40) in the discourse around teaching in STEM disciplines. Participants in the present study did not passively observe and mimic what they saw their instructors or mentors doing in the classroom. Rather, they engaged in active critical reflection and made agentic decisions not to engage in practices that they judged to be unhelpful either personally or to their fellow undergraduate students. These observations would play just as important a role as their experiences of legitimate peripheral participation in teaching while serving as teaching assistants. Oleson and Hora (2014) illuminated the variety of sources of learning about teaching that exist among early career STEM beyond the models provided by their past instructors. Although their research suggests that faculty learn about teaching through a variety of influences – including modeling after previous instructors – it does not illuminate the faculty’s decision-making processes on the teaching practices they adopt and by extension, the kinds of identities they are building. The Wengerian concept of negotiation of meaning describes a process that is continuously in play, views human beings as active meaning-makers, and conceptualizes meaning making as a consistent motivational force and conceptual tool that helps to illuminate such processes.

My findings show that participants’ observations of teaching and their responses as students shaped their ideas about their own teaching approaches and dispositions. These early negotiations of identities of competence in teaching influenced early career faculty members’ choices to identify or disidentify with particular ways of being a teacher. My analysis further revealed how engineering faculty members’ identity trajectories were rooted in experiences of meaning-making across engagements over time and space as students and how they had consequences for their teacher identities as new faculty. These experiences included those relating to the formation of their own student identities and those relating to their subsequent

formation of identities as teaching assistants and later as early career faculty. Even as students, participants did not simply experience or observe teacher identities in practice from which they critically configured ideal teacher identities; some developed images of preferable or ideal student identities that they would bring with them into their new faculty positions. A pattern of caring learned through observation and practiced by a novice instructor or professor is not a simple replication but represents ongoing negotiation of meaning. For example, one of my participants, Grey, in his first year on the tenure track, deployed an extensive repertoire of practices reflecting empathy for students learning STEM subjects. This repertoire included the use of his humor and sharing transparently about the impact of being a first-generation college student. These meanings had their genesis in his active processing of the many ways in which care was demonstrated to him throughout his journey as a student and research advisee – a pattern which he embraced but also defined for himself based on direct and indirect student feedback on his work as a teaching assistant. The pattern of caring, also demonstrated by Hayden, could be seen as a replication of his past professor’s availability and creation of a comfortable environment for learning and testing ideas – if we use the blanket brush of *teaching as taught*. However, Hayden had constructed his own meanings of availability that drew on both his experiences as an undergraduate and graduate student teaching assistant. These findings lead to the following proposition to be explored in future studies:

Proposition 1: Early career engineering faculty members’ observations of teaching as students, and their engagement and critical reflection on the varied practices of their instructors and/or research mentors, constitute a strong base for legitimate peripheral participation and thus form the foundations of learning and identity construction around teaching.

The Open Economy of Teaching Practice in Research University Departments

My analysis also revealed how participants' learning about teaching and the construction of their teacher identity were informed through 1) engagement within and across communities of practice; 2) the meanings they made of such engagement; and 3) their choices to identify with certain teaching conceptions and approaches. As new faculty began to engage in the work of teaching, they interacted with engineering faculty, and some interacted with adjacent and related communities in the institutional landscape of practice, such as engineering education experts, other academic units such as the writing center (from which a colleague had borrowed and shared useful learning activity) and significantly, students.

The present inquiry also revealed a diffuse community around teaching in the participants' engineering departments. What the study participants experienced in terms of community engagement, negotiability of the repertoire of acceptable teaching practices, and accountability to the enterprise (of their engineering department), suggests a loosely bounded and loosely structured community of practice. For example, modes of mutual engagement in departmental practice included becoming familiar with how a course was taught in the past while being trusted to bring one's content expertise to creating a good course. In this setting, sharing of artifacts such as syllabi that reflected course histories seemed to be a core mode of mutual engagement. Further, this "open" economy of meaning was situated within a climate of relative autonomy for teaching, thus providing participants with broad opportunities for ownership of meaning. Even in a co-teaching context, there was a mutual understanding that teaching was a pretty autonomous affair. For example, although Cameron was co-teaching one section of a course while his colleague taught another, and while students took the same tests, Cameron taught in a completely different way from his colleague. Although he and his co-instructor discussed student assessments, they had no conversation about teaching approaches.

Faculty participants described departments in which they had occasional and casual conversations about the practice of teaching. The topics included approaches to homework, assessment methods, the existence of good teachers who taught in ways that seemed equally effective, and more. It appeared that this knowledge floated in the department with potential for deeper individual and collective meaning making that was not typically realized. Moments of deeper conversations were few. For example, Brighton had engaged in conversations with more senior faculty members to learn how they coped with trying to serve doctoral and master's students in the same course. In this context, he learned that other faculty were also concerned about the same issue and that one of the ways in which some senior faculty addressed it was through providing a class solely for doctoral students. This was a solution he could not yet afford the time to implement given that he had to guard his time in the interest of building his research portfolio.

The "open" economy of meaning in their departments allowed participants to negotiate their repertoire of practices and how they maintained accountability to the enterprise of teaching engineering. Faculty could freely make their own pedagogical decisions. For example, Alex began reinventing her upper-level undergraduate course by creating authentic problems at the intersection of the two disciplines that comprised her interdisciplinary field, and included a research activity that came from a process used in her doctoral research. After receiving negative evaluations for his first iteration of his undergraduate course, Ainsley planned to "own" his course and did so with a focus on careful scaffolding. We can view such investments in course development as reflecting participants' sense of accountability to the enterprise of providing a high-quality learning experience for students and contributing to the overall quality of teaching in one's department. While other studies have revealed the looseness of departmental

communities (e.g., Blanton & Stylianou, 2009; Warhurst, 2006), they have typically not utilized the broad range of conceptual vocabulary that communities of practice offers, such as the idea of economies of meaning and ownership of meaning to help illuminate the workings of such communities as distinct from more tightly bounded communities of practice, such as might be found in liberal arts institutions.

The occasional formal conversations about teaching that participants described centered principally on course content and content across the curriculum. Notwithstanding this limited in-depth engagement with departmental colleagues regarding the work of teaching, participants' departments were sites of interaction, meaning making, and identification. These encounters and interactions thus served as resources through which new faculty would gain some knowledge about teaching and themselves as teachers.

The foregoing findings that emerged from the narratives of early career faculty negotiating a teacher identity in this research-intensive environment suggest a second proposition about how learning and identity construction in relation to teaching take place in ways that might be referred to as ad hoc and often tacit.

Proposition 2: A diffuse community of practice provides limited formal opportunities for learning and identity development around teaching, but also permits faculty members opportunities to engage in their own meaning-making around effective practice and decision-making regarding identification or disidentification with certain practices.

The participants of the present research took advantage of the open economy of meaning and created their own learning opportunities, which is perhaps in line with their manifested orientation to teaching as one requiring ongoing development and improvement. However, further research is needed to determine if such departmental contexts would be productive for

other early career faculty across the board, or whether some faculty may fail to thrive as teachers under such conditions (i.e., lack of structure around learning how to teach).

Engagement Across Landscapes of Practice

Wenger's notion of landscapes of practice (Wenger-Trayner & Wenger-Trayner, 2015) acknowledges that multiple communities can have a say or are potentially informative to one's attainment of professional competence. In this regard, they coined the term *knowledgeability* to encompass the ways in which individuals in particular professions of necessity must be informed by the practices and concerns of multiple communities. For example, a faculty member will not only have to engage with the concerns of their immediate departmental community but those of professional associations and regulatory bodies associated with the practice side of their fields.

In my study, STEM education developers, staff in other academic units, colleagues from academic communities of practice located in other institutions, and the student community constituted the landscape of practice for individual faculty. Regarding the broader collegial landscape of practice of the institution and beyond it, interactions with science and engineering education researchers and consultants also contributed to faculty members' identity trajectories. Beyond spaces that were proximate on the disciplinary level, a few participants experienced brokering from departments in the broader campus landscape. This included accessing a useful activity from the campus writing center through a departmental colleague and accessing movement specialists for the purposes of embodied demonstrations via a department that aims to facilitate initiatives that incorporate the arts into science and engineering instruction to enhance inquiry and critical thinking skills.

The greatest learning and provocation for meaning-making and identity construction around teaching, however, arose from interaction with and feedback from the student

community, which I argue is an adjacent community with a claim to defining competence in the area of teaching. Student feedback occurred through faculty's direct interaction with students in their classrooms (both from observation of and conversations with students), through faculty direct requests, and students' formal evaluations of teaching. Moreover, students' performance on exams or homework served as another important form of feedback. Faculty experienced moments of ease as a result of the positive student feedback about their teaching. However, for some faculty, the experience of student feedback was complicated by encounters with student identities and needs that ran counter to their expectations and challenged them to adjust their teaching approaches. Overall, participants engaged in a great deal of thinking about students' learning and problem-solving. In many instances, their narratives revealed their reflections on the students as whole persons as they considered the cognitive, emotional, and social dimensions of students' learning experiences. These included considerations of students' preparation levels, disciplinary background, and in one instance, cultural attitudes to help-seeking.

Participants learned from their interactions with students from the time they were teaching assistants up to the present. These lessons included the value of patience, being available outside of the classroom, creating a comfortable environment for students to ask questions, the value of student effort, and the value of co-discovery (in partnership with students). As faculty fully responsible for all aspects of teaching a course, their learning from students deepened as they received feedback on an array of course elements, from the use of textbooks and demonstrations, the impact of homework and tests, and the level of energy or enthusiasm brought to the classroom. These findings align with those from other studies that reveal interactions with students as a significant contributor to faculty members' teacher identity construction (e.g., Ceglie & Settlage, 2019; Hockings et al., 2009; Levin & Hernandez, 2014).

A third proposition, which recognizes the voluntary nature of faculty participation in this study as well as the role of students in early career learning about teaching, thus posits:

Proposition 3: For early career faculty in engineering who value teaching, interactions with students in their courses is a significant source of learning that contributes to the construction of a teaching identity.

Among the considerations for future research could be a focus on the conditions under which faculty engage in mutual learning with students and to what extent such arrangements approximate those of students-as-partners that are a type of faculty-student collaboration aimed at improving the teaching and learning experience (e.g., Brown, 2018; Daviduke, 2018; Dunn et al., 2018; Hadgraft et al., 2017; Pearlston et al., 2020). Further, to inquire into the nature of student-faculty interactions that help to facilitate faculty's learning about teaching, the learning partnerships model that has been typically applied to students' holistic development – academic, personal, social, and career, might be a useful framework (Magolda & King, 2004).

Student Identities in Contention

From their interactions with students, faculty reflected upon students' demonstrated responsiveness to particular teaching and learning activities, apparent preferences, direct positive feedback and suggestions for improvement, knowledge gaps that became apparent in multiple ways, and in many instances directly solicited student feedback on their teaching. Further, they sought to problem solve and respond, even when the student concerns did not initially completely resonate with their assumptions. This was the case with Ainsley, who thought that students who wanted all “the parameters up front” would not be well prepared for the dynamics of the work environment if he responded to this request. Thus, Ainsley had experienced internal conflict regarding who he wanted to be as a teacher of undergraduates. He had hoped that all

students would relish hard work and bring curiosity to novel problems, as was the norm (at least as he experienced it) at his undergraduate institution. Thus, his students' demands seemed contrary to what his own student identity and those of his past peers had taught him was important in the teaching and learning process. Later in his journey across the landscapes of practice, he would join discussions with engineering education faculty, discussions that led him to think about how one could create customized learning for students in large classes. I wondered whether these contemplations would mean he would no longer lead with disciplinary commitments or would he extend his disciplinary commitments to include engineering education that was more care-centered.

While teaching his graduate-level course Brighton also experienced his own student identity as being in contention with those of his students. He admitted that he had expected to be teaching students with personal histories of learning that were similar to his own. However, their preparation for the material was diverse and quite different from his own. Thus, Brighton was challenged to teach his course in ways that reflected both his (highly valued) personal student identity and the teacher identity that best serves a different kind of student. Such tensions between faculty and student identities were demonstrated by Bathmaker and Avis (2005). These authors revealed the existence of a clash of identities between themselves and the senior faculty. Further, they uncovered tensions between the teaching and learning regimes that had helped to forge student dispositions that were unfavorable towards the meaningful enterprise of deep learning and those to which these early career faculty were exposed as students (i.e., those that facilitated deep learning). From these narratives of contending student identities, a fourth proposition emerges:

Proposition 4: Early career faculty in engineering who are exposed to a multiplicity of student academic identities struggle with the clash between their own personal student identities and those of students that seem distant from their own experience.

Research emanating from this proposition might inquire more deeply into the meaning-making processes and strategies that help faculty decenter their own student identities (along with the related approaches to learning and preferences for teaching) to respond to the student in front of them.

The Construction of Identity Trajectories over Time

My findings also revealed an overarching trajectory that I characterized as a learning disposition towards teaching. Within this trajectory type, my findings revealed two trajectory sub-types that I framed as: (a) leading with care and (b) leading with disciplinary commitments and values. Both sub-groups exhibited a commitment to continuous learning about teaching. Thus, my findings suggest that faculty can have a teacher identity sub-trajectory that is predominant within the overarching trajectory reflecting a learning and developmental approach to teaching. The leading with care sub-trajectory seemed to have as its genesis significant encounters with and meanings made of experiences of vulnerability as a student, for example, threats to academic identity. This pattern was characterized by responses to participants' vulnerabilities, by instructors and/or mentors that were supportive to them as learners. This response pattern would become central to their narratives across time. Leading with disciplinary commitments seemed to emerge from meaningful experiences with the construction of disciplinary knowledge that led to the shaping of teacher identities around disciplinary fundamentals or general scholarly commitments and values that supported the integrity of the discipline in question. Albeit participants' narratives were marked by stories revealing these

dominant patterns, I must emphasize that this did not mean that the patterns were mutually exclusive – that caring was absent from leading with disciplinary commitments or that disciplinary commitments were absent from caring trajectory patterns.

My findings further suggest that faculty may use the more dominant identity strand to serve the less dominant strand or vice versa. For example, Grey led with care and leveraged it to help students achieve desired disciplinary perspectives, values, and commitments and what he perceived as the general scholarly values and commitments that are supportive of disciplinary ones. By this I mean that he demonstrated care by thinking about his students holistically, normalizing their anxiety about doing well in the course, providing transparency regarding course navigation, study skills, and ways that they might productively approach their exams, among other provisions. However, a central goal of his was to have students embrace the scholarly value of “learn[ing] how to learn” and having them see the linkages between concepts. Further, Grey wanted them to begin to envisage themselves as researchers as well as scholarly practitioners, using conceptual linkages to problem solve. Illustrating leading with disciplinary and/or scholarly concerns and demonstrating care through this means as a subsidiary thread, consider Ainsley, who was of the firm belief that the School of Engineering should be training engineering leaders able to handle a dynamic work environment. His preferred approach had been to encourage students to tackle novel problems as opposed to simply tackling those that had a familiar shape and form (i.e., too similar to homework problems), thus expanding their conceptual understandings. Ultimately, he would strike a compromise concerning the undergraduate course in which this dilemma obtained. When we parted at the conclusion of the last interview, I wondered how he would work through the uneasy compromise he made by

having a mix of problems – a large cluster containing familiar problems and a smaller cluster of novel problems.

For the early career engineering faculty who led with care, experiences of personal vulnerability within the academic sphere represented a strong through-line of meaning-making. In this study, some participants related stories of their own vulnerabilities as students who were or who felt underprepared for university-level learning or lacking something essential or that of being in a less than optimal situation. I view this type of vulnerability as having the outcome of empathy towards students (or openness to be moved by or connect to their experiences). For example, Grey told the story of his high school self – doubting his academic acumen in STEM – a self that was transformed by the encouragement and belief of a science teacher during his senior year. This support and care would propel him to invest greater effort in becoming a science person. In college, he profoundly appreciated the care of teachers and mentors. These experiences led him to be deeply concerned about students' learning experiences, to think holistically about the optimal conditions for their learning, and to even share his moments of challenge experienced as an undergraduate so that they would share a point of identification that would add to the motivational mix of the course environment.

By contrast, faculty leading with disciplinary commitments and values did not narrate experiences that suggested such a sense of personal vulnerability. Rather, the stories of these faculty members reflected a sense of thriving. Their stories consistently focused on how they relished the rigors of academic life and the rewards they obtained through their educational efforts. Their negotiation of the meaning of good teaching seemed as much a matter of how they perceived the traits of good teachers or characteristics of good teaching as much as it was a matter of how they saw themselves as students – responding to their teaching and learning

situations with a commitment to engage in the labor-intensive problem-solving their instructors required. Still, through reflecting on engagement with the students and in one case, with a departmental colleague, these participants identified ways in which they could make their teaching more engaging for students. This interest in student engagement was not new to them, just as it was not new to those who led with care. This is not to say that challenges were necessarily absent from their academic journeys or to suggest that those who led with care did not thrive academically. Rather, the narratives of those who led with care contrasted in notable ways from those who led with disciplinary concerns and scholarly commitments to the discipline. Thus, a fifth proposition posits a mechanism through which such prior experiences might shape teaching identities:

Proposition 5: Early career engineering faculty members' negotiation of the meaning of their student experiences facilitates the formation of distinct teacher trajectory types that can be traced across the narratives of their journeys across academic landscapes into their early years as tenure track faculty.

Based on this proposition, future research might consider whether these patterns and even other trajectory types would be apparent in a larger group of early career engineering faculty in the same institution. Further, researchers might explore whether these patterns appear across other institutional types, such as liberal arts colleges that are reputed or purport to be more teaching-focused. Additionally, would the patterns be evident in other research-intensive institutions that might have a different structure of work, collegial relations, and deep institutionalization of teacher professional development or the scholarship of teaching and learning? Another question arising from my findings about trajectories is whether (and if so, how) faculty such as those in my study would sustain a life-long learning orientation to teaching in a diffuse community of

practice that offers little structured attention to building teaching practices or identities. Given the demands associated with faculty members' research priorities, what would be the minimum inputs to help them sustain their trajectories? Further, what would be the impact of deeper engagement with the more tacit teaching-related resources of their departmental communities of practice, if the department created structures to make these more visible and accessible for reflection and analysis? Further, given the overarching learning and developmental trajectory of faculty in this study, their reflective nature, responsiveness to students, and their inventiveness, researchers might inquire how faculty demonstrating these patterns over time take up evidence-based practices.

Implications for Theory and Research

The implications for theory (and by extension for research) reside within the research propositions articulated in the foregoing paragraphs. They suggest that theory-building investigations of the construction of early career engineering faculty must inquire into: (a) faculty members' meaning-making around their observations of teaching and their own teaching experiences; (b) the nature of faculty's interaction with students and how faculty make meaning of these in ways that inform their identity trajectories; (c) the genesis of early career engineering faculty-teacher identity trajectories; and (d) the question of whether and to what extent the identity trajectories that faculty have manifested through time will change or be maintained as faculty continue their work.

The present study focused on early career faculty who were within years one to three of beginning their tenure track faculty positions, with only two faculty members who were in the first year. Future research should follow early career engineering faculty from year one of their faculty appointment over time to uncover critical points of learning and identity construction

across the landscape of their professional academic journeys. A longitudinal approach might also take advantage of participants' more immediate recall of the details of their experiences and provide greater opportunity to understand the effect of additional teaching experiences as well as the impact of changing circumstances of their work.

The current study also focused on new engineering faculty in a research-intensive institution. Future inquiry could focus on different institutional types and cultures to understand the experiences of engineering faculty in smaller, teaching-oriented programs. Given that most engineering faculty are trained in research-intensive environments, the question arises as to whether the cultures of engineering departments within teaching-focused institutions (and the institution at large) might be more influential than those that these early career faculty encountered while they were graduate students in research-intensive universities and thus have some overriding effect over that of faculty's new context. Also, this research might seek to uncover whether engineering faculty who hold positions in teaching institutions experience a different landscape of practice or make meaning of their teaching in ways that are different from those of faculty in research-intensive institutions. And, if this is so, where do such differences lie? Further, it would be useful to explore what aspects of the cultures of engineering departments located in different institutional types support the construction of particular kinds of teacher identities.

The participants in this study self-selected to spend time conversing in detail about their academic experiences and teaching lives. Future research that includes a more diverse sample (e.g., engineering faculty who have teacher identity trajectories that represent a minimal investment in teaching or who are not necessarily predisposed to participating in a study about

teaching) would help researchers understand their experiences and meaning making about teaching across time.

While the current inquiry focused on faculty in engineering, future research could seek to illuminate the teacher identity construction/trajectories of early career faculty in other STEM disciplines in order to understand whether there are differences in the contextual effects through time – from the science student in the high school and/or undergraduate classroom across their experiences as new faculty in research-intensive institutions. Thereafter, as was suggested for early career engineering faculty, additional inquiry could also focus on STEM faculty in small teaching-oriented institutions from which a disproportionate number of students go on to undertake graduate training. Further, consideration could be given to including institutions that have strong teaching development programs and cultures in which high faculty participation and investment is the norm (whether these are small liberal arts colleges or research-intensive institutions).

Finally, given that I was only able to study my participants for one year, I was unable to determine how changes in their local contexts might change their teacher identity trajectories. Albeit that the early career faculty in my study showed investment in teaching no matter which sub-trajectory was dominant for them, the local context of their work could potentially have an impact on their identity trajectories over time. This local context includes ever-increasing demands to strengthen their research profile through grant-writing, a time-consuming activity requiring a great deal of strategy. If it holds true that identity trajectories are grounded in earlier educational experiences and reinforced by later ones, then trajectories might be temporarily put on hold if difficulties or unforeseen circumstances arise. In such instances, environmental pressures might cause early career engineering faculty to adopt provisional identities that allow

them to navigate such conditions while maintaining a projection of themselves into the future consistent with their original identity trajectory. However, it is also possible that they would exercise agency and imaginatively create the necessary identity reconciliation between their original teacher identity trajectory and that which the circumstances demand, in ways that feel authentic and meaningful to the faculty member and thus they may not wish to take a provisional stance in relation to this newly emerged identity. This suggests a line of inquiry that might focus on the conditions under which faculty construct provisional identity trajectories and, as a follow-up, how provisional identity trajectories might become woven into and consistent with the main trajectory in ways that are deeply meaningful to the individual, and potentially to the departmental community of practice. These considerations suggest that future research could explore the conditions under which early career faculty sustain an identity trajectory or experience significant trajectory changes that seem unreconcilable with their original trajectory.

Implications for Practice

The current research study helped to illuminate the complex ways in which early career engineering faculty might encounter the many dimensions of the academic and disciplinary landscapes they inhabit and or/make meaning of encounters in ways that have implications for their teaching identity, including conceptions, dispositions, values, motivations, and sense of fulfillment. Encountering the landscape of practice in terms of relationships with students and different students' identities emerged as a critically important resource for early career faculty members' construction of a teaching identity. Some faculty brought with them to teaching in their first tenure-track positions, their own student identities or schemas for ideal student identities, and these were in tension with those who show up in their courses. These served as "boundary encounters" – a kind of meeting that offers rich learning potential. The interactions

that faculty had with STEM and engineering education experts, conceivably may have helped to reveal identity possibilities in relation to teaching that they might have missed when they were undergraduate students. However, in this study, the interactions that faculty had with departmental colleagues around teaching approaches occurred in very casual ways and did not reveal opportunities for deep exploration of the identity possibilities contained within more experienced faculty members' paradigmatic trajectories.

Given the exploratory nature of the study on a self-selected group of early career engineering faculty who chose to opt into this inquiry, I tender the following implications for practice with caution. These implications are two-fold: (a) those that might be implemented at the departmental level and (b) those that might be taken up by faculty developers who support engineering faculty. Concerning the first, given that the faculty members in this study demonstrated a learning orientation to teaching, irrespective of whether they led with care or with disciplinary commitments and values, they revealed that they could be a rich learning resource for each other. Engineering schools could consider ways to optimize faculty with such learning dispositions towards teaching to both find each other (since my study found that they reside in different programs and departments and have little opportunity to meet) and to communicate about teaching through time-efficient means. For example, a messaging platform could facilitate collaborative problem-solving around teaching questions they have in common. Given the currency of tools like Slack that are already familiar to engineers, these might be valuable in facilitating the process given that time is at a premium with the many research demands that early career faculty face. Other initiatives might include the assignment of a teaching mentor to each new faculty member or perhaps the creation of learning partnerships that assume that the new faculty member has ideas from which the more senior member of the

partnership might also be able to learn (rather than assuming a unidirectional process). With respect to overall departmental learning opportunities, initiatives could be developed that help make the departmental histories of learning around teaching particular courses more transparent so that the community is better placed to critically analyze its approaches to teaching those courses and learn from best practices.

Of value to the work of faculty developers, the results of this study indicate that within early career faculty members' histories of learning, there exist rich experiences of observation, engagement with practice, and meaning-making that are identity-informing in the domain of engineering instruction. Consultative work with new faculty should ideally be informed by an understanding of early faculty members' identity trajectories. Key experiences of meaning-making around teaching across the faculty members' experience in the landscape of practice could serve as meaningful and productive scaffolding for building both identity and practice. Given that teacher identities seem to motivate educators towards particular types of actions and investments in teaching (e.g., Ash et al., 2009; Hammerness et al., 2005; Martensson et al., 2011; Skelton, 2013; Viskovic, 2006), providing new faculty with training, various reifications and artifacts that represent certain novel conceptions and styles of teaching, without consideration to their identity trajectories, may result in lack of uptake or a problematic form of uptake of these new approaches.

Conclusion

The present inquiry revealed that some early engineering career faculty in research-intensive environments (at least those in my study) take a learning orientation to teaching notwithstanding the "narrative of constraint" (Terosky et al., 2014, p. 58) that characterizes the higher education discourse around their seemingly narrow investments in teaching, particularly

evidence-based instructional practices (e.g., Stains et al., 2018). Findings included the identification of faculty identity trajectories marked by reflection on experiences of teaching and learning as students and, in some cases, as research mentees. Additionally, these trajectories were furthered through legitimate peripheral participation as teaching assistants – a process for which learning by critical observation provided a strong foundation. Experiences in the early career phase involved encounters and interactions with people and artifacts in the loosely structured communities of practice of their engineering departments, albeit that it was evident through what was exchanged in passing and in a few cases, during more substantive interactions, that there was likely much untapped potential for deeper meaning making if the time and space were created for such, and perhaps, if meaningful incentives were provided by their departments that would help to seed the exploration of this local learning and identity constructive potential.

Participants' accounts of engaging the landscape of practice revealed that interactions with students served as the predominant resource for learning and identity construction, throwing up questions for reflection that were inspired by the emerging needs of students as manifested through both direct and indirect feedback. Also, students provided affirming feedback for many of the ways in which faculty expressed their teaching selves and carried out their teaching work. Moreover, faculty took evaluations seriously and even invited feedback outside of the mainstream campus-wide evaluations. Another aspect of learning from students emerged through the experience of identities in contention between the student identities of faculty and those of students who presented with different needs and histories of learning. This indeed was the site of identity work for some faculty.

The results of the study find resonance with those of previous research and extend the previous findings and offer support for several directions of inquiry. This is in addition to

offering propositions from which research questions can be derived, which seek to add nuance to the current findings. These include explorations into the teacher identity construction of faculty starting from the first year on the tenure track and following them across three years; studying early career engineering faculty located in research institutions that have different configurations of work and different levels of institutionalization of professional development; and inquiring into the experiences of faculty from other STEM disciplines in similar vein. Further, the question of the existence of other identity trajectory types in addition to those emerging from the present study is another consideration for future research, and in addition, what are the factors that maintain or break down particular teacher identity types and their strength over time? Moreover, acquiring knowledge about the impact of interactions with students on early career faculty identities would add value to the existing literature. Questions exploring these dynamics can be applied in multiple contexts to illuminate the unique interactions that may take place between faculty and student, not just driven by students' incoming identities, but also through the ways in which they evolve through interaction with institutional culture. Finally, this inquiry suggests multiple areas for practice, albeit that these ideas are tentative given the small scale of my study. Chief among these recommendations is the idea of helping faculty with strong learning orientations to teaching find each other, perhaps using technology such as Slack – an emerging (or not so emergent) critical reification that creates time efficiencies for communications and collaborative problem-solving in academic environments.

APPENDIX A: Interview 1 (Protocol 1)

Background Interview (90 minutes)

1. When did you become interested in becoming a faculty member? What attracted you to faculty work?
2. So back then, what **characteristics and skills** did you associate with being a good researcher in your discipline?
3. (a) **Where did those ideas** about good researchers come from? b) At that time, to what extent **did you think you possessed the characteristics and skills you named?** (c) **Were there certain people that you saw as role models? If so, who served as a role model? Why?**
4. Did you **have any concerns at that time, about your ability to be a good researcher?** If so, what were they? How, if at all, did you **address these concerns?**
5. That was back then. **Now, let's talk about right now.** How would you describe yourself as a researcher? What adjectives would you use?
PROBE: Why did you choose those words?
PROBE: Are there other descriptors that you wished applied to you? Or that you hope will apply in the future?

We have been talking about research. I'd like to shift and ask you about teaching.

6. Again, thinking back to when you first decided you wanted to be a faculty member, what characteristics and skills did you associate with being a good teacher in your discipline? Where did those ideas come from?
7. Were there certain people that you saw as role models? If so, who were they and why did you view them as a model? Did your own experiences as a student influence your thinking about what it means to be a good teacher in your discipline?
8. Did you **have any concerns at that time, about your ability to be a good teacher?** If so, what were they? How, if at all, did you **address these concerns?**
9. Please tell me about any formal training and experiences in teaching at the postsecondary level you've had.
PROBE: When did it/they occur?

10. **PROBE:** Did this training influence your views of what it means to be a teacher? Has this training influenced the ways in which you have approached your work as a teacher? If so, how? **Now, let's talk about the present.** How would you describe yourself as a teacher? What adjectives would you use?
11. Have your ideas about what it means to be a good university teacher changed over time? **If yes**, what has influenced those changes? Are there times that you considered changing who you wanted to be as a teacher (your thinking, planning, approaches)? If so, why?
If yes, PROBE: How did you go about these changes, and with what success? What was that journey like for you?
PROBE: Have your role models changed over time? **If they have**, what led to this?
12. When you think about classroom teaching, what do you see as core or essential practices to your work as a teacher?
PROBE: How did you learn these practices? How did you come to view these as core practices?
PROBE: Do those ideas and practices apply to non-classroom interactions in which you may be doing instructional work, for example, your office hours?
13. Do you see a relationship between who you are as a researcher and who you are as a teacher? If so, how would you describe this relationship? If not, why not?
14. **I'D LIKE TO TALK TO YOU ABOUT THE MESSAGES YOU'VE GOTTEN FROM THE UNIVERSITY BOTH FROM YOUR DEPARTMENT AND FROM THE UNIVERSITY. Let's go back to when you were being hired at this institution.** What messages did you get about research and teaching (expectations and preferred practices)? From whom/where did these messages come?
PROBE: Was there anything that surprised you or seemed different from how thought about academic work in your discipline? Did you do anything in response to these messages?
PROBE: Have these messages from your department been consistent over time? If not, how have they changed?
15. **Now, let's talk about your formal orientation to your institution** What messages did you get about research and teaching (expectations and preferred practices)?
PROBE: Was there anything that surprised you, given how you thought about academic work and what you and learned from the department? Did you do anything in response to these messages? If so, what?
16. Is there anything else I should have asked you about your teaching or research that I haven't asked? Is there anything else that you would like to share?

APPENDIX B: Interview Protocol 2 (End of Semester 2)

Follow-up Interview (60 minutes)

1. I'd like to start by asking about your research. Are things going as planned? Since you've been at this institution, have your thoughts around engaging in research as a faculty member in your field evolved? What influenced these shifts?
2. Did any experiences during the semester lead you to think differently about research?
3. When we first met you described yourself as X and Y (remind them of the words they chose in the last interview). Do those adjectives still apply? *Why or why not.*

PROBE: How do you feel about these changes?

4. What are you learning about research practices from others in your department?

PROBE: Did the knowledge gained about research influence how you evaluated yourself as a researcher? How did you approach your work?

PROBE: Do you have unanswered questions about the research aspect of your professional role? If so, what are they? How have you gone about trying to answer these questions? With what results?

5. What went well for you in teaching this past semester? What did not go well?

PROBE: What did you learn from these experiences?

PROBE: Did this knowledge influence how you evaluated yourself as a teacher? How?

PROBE: Did it have an impact on your teaching beliefs and practice? If so, how?

6. Outside of your teaching experience, did you pick up any new knowledge, clues, or cues about who and what you needed to be as a teacher in your department? How did you learn these things (e.g., other departmental faculty, faculty outside of the department, GSIs, undergraduate students, UROP students)?

PROBE: What impact has this knowledge had on you?

PROBE: Did this knowledge influence how (the criteria by which) you evaluated

yourself as a teacher? How?

PROBE: Did it have an impact on your teaching beliefs and practice? If so, how?

7. Is there anything new that happened this semester outside of this institution through which you learned new things about teaching in higher education?

PROBE: What did you learn?

PROBE: Did this influence your own teaching ideas? How?

PROBE: Did this influence your teaching practice? (If so, how?)

8. You've told me about your teaching philosophy. Do you feel that you've been able to fully express that philosophy in your current teaching?

PROBE: If no, what is about (the context) that doesn't allow for that?

PROBE: Have you in any way modified your philosophy as a consequence of your experiences. If so, how?

9. What are the unanswered questions that remain for you about who you need to be and what you need to do as a teacher in your discipline? Have you been trying to answer these questions? With what results?

10. In reviewing your experiences in navigating both teaching and research roles, how much time would you estimate that you spent in each role?

PROBE: Were there any occasions when you felt that there was a conflict between your research and teaching roles? Under what circumstances did you experience such a conflict and what did you do about it?

11. At this stage, how would you describe yourself as an academic professional? Is this where you want to be? If not, what would you like to be able to say about yourself as an academic?

APPENDIX C: Interview Protocol 3 (End of Semester 3)

Follow-up Interview (60 minutes).

1. What was the past semester like for you as you continued to adjust to being a faculty member at UM?

PROBE: How was it in terms of engaging in research?

PROBE: How was your teaching experience?

PROBE: What did you learn from your experiences in navigating these roles in your department? What was comforting? What was particularly challenging?

PROBE: How much time would you estimate that you spent on each role?

PROBE: Were there any occasions on which you felt that there was a conflict between your research and teaching roles? Under what circumstances did you experience such a conflict and what did you do about it?

2. What did you learn about research in your department throughout the past semester? How or from whom did you learn these things?

PROBE: Did the knowledge gained about research influence how you evaluated yourself as a researcher? How you approached your research work? If so how? How do you feel about these changes?

PROBE: Did your experiences during the semester lead you to think differently about or describe yourself as a researcher from when we last met (remind them of the words they chose in the last interview)? *If yes*, please tell me about what happened.

PROBE: Do you have unanswered questions about the research aspect of your professional role? If so, what are they? How have you gone about trying to answer these questions? With what results?

3. What went well for you in teaching this past semester? What did not go well?

PROBE: What did you learn from these experiences?

PROBE: Did this knowledge influence how (the criteria by which) you evaluated yourself as a teacher? How?

PROBE: Did it have an impact on your teaching beliefs and practice? If so, how?

PROBE: Did your experiences during the semester lead you **to think differently about or describe yourself as a teacher** from when we last

met (remind them of the words they chose in the last interview)? *If yes*, please tell me about what happened.

4. Outside of your teaching experience, what, if any, new knowledge, clues, or cues did you pick up through the semester about who and what you needed to be as a teacher in your department? From whom/what experiences did you learn these things (e.g., other departmental faculty, faculty outside of the department, GSIs, undergraduate students, UROP students)?

PROBE: What impact has this knowledge had on you?

PROBE: Did this knowledge influence how (the criteria by which) you evaluated yourself as a teacher? How?

PROBE: Did it have an impact on your teaching beliefs and practice? If so, how?

PROBE: Did you have similar learning experiences in research? If so, how did they occur? What did you learn from them?

PROBE: Did the knowledge gained about research influence how you evaluated yourself as a researcher? Did the knowledge you gained about research influence how you approached your research work? If so how?

PROBE: Having made these adjustments, how do you feel about the academic professional that you are at this stage? In fact, how would you describe that professional overall?

5. Is there anything new that happened this semester outside of this institution through which you learned new things about teaching in higher education?

PROBE: What did you learn?

PROBE: Did this influence your own teaching ideas? How?

PROBE: Did this influence your teaching practice? (If so, how?)

6. We've discussed your teaching philosophy in the past two interviews. Have there been any changes in the extent to which you've been able to express your philosophy in your teaching here?

PROBE: If no, what is about (the context) that doesn't allow for that?

PROBE: Have you in any way modified your philosophy as a consequence of your experiences. If so, how?

7. What are the unanswered questions that remain for you about who you need to be and what you need to do as a teacher in your discipline? What are these questions? How have you gone about trying to answer these questions? With what results?
8. In looking back across your entire time at UM, were there any major changes in your thoughts about who you want to be as an academic? (In terms of research, teaching)

PROBE: How would you describe these changes? If we take each change in turn (list the areas they have mentioned), what would you say has been responsible for these changes in your thinking? What have been the most significant impacts of this altered thinking? To what extent has this changed thinking already affected your work?

9. At this stage, how would you describe yourself as an academic professional – *what descriptors* would you choose?

PROBE: Is this where (who) you want to be? *If not*, what would you like to be able to say about yourself as an academic?

10. If you had to advise prospective faculty members regarding preparation for a faculty position, what would you advise them to do (in the areas of research, teaching)?

PROBE: What experiences (et cetera) would you suggest that they seek out (prioritize)?

11. Have you thought about how you will chart your professional path going forward? What are the kinds of commitments that you think are important to develop and act upon (in research, teaching)?

APPENDIX D: Codebook

Table D.1 Codebook

Teaching			
Conceptions of Teacher Self	TCH_CON_SELF	Conception of self as a teacher – how the participant describes him- or herself as a teacher – past, present, future (aspirational).	The teaching side – caring, passionate for teaching but also for research, maybe – adjectives for myself. This is good ‘cause I haven’t thought about this. I’d say organized, empathetic, goal-oriented, objective-orientated, novice (laughs).

<p>Conceptions of the Exemplary Teacher</p>	<p>TECH_CON_EXPLARY</p>	<p>Participant talks about the elements that make an exemplary teacher – activities, dispositions, habits of mind, habits of work, problem-solving, instructional choices/decisions, values, philosophies, explicit or implicit goals.</p>	<p>Um, I think, uh, well, I can talk more about maybe engineering, so because I have seen really bad teachers and good teachers in engineering. And in, in my case especially, right, because I told you I am interested in practical problems... what makes a difference really in a good teacher, is really being example-driven in engineering.</p>
<p>Teaching Conceptions (nature of teaching work)</p>	<p>TCH_CON_WK</p>	<p>Participant talks about his/her view of teaching work – the purposes to which one should be undertaking the work, the goals of the work, and the activities, approaches, dispositions, and habits of mind that serve the purposes and goals of the work. The includes the must-haves (the critical practices). This would include things like scaffolding.</p>	<p>I mean like my main thing is – for teaching, the main goal should be for them to learn how to learn on their own so that they can go off and teach themselves whatever they need whenever</p>

			they encounter problems in everyday life.
Teaching philosophy	TCH_PHIL	Participant talks about values and beliefs about teaching (how do you separate conceptions). [In revisiting, I thought, oh, this is pretty brief. Then, in considering how I would expand it, the description for conceptions of the work seemed to belong.	Um, so that's probably been something that's brought a lot more color or has received a lot more attention from me now. So I've highlighted that value more. Um, and maybe another one is, again, this kind of whole philosophical thing of the teaching is nonlinear so let's provide the resources well and make it accessible to everybody so they have the same resources, they can get this information in different ways. Um, that's probably

			become more clear and much more pronounced in my philosophy than it was before.
Teaching goals	TCH_GOALS	Participant talks about their goals in teaching generally but also in specific classes or with specific kinds of students. [Perhaps this should simply be refined to teaching goals in specific contexts and the general piece is philosophy].	I mean like ...the main goal should be for them to learn how to learn on their own so that they can go off and teach themselves whatever they need whenever they encounter problems in everyday life.
Teaching affordances (supports – structures in the department that facilitate optimal teaching work)	TCH_AFFORD	Participant talks about resources and structures within the department and university more broadly which facilitate his/her teaching work.	it's just that I did the midterm evaluation and that helped, really helped....that really helped in turning around the class then. Um, since then, actually I've reworked the class again. So this past semester I taught the same class, and I've

			reworked it again.
Teaching constraints (structures et cetera in the department that make it challenging to do optimal teaching or to develop optimally as a teacher.	TCH_CONSTR	Participant talks about resource challenges and structures within the department and university more broadly which make it challenging for the participant to carry out their teaching work.	Um, the other way I would say like it would be nice when you come to a new place to get sort of um, some kind of overview or lecture on how the curriculum at that place works. (I: Okay). Um, I think, you know, that would be nice. I think starting by working with other faculty would be good too.
Teaching experience	TCH_EXPS (PAST/PRES)	Participant mentions any past/present teaching experiences (code suffixes applied as necessary).	There was only a lab class and you gave a 10 to 15 minute lab introduction. And so the actual lecturing part was light and the lab was more about sheep herding (collective laughter), trying to make sure

			everybody could get out of there (I: Right) in a reasonable amount of time.
Past learning experiences	LEARN_EXPS_COLL	Learning experiences as a college student undergraduate and grad school).	I like the teacher on the stage presenting to me but having lots of available hours. It's the one professor – the professor that had swung me into switching my major to Physics and really, I felt gave me the confidence and the interest in going to grad school early on – he was that. He had very long office hours and he created a comfortable space that I would bring questions outside of the class.
High school experiences with teachers/teachi	HS_EXPS	Experiences in high school learning/academic preparation.	I think I had a little bit of catching up to do in my

<p>ng and learning experiences.</p>			<p>first semester just coming out of high school. I don't think that I had – I wasn't as strong as my peers. So he was patient to – to sort of step out and teach me some tips. So like for example, when I did algebra it was very disorganized. (I: Okay). And so even though conceptually I had no problem and I had great grades and good SAT scores and all of that but it doesn't necessarily mean that you have – you're – I don't know how good those metrics are – that is high school GPA and SAT at preparing you for</p>
-------------------------------------	--	--	--

			college-level curriculum.
Teacher Training	TCH_TRAIN	Participant talks about any formal teacher training (even of the most modest kind).	And those would be, you know – they could range from using technology in the classroom to addressing different learning styles. So there's a lot more – trying to reflect on teaching and trying to understand teaching in a deeper sense – that was fostered through this fellowship.
Personal study about teaching	TCH_PERS_STUDY	Participant talks about personal research done.	Well, I'm uh – the book I'm using is uh (unintelligible) by Felder. And he wrote a book which is, I think, the book in STEM that just came out about teaching and learning in STEM. So I'm using that as a resource

			and it's perfect because he wrote the textbook for my class and he wrote the learning textbook.
Teaching Across Disciplines	TCH_MULTI_DISC	Participant talks about anything having to do with teaching at the intersection of two or more disciplines.	Well yeah, it's hard because whenever you include the biology, things get a little softer, you know, there's a little bit more uncertainty, a little bit more difficult – um, but then like I said, on the flip side, you want them to have these like hard engineering skills. I mean I don't know what – I'm not sure I always made the best choices (participant laughs) but 'um, um, yeah, sometimes I felt

			disorganized trying to combine the two I guess.
Active Teaching and Learning	TCH_ACT	Participant talks about active teaching and learning	I've seen a little bit here and I've seen in graduate school. (I think it depends on – in terms of active learning – I think it depends on the course and the instructor. (And I can imagine in a future that blends – that blends or has, you know, both traditional teaching and active learning projects obviously lend themselves to active learning.
Diversity and Inclusion	TCH_DIV_INCL	Participant talks about issues of diversity and inclusion that have come up in teaching or trying to understand what might be required in considering issues of diversity and inclusion.	In terms of like – I don't know if you see the racial minorities – you probably see that – or maybe like maybe African-

			American students, I don't – I don't have any in my class. So, yeah, I don't – I didn't have any African-Americans. I didn't have any, um, Native Americans.
Teaching grad students versus undergrads (this may not be needed at all)	TCH_STUD_TYPE	Participant talks about the ways in which he or she views and/or approaches the teaching of graduate vs undergraduate students or undergraduate vs graduate students; teaching students of varying backgrounds and preparation levels.	Yeah I mean effective teaching is hard. It's like, how do you make sure that students understand what you're saying? How do you know what background they have? Especially master students. Undergrads, I know what class they've taken, I can look out what the material is, what they're supposed to know. It's always hard to know if it was taught

			properly, how much of it they got?
Engaging in the Teaching Work (content choices, responses to challenges, instructional decisions)	TCH_DECS	Participant discusses the cut and thrust of teaching work past and present as well as choices/adjustments/changes it might be desirable/necessary to make in the future.	Ten, and um, I – I’d only taught undergrad courses before so my expectation was that the students should be capable of, um, undertaking more complicated assignments and that probably wasn't a fair expectation ...
Teaching self-efficacy	TCH_SELF_EFF	Participant talks about a sense of skill, ability, competence in any aspect of teaching.	And then he was – he was next to me and he hears and he follows me into the office – Like, “Oh, yeah you got all 4.85s, basically. And seriously, like wow! I mean that's really good apparently... And then my department chair said, "Okay, you

			have the formula." I just (thought?), "Okay, I have the formula, I can do this, I just need to do it again (I: Right) and I just need to keep that up for next time.
Teaching conversations with colleagues	TCH_CONV_INT/EXT	Participant talks about conversations had with colleagues (both internal and external)	So this course, we, uh, we, we – I talk to my colleague a bit about, um, what – what we want to get through, how far we want to get through the material by the end of the semester, homeworks – this and that. So we talk quite a bit about that.
Teaching conversations with non-faculty persons	TCH_CONVER_NONCOLLEG	Participant mentions conversations about teaching had with people who are not colleagues.	Rudolf Steiner School. You know they are – their kindergartners, they plant the seeds of just the way that they,

			<p>they keep their notebooks or tell stories. If you just looked at it from the outside, it would look like, oh, you're just telling stories or whatever, but it's everything they do has intention and thought and planting the seeds – thinking two, three, four years down the road and how that's a foundation for that. [They] learn their three times tables by standing in a circle and tossing a ball and, and they find all the patterns in math. And so everything, I mean they bring games and play into learning really well. So how do you extend</p>
--	--	--	--

			those ideas to higher education, I don't know, but it could be motivating, I think to do so.
What went well and what didn't go well in teaching.	TCH_POS_NEG_EXPS	Participant talks about what went well and what didn't go well or was challenging in teaching.	Um, I think I like to teach which you know wasn't a given because I hadn't taught a whole class before and I think – um, I think for me, you know, preparing and all this is always just a lot of work, whatever. And it's not that enjoyable. (Garbled). But I really like being like standing in front of the class and just like rolling... This was really kind of nice to be like, “Oh, wow! This is cool. I really like it!”

<p>Teaching expectations for tenure</p>	<p>TCH_EXPTN_TEN</p>	<p>Participant talks about his/her understanding of teaching expectations.</p>	<p>Teaching – teaching has to be, um, good, is what I was told, but it, uh, shouldn't jeopardize research in any significant way. Um, again, good teaching is another ambiguous thing 'cause it seems to be more about what are the teaching scores and that's what defines a good teaching part or whatever - whatever I'll be.</p>
<p>Teaching experiences in the future</p>	<p>TCH_FUT</p>	<p>Participant talks about teaching future classes/and or how he or she might approach this work or improve on it.</p>	<p>And, um, it might still feature in homework sets. I think that's kind of a neat application, but also maybe having them put together a poster on it, right. Have a group of four or five of them, and</p>

			they'll put a poster together which gives a history of the engine that applies their analysis, right, that they learned from the class...it would be almost a professional poster that would live there permanently
Academic Professional (General)			
Motivation to attend grad school	AC_GRAD_SCHL_MOTN	Participant talks about motivation to attend grad school.	And then – so then, I actually had a master's lined up at [name of school redacted]. So, as an undergrad, I wasn't even thinking of doing a PhD, like, you know, it was a Master's lined up at Cornell – one-year Master's like an M. Eng and then I did my Master's and basically

			halfway through the Masters, my professor like talked to me it was like, you know, you really have a profile to do a PhD so you should try – consider doing a Ph.D.”
Motivation to become an academic (pull & push factors)	AC_PROF_MOTN	Participant talks about how they became interested in becoming a faculty member (pull and push factors), how the interest was sustained et cetera.	Um, um, I would say another part of it was working with graduate students and, you know, the people you surround yourself with in general. I know that you know, being surrounded by other faculty and then the students who are young and, you know, eager to learn, that was the type of environment I wanted to be in.
How faculty describe	AC_PROF_ORALL_SELF	Participant provides an overall description of how	Um, still I’m uncertain,

<p>themselves as overall academic professionals.</p>		<p>they see themselves as an academic.</p>	<p>um, but hopeful ...but definitely still uncertain, now, whether I – I would meet the mark and I still feel, you know, uncertain.).</p>
<p>Early Academic Identity</p>	<p>AC_IDENT_EARLY</p>	<p>Academic identity in grade school and undergraduate years.</p>	<p>.. I didn't know what I was good at 'cause I remember talking to him) ...after kind of maybe a disappointing performance and I thought – well and I couldn't answer his question.</p>
<p>Personal ways of structuring or organizing professional work.</p>	<p>AC_PERS_STRUCS_WK</p>	<p>Participant talks about ways of structuring work – time management, creating workflow and systems to get things done.</p>	<p>[I] really prefer having that like – like that division – you know, a semester where I can focus and not feel guilty about focusing entirely on teaching which is pretty much what I did.</p>

Culture of department	AC_CULT_CONTEXT	Participant talks about the collegial atmosphere, norms, cultural dimensions.	Example: participant narrates stories that mention the same names repeatedly as go-to people or people he might float an idea by.
Grad research mentors (mentoring) of the participant	RES_MENT	Experiences with and learning from past mentors.	...one thing: giving students flexibility, which I learned from my advisor. And then in general, um, treating the students in a way that would, would enhance their self-confidence.
Participant's mentoring of grad or other research mentees.	RES_MENTOR	Participant talks about mentoring research mentees e.g., the kind of guidance and structure provided et cetera.	So then it's time to take those results, put them in a form that we can discuss it and tease out what's interesting and then find questions or find answers.
Conceptions of Research Work	RES_CON_WK	The ways in which the participant conceived of research – the nature of the work involved.	Yeah. I mean, okay, so I mean strong literature review. You just need to

			be an expert in what's already been done. Then, uh, identifying what the problem is...
Reflections on navigating the research aspect of the faculty role.	RES_NAV	The ways in which participant navigated research role especially grant-getting.	I mean I'm doing the best I can. I don't feel like there were some things I wanted to do that I didn't get to do. I wanted to submit a grant, but then I just couldn't meet the deadline
Institutional Messaging	AC_MESSAGE	Messaging from institution regarding expectations for elements of work.	
Mentorship	AC_MENTOR	Collegial mentoring	He said what's wrong with everyone getting an A if everyone knows the material? (I: Oh). I'm like, 'Yeah, there is nothing wrong with that', right.
Time	TIME	Any reference to time challenges, time management et cetera.	Yeah, yeah. Then I was like, "You know what, if I can get like PhD students

			to help me, and give lectures, and give me like their code” – ‘cause I have – at first I was like daunted because I have to do all these – I have to do all this coding and make all these modules, and this is so time- consuming.
--	--	--	--

APPENDIX E: Email Invitation to the Study

Subject: Requesting Your Participation in Dissertation Study

Dear Professor [Name],

I am inviting you to participate in a dissertation study titled, “Professional Identity Development of New Engineering Faculty.” I am a doctoral candidate in the Center for the Study of Higher and Postsecondary Education at the University of Michigan and my research focuses broadly on faculty work in higher education institutions, particularly on how faculty members engage in research, teaching, and service.

In this study, I will be exploring how new engineering faculty members’ professional identities evolve during the early years of their faculty careers in research universities. If you agree to participate, I will interview you three times during the coming academic year about your experiences in your department and the university as a whole, and talk with you at length about your research and teaching activities. This interview data would be part of a larger data corpus created from the combined interviews of all the study participants. All information collected during the study will be confidential. Your identity will be known only to me and members of my dissertation committee. For my dissertation and reports on it, I would work with you to mask any potentially identifying information that was relevant to the study. As a small token of my appreciation you would receive a total of \$150.00 in Amazon gift cards for your participation in the study.

Please reply to this email to let me know if you are interested in participating or if I can answer questions about the study. If I don’t hear from you by July 14th, I’ll check in again.

Thank you for considering my request.

Yours sincerely,

Jennifer R. Pollard

References

- AAU (2017) A progress toward achieving systemic change: A five-year status report on the AAU undergraduate STEM education initiative. <https://www.aau.edu/sites/default/files/AAU-Files/STEM-Education-Initiative/STEM-Status-Report.pdf>
- Adler, S. R., Chang, A., Loeser, H., Cooke, M., Wang, J., & Teherani, A. (2015). The impact of intramural grants on educators' careers and on medical education innovation. *Academic Medicine, 90*(6), 827-831.
- Akerson, V. L., Medina, V. F., & Wang, N. (2002). A collaborative effort to improve university engineering instruction. *School Science and Mathematics, 102*(8), 405-419. <https://doi.org/10.1111/j.1949-8594.2002.tb17892.x>
- Andrew, N., Ferguson, D., Wilkie, G., Corcoran, T., & Simpson, L. (2009). Developing professional identity in nursing academics: The role of communities of practice. *Nurse Education Today, 29*(6), 607-611. doi:10.1016/j.nedt.2009.01.012
- Archer, L. (2008a). Younger academics' constructions of 'authenticity', 'success' and professional identity. *Studies in Higher Education, 33*(4), 385-403. <https://doi.org/10.1080/03075070802211729>
- Archer, L. (2008b). The new neoliberal subjects? Young/er academics' constructions of professional identity. *Journal of Education Policy, 23*(3), 265-285. <https://doi.org/10.1080/02680930701754047>
- Arvaja, M. (2018). Tensions and striving for coherence in an academic's professional identity work. *Teaching in Higher Education, 23*(3), 291-306. <https://doi.org/10.1080/13562517.2017.1379483>
- Ash, D., Brown, C., Kluger-Bell, B., & Hunter, L. (2009). Creating Hybrid Communities Using Inquiry as Professional Development for College Science Faculty. *Journal of College Science Teaching, 38*(6), 68-76. <https://doi.org/10.1080/02680930701754047>
- Austin, A. E. (1990). Faculty cultures, faculty values. *New Directions for Institutional Research, 68*, 61-74.

- Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, 73 (1), 94-122.
- Austin, A. E., Campa, H., Pfund, C., Gillian-Daniel, D. L., Mathieu, R., & Stoddart, J. (2009). Preparing STEM doctoral students for future faculty careers. *New Directions for Teaching and Learning*, 117, 83-95. [https://doi: 10.1002/tl.346](https://doi.org/10.1002/tl.346)
- Bailey, J. M., & Nagamine, K. (2012). Experiencing conceptual change about teaching: A case study from astronomy. *American Journal of Physics*, 80(6), 542-551. <https://doi.org/10.1119/1.3699064>
- Baker, L. A., Chakraverty, D., Columbus, L., Feig, A. L., Jenks, W. S., Pilarz, M., & Wesemann, J. L. (2014). Cottrell Scholars Collaborative New Faculty Workshop: Professional development for new chemistry faculty and initial assessment of its efficacy. *Journal of Chemical Education*, 91(11), 1874-1881. <https://doi.org/10.1021/ed500547n>
- Baker, V. L., & Lattuca, L. R. (2010). Developmental networks and learning: Toward an interdisciplinary perspective on identity development during doctoral study. *Studies in Higher Education*, 35(7), 807-827. [https://doi: 10.1080/03075070903501887](https://doi.org/10.1080/03075070903501887)
- Baldwin, R., DeZure, D., Shaw, A., & Moretto, K. (2008). Mapping the terrain of mid-career faculty at a research university: Implications for faculty and academic leaders. *Change: The Magazine of Higher Learning*, 40(5), 46-55. <https://doi.org/10.3200/CHNG.40.5.46-55>
- Bathgate, M. E., Aragón, O. R., Cavanagh, A. J., Waterhouse, J. K., Frederick, J., & Graham, M. J. (2019). Perceived supports and evidence-based teaching in college STEM. *International Journal of STEM Education*, 6(1), 1-14. <https://doi.org/10.1186/s40594-019-0166-3>
- Bathmaker, A. M., & Avis, J. (2005). Becoming a lecturer in further education in England: The construction of professional identity and the role of communities of practice. *Journal of Education for Teaching*, 31(1), 47-62. <https://doi.org/10.1080/02607470500043771>
- Beauchamp, C., & Thomas, L. (2009). Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Cambridge Journal of Education*, 39(2), 175-189. [https://doi: 10.1080/03057640902902252](https://doi.org/10.1080/03057640902902252)
- Beijaard, D., Meijer, P. C., & Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and Teacher Education*, 20(2), 107-128. <https://doi.org/10.1016/j.tate.2003.07.001>

- Billett, S. (2001). Knowing in practice: Re-conceptualising vocational expertise. *Learning and Instruction, 11*(6), 431-452.
- Billett, S. (2008). Learning throughout working life: A relational interdependence between personal and social agency. *British Journal of Educational Studies, 56*(1), 39-58. <https://doi.org/10.1111/j.1467-8527.2007.00394.x>
- Billot, J. (2010). The imagined and the real: Identifying the tensions for academic identity. *Higher Education Research & Development, 29*(6), 709-721.
- Blackburn, R. T., & Fox, T. G. (1974). The Socialization of a Medical School Faculty. <https://eric-ed-gov.proxy.lib.umich.edu/?id=ED090903>
- Blanton, M. L., & Stylianou, D. A. (2009). Interpreting a community of practice perspective in discipline-specific professional development in higher education. *Innovative Higher Education, 34*(2), 79-92. <https://doi.org/10.1007/s10755-008-9094-8>
- Bolden, R., Gosling, J., & O'Brien, A. (2014). Citizens of the academic community? A societal perspective on leadership in UK higher education. *Studies in Higher Education, 39*(5), 754-770. <https://doi.org/10.1080/03075079.2012.754855>
- Borrego, M., Froyd, J. E., & Hall, T. S. (2010). Diffusion of engineering education innovations: A survey of awareness and adoption rates in US engineering departments. *Journal of Engineering Education, 99*(3), 185-207. <https://doi.org/10.1002/j.2168-9830.2010.tb01056.x>
- Bottoms, S., Pegg, J., Adams, A., Wu, K., Smith Risser, H., & Kern, A. L. (2013). Mentoring from the outside: The role of a peer mentoring community in the development of early career education faculty. *Mentoring & Tutoring: Partnership in Learning, 21*(2), 195-218. <https://doi.org/10.1080/13611267.2013.813730>
- Bouwma-Gearhart, J. (2012). Research university STEM faculty members' motivation to engage in teaching professional development: Building the choir through an appeal to extrinsic motivation and ego. *Journal of Science Education and Technology, 21*(5), 558-570. <https://doi.org/10.1007/s10956-011-9346-8>
- Braxton, J. M. & Hargens, L. L. (1996). "Variation Among Academic Disciplines: Analytical Frameworks and Research." In J. C. Smart (ed.), *Higher education: Handbook of theory and research*, Vol. XI. Agathon Press.
- Braxton, J. M., Jones, W. A., Hirschy, A. S., & Hartley III, H. V. (2008). The role of active learning in college student persistence. *New Directions for Teaching and Learning, (115)*, 71-83. <https://doi.org/10.1002/tl.326>

- Broggt, E. (2007). Instruction as a scientific experiment: A professional development case study of a professor changing the introductory astronomy course for non-science majors. *Astronomy Education Review*, 6(2), 20-31.
- Brown, A. (2018). Engaging students as partners in developing online learning and feedback activities for first-year fluid mechanics. *European Journal of Engineering Education*, 43(1), 26-39.
- Brown, P. L., Abell, S. K., Demir, A., & Schmidt, F. J. (2006). College science teachers' views of classroom inquiry. *Science education*, 90(5), 784-802. <https://doi.org/10.1002/sce.20151>
- Brownell, S. E., & Tanner, K. D. (2012). Barriers to faculty pedagogical change: Lack of training, time, incentives, and tensions with professional identity? *CBE-Life Sciences Education*, 11(4), 339-346. <https://doi.org/10.1187/cbe.12-09-0163>
- Burton, S., Boschmans, S. A., & Hoelson, C. (2013). Self-perceived professional identity of pharmacy educators in South Africa. *American Journal of Pharmaceutical Education*, 77(10). Article 210.
- Campbell, C. M., & O'Meara, K. (2014). Faculty agency: Departmental contexts that matter in faculty careers. *Research in Higher Education*, 55(1), 49-74. <https://doi.org/10.1007/s11162-013-9303-x>
- Carrillo, C., & Baguley, M. (2011). From schoolteacher to university lecturer: Illuminating the journey from the classroom to the university for two arts educators. *Teaching and Teacher Education*, 27(1), 62-72. <https://doi.org/10.1080/0305764X.2017.1394982>
- Cawyer, C. S., Simonds, C., & Davis, S. (2002). Mentoring to facilitate socialization: The case of the new faculty member. *International Journal of Qualitative Studies in Education*, 15(2), 225-242. <https://doi.org/10.1080/09518390110111938>
- Ceglie, R. J., & Settlage, J. (2019). Developing as a college science teacher: Using identity to examine transformation. *International Journal for the Scholarship of Teaching and Learning*, 13(2), 13. <https://doi.org/10.20429/ijstl.2019.130213>
- Charmaz, K. (1996). The search for meanings – grounded theory. In J.A. Smith, R. Harré & L. Langehove (Eds.), *Rethinking Methods in Psychology* (pp. 27-49). Sage Publications.
- Churchman, D., & King, S. (2009). Academic practice in transition: Hidden stories of academic identities. *Teaching in Higher Education*, 14(5), 507-516. <https://doi.org/10.1080/13562510903186675>

- Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research*. Jossey-Bass.
- Clandinin, D. J. & Rosiek (2007). Mapping a landscape of narrative inquiry: Borderland spaces and tensions. In D.J. Clandinin (Ed.), *Handbook of narrative inquiry: Mapping a methodology* (pp. 35-75). Sage Publications.
- Clarke, C., Knights, D., & Jarvis, C. (2012). A labour of love? Academics in business schools. *Scandinavian Journal of Management*, 28(1), 5-15.
<https://doi.org/10.1016/j.scaman.2011.12.003>
- Clegg, S. (2008). Academic identities under threat? *British Educational Research Journal*, 34(3), 329-345. <https://doi.org/10.1016/10.1080/01411920701532269>
- Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19(5), 2-14.
- Connelly, F. M., Clandinin, D. J., & He, M. F. (1997). Teachers' personal practical knowledge on the professional knowledge landscape. *Teaching and Teacher Education*, 13(7), 665-674.
- Clandinin, D. J. (2006). Narrative inquiry: A methodology for studying lived experience. *Research Studies in Music Education*, 27(1), 44-54.
<https://doi.org/10.1177/1321103X060270010301>
- Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology*, 13(1), 3-21.
- Corcoran, M., & Clark, S. M. (1984). Professional socialization and contemporary career attitudes of three faculty generations. *Research in Higher Education*, 20(2), 131-153.
- Cox, B. E., McIntosh, K. L., Terenzini, P. T., Reason, R. D., & Quaye, B. R. L. (2010). Pedagogical signals of faculty approachability: Factors shaping faculty–student interaction outside the classroom. *Research in Higher Education*, 51(8), 767-788.
<https://doi.org/10.1007/s11162-010-9178-z>
- John, W. C., & John, W. C. (2007). *Qualitative inquiry and research design: Choosing among five approaches*. Sage.
- Daviduke, N. (2018). Growing into pedagogical partnerships over time and across disciplines: My experience as a non-STEM student consultant in STEM courses. *International Journal for Students as Partners*, 2(2), 151-156.

- DeChenne, S. E., Enochs, L. G., & 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.
- Donald, J. (2002). *Learning to think: Disciplinary Perspectives*. Jossey Bass.
- Duffy, R. (2013). Nurse to educator? Academic roles and the formation of personal academic identities. *Nurse Education Today*, 33(6), 620-624.
<http://doi.org/10.1016/j.nedt.2012.07.020>
- Dunn, M., Loch, B., & Scott, W. (2018). The effectiveness of resources created by students as partners in explaining the relevance of mathematics in engineering education. *International Journal of Mathematical Education in Science and Technology*, 49(1), 31-45. <https://doi.org/10.1080/0020739X.2017.1338771>
- Elbaz-Luwisch, F. (2007). Studying Teachers' Lives and Experience: Narrative Inquiry into K–12 Teaching. In D.J. Clandinin (Ed.), *Handbook of narrative inquiry: Mapping a methodology* (pp. 357-382). Thousand Oaks, CA: Sage Publications.
- Fairweather, J. S. (2005). Beyond the rhetoric: Trends in the relative value of teaching and research in faculty salaries. *The Journal of Higher Education*, 76(4), 401-422.
<https://doi.org/10.1080/00221546.2005.11772290>
- Fairweather, J. (2008). Linking evidence and promising practices in science, technology, engineering, and mathematics (STEM) undergraduate education. *Board of Science Education, National Research Council*. The National Academies.
- Fanghanel, J., & Trowler, P. (2008). Exploring academic identities and practices in a competitive enhancement context: a UK-based case study. *European Journal of Education*, 43(3), 301-313.
- Finelli, C. J., Richardson, K. M., & Daly, S. R. (2013). Factors that influence faculty motivation of effective teaching practices in engineering. In *Proc. ASEE Annual Conference. Expo* (pp. 1-11).
- Fitzmaurice, M. (2013). Constructing professional identity as a new academic: A moral endeavour. *Studies in Higher Education*, 38(4), 613-622.
<https://doi.org/10.1080/03075079.2011.594501>
- Fox, S. (2000). Communities Of Practice, Foucault And Actor-Network Theory. *Journal of Management Studies*, 37(6), 853-868.

- Fuller, A., Hodkinson, H., Hodkinson, P., & Unwin, L. (2005). Learning as peripheral participation in communities of practice: a reassessment of key concepts in workplace learning. *British Educational Research Journal*, 31(1), 49-68.
<https://www.jstor.org/stable/1502156>
- Kember, D. (1997). *A Reconceptualisation of the Research into University Academics Conceptions of Teaching. Learning and Instruction*, 7, 255-275.
- Guzmán-Valenzuela, C., & Barnett, R. (2013). Academic fragilities in a marketised age: The case of Chile. *British Journal of Educational Studies*, 61(2), 203-220.
<https://doi.org/10.1080/00071005.2013.776006>
- Hadgraft, R. G., Francis, B., Lawson, J., Jarman, R., Stewart, C., Hsieh, I., & Jenkins, G. (2017). Curriculum transformation with students as partners. Proceedings of the Annual Conference of the Australasian Association for Engineering. Australasian Association for Engineering Education.
- Hammerness, K., Darling-Hammond, L., & Bransford, J. (2005). How teachers learn and develop. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 358–389). Jossey-Bass.
- Harman, K., & McDowell, L. (2011). Assessment talk in design: The multiple purposes of assessment in HE. *Teaching in Higher Education*, 16(1), 41-52.
<https://doi.org/10.1080/13562517.2010.507309>
- Harper, R. P., Weston, T. J., & Seymour, E. (2019). Student responses to problematic STEM teaching methods. In E. Seymour & A.B. Hunter (Eds.), *Talking about leaving revisited* (pp. 149-195). Springer.
- Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching*, 48(8), 952-984. <https://doi.org/10.1002/tea.20439>
- Henderson, C., & Dancy, M. H. (2007). Barriers to the use of research-based instructional strategies: The influence of both individual and situational characteristics. *Physical Review Special Topics-Physics Education Research*, 3(2), 020102.
<https://link.aps.org/doi/10.1103/PhysRevSTPER.3.020102>
- Hiller, S. C., & Nelson Laird, T. F. (2021). Disciplinary differences in faculty emphasis on deep approaches to learning. Proceedings of the Annual Meeting of the American Educational Research Association, Virtual, 2021.

- Hockings, C., Cooke, S., Yamashita, H., McGinty, S., & Bowl, M. (2009). 'I'm neither entertaining nor charismatic...' negotiating university teacher identity within diverse student groups. *Teaching in Higher Education, 14*(5), 483-494. <https://doi.org/10.1080/13562510903186642>
- Holland, D., Lachicotte, W., Skinner, D., & Cain, C. (1998). *Agency and identity in cultural worlds*. Harvard University Press.
- Hora, M. T., Bouwma-Gearhart, J., & Park, H. J. (2017). Data driven decision-making in the era of accountability: Fostering faculty data cultures for learning. *The Review of Higher Education, 40*(3), 391-426. <https://doi.org/10.1353/rhe.2017.0013>
- Huisman, J., & Currie, J. (2004). Accountability in higher education: Bridge over troubled water?. *Higher Education, 48*(4), 529-551. <https://doi.org/10.1023/B:HIGH.0000046725.16936.4c>
- Hunter, A. B. (2019). Why undergraduates leave STEM majors: Changes over the last two decades. In E. Seymour & A.B. Hunter (Eds.), *Talking about leaving revisited* (pp. 87-114). Springer, Cham.
- Seymour, E. & Hunter, A. B. (2019). Why undergraduates leave STEM majors: Changes over the last two decades. In E. Seymour and A. B. Hunter (Eds.), *Talking about leaving revisited* (pp. 87-114). Springer.
- Ibarra, H. (2004). Our many possible selves: Re-working Our identities to reinvent our careers. INSEAD.
- Indorf, J. L., Benabentos, R., Daubenmire, P., Murasko, D., Hazari, Z., Potvin, G., & Stanford, J. S. (2021). Distinct factors predict use of active learning techniques by pre-tenure and tenured STEM faculty. *Journal of Geoscience Education, 1*-16.
- Janke, E. M., & Colbeck, C. L. (2008). Lost in translation: Learning professional roles through the situated curriculum. *New Directions for Teaching and Learning, 2008*(113), 57-68. <https://doi.org/10.1002/tl.308>
- Jauregui, J., O'Sullivan, P., Kalishman, S., Nishimura, H., & Robins, L. (2019). Remooring: A qualitative focus group exploration of how educators maintain identity in a sea of competing demands. *Academic Medicine, 94*(1), 122-128. doi: 10.1097/ACM.0000000000002394
- Jawitz, J. (2007). New academics negotiating communities of practice: Learning to swim with the big fish. *Teaching in higher education, 12*(2), 185-197. <https://doi.org/10.1080/13562510701191943>

- Jawitz, J. (2009a). Academic identities and communities of practice in a professional discipline. *Teaching in Higher Education*, 14(3), 241-251.
<https://doi.org/10.1080/13562510902898817>
- Jawitz, J. (2009b). Learning in the academic workplace: The harmonization of the collective and the individual habitus. *Studies in Higher Education*, 34(6), 601-614.
<https://doi.org/10.1080/03075070802556149>
- Jamieson, L. H., & Lohmann, J. R. (2012). Innovation with impact: Creating a culture for scholarly and systematic innovation in engineering education. *American Society for Engineering Education*. https://www-asee-org.proxy.lib.umich.edu/member-resources/reports/CCSSIE/CCSSIEE_Phase1Report_June2009.pdf
- Jazvac-Martek, M. (2009). Oscillating role identities: The academic experiences of education doctoral students. *Innovations in Education and Teaching International*, 46(3), 253-264.
<https://doi.org/10.1080/14703290903068862>
- Jones, A. (2010). Not some shrink-wrapped beautiful package: Using poetry to explore academic life. *Teaching in Higher Education*, 15(5), 591-606.
<https://doi.org/10.1080/13562517.2010.491902>
- Khan, H. K. (2011). Becoming teacher educators in Pakistan: voices from the government colleges of education. *Journal of Education for Teaching*, 37(3), 325-335.
<https://doi.org/10.1080/02607476.2011.588022>
- Kosnik, C., Menna, L., Dharamshi, P., Miyata, C., & Beck, C. (2013). A foot in many camps: Literacy teacher educators acquiring knowledge across many realms and juggling multiple identities. *Journal of Education for Teaching*, 39(5), 523-540.
<http://doi.org/10.1080/02607476.2013.844954>
- Kramp, M. K. (2003). Exploring life and experience through narrative inquiry. In K. DeMarais, K. & S.D. Lapan (Eds.), *Foundations for research* (pp. 119-138). Routledge.
- Kreber, C. (2010). Academics' teacher identities, authenticity, and pedagogy. *Studies in Higher Education*, 35(2), 171-194. doi: 10.1080/03075070902953048
- Kumar, K., Roberts, C., & Thistlethwaite, J. (2011). Entering and navigating academic medicine: Academic clinician-educators' experiences. *Medical Education*, 45(5), 497-503.
 doi:10.1111/j.1365-2923.2010.03887.x
- Leslie, K., Lingard, L., & Whyte, S. (2005). Junior faculty experiences with informal mentoring. *Medical Teacher*, 27(8), 693-698.
<https://doi.org/10.1080/01421590500271217>

- Lieff, S., Baker, L., Mori, B., Egan-Lee, E., Chin, K., & Reeves, S. (2012). Who am I? Key influences on the formation of academic identity within a faculty development program. *Medical Teacher, 34*(3), e208-e215. <https://doi.org/10.3109/0142159X.2012.642827>
- Levin, J. S., & Hernandez, V. M. (2014). Divided identity: Part-time faculty in public colleges and universities. *The Review of Higher Education, 37*(4), 531-557.
<https://doi.org/10.1353/rhe.2014.0033>
- Lindblom-Ylanne, S., Trigwell, K., Nevgi, A., & Ashwin, P. (2006). How approaches to teaching are affected by discipline and teaching context. *Studies in Higher Education, 31*(03), 285-298. <https://doi.org/10.1080/03075070600680539>
- Liu, Y., & Xu, Y. (2011). Inclusion or exclusion?: A narrative inquiry of a language teacher's identity experience in the 'new work order of competing pedagogies. *Teaching and Teacher Education, 27*(3), 589-597.
- Lortie, D. (1975). *Schoolteacher: A sociological study*. University of Chicago Press.
- Luft, J. A., Kurdziel, J. P., Roehrig, G. H., & Turner, J. (2004). Growing a garden without water: Graduate teaching assistants in introductory science laboratories at a doctoral/research university. *Journal of Research in Science Teaching, 41*(3), 211-233.
<https://doi.org/10.1002/tea.20004>
- Lund, T. J., & Stains, M. (2015). The importance of context: an exploration of factors influencing the adoption of student-centered teaching among chemistry, biology, and physics faculty. *International Journal of STEM Education, 2*(1), 1-21.
<https://doi.org/10.1186/s40594-015-0026-8>
- Magolda, M. B. B., & King, P. M. (2004). *Learning partnerships: Theory and models of practice to educate for self-authorship*. Stylus Publishing, LLC..
- Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist, 41*(9), 954.
- Martensson, K., Roxå, T., & Olsson, T. (2011). Developing a quality culture through the scholarship of teaching and learning. *Higher Education Research & Development, 30*(1), 51-62. <https://doi.org/10.1080/07294360.2011.536972>
- Mathe, L., & Hapazari, J. (2019). The Development of Professional Identity among Lesotho University Lecturers. *International Journal of Scientific and Research Publications*.
<http://doi.org/10.29322/IJSRP,9,2019>.

- Mathieu, R. D., Austin, A. E., Barnicle, K. A., Campa III, H., & McLinn, C. M. (2020). The center for the integration of research, teaching, and learning: a national-scale network to prepare stem future faculty. *New Directions for Teaching and Learning*, 163, 45-53. <https://doi.org/10.1002/tl.20416>
- Mathison, K. (2015). Effects of the performance management context on Australian academics' engagement with the scholarship of teaching and learning: A pilot study. *The Australian Educational Researcher*, 42(1), 97-116. doi 10.1007/s13384-014-0154-z
- McAlpine, L., Amundsen, C., & Turner, G. (2014). Identity-trajectory: Reframing early career academic experience. *British Educational Research Journal*, 40(6), 952-969. <https://doi.org/10.1002/berj.3123>
- McCune, V. (2019). Academic identities in contemporary higher education: Sustaining identities that value teaching. *Teaching in Higher Education*, 26(1), 20-35. <https://doi.org/10.1080/13562517.2019.1632826>
- McGregor, D., Hooker, B., Wise, D., & Devlin, L. (2010). Supporting professional learning through teacher educator enquiries: An ethnographic insight into developing understandings and changing identities. *Professional development in education*, 36(1-2), 169-195. <http://doi.org/10.1080/19415250903457117>
- McGroarty, E., Jimenez, T. R., Linley, J., Li, Y., Granberry-Russell, P., & Williams, K. P. (2014). External funding: Impact on promotion and retention of STEM assistant professors. *Journal of Academic and Business Ethics*, 8, 1-17. <https://doi.org/10.1016/j.ijnurstu.2009.05.013>
- Merriam, S. B. (2002). Introduction to qualitative research. In S. B. Merriam (Ed.), *Qualitative research in practice: Examples for discussion and analysis* (pp. 3-17). Jossey-Bass.
- Mewborn, D. S., & Tyminski, A. M. (2006). Lortie's apprenticeship of observation revisited. *For the Learning of Mathematics*, 26(3), 23-32.
- Momsen, J., Offerdahl, E., Kryjevskaiia, M., Montplaisir, L., Anderson, E., & Grosz, N. (2013). Using assessments to investigate and compare the nature of learning in undergraduate science courses. *CBE—Life Sciences Education*, 12(2), 239-249. <https://doi.org/10.1187/cbe.12-08-0130>
- Mortimer, J. T., & Simmons, R. G. (1978). Adult socialization. *Annual Review of Sociology*, 4(1), 421-454.

- Murakami-Ramalho, E., Militello, M., & Piert, J. (2013). A view from within: How doctoral students in educational administration develop research knowledge and identity. *Studies in Higher Education, 38*(2), 256-271. <http://doi.org/10.1080/03075079.2011.578738>
- Murphy, S., McGlynn-Stewart, M., & Ghafouri, F. (2014). Constructing our identities through a writing support group: Bridging from doctoral students to teacher educator researchers. *Studying Teacher Education, 10*(3), 239-254. <https://doi.org/10.1080/17425964.2014.949656>
- Murray, J., & Male, T. (2005). Becoming a teacher educator: Evidence from the field. *Teaching and Teacher Education, 21*(2), 125-142.
- Neumann, A. (2009). *Professing to learn: Creating tenured lives and careers in the American research university*. Johns Hopkins University Press.
- Neumann, R., Parry, S., & Becher, T. (2002). Teaching and learning in their disciplinary contexts: A conceptual analysis. *Studies in Higher Education, 27*(4), 405-417.
- Nevgi, A., & Lofstrom, E. (2015). The development of academics' teacher identity: Enhancing reflection and task perception through a university teacher development programme. *Studies in Educational Evaluation, 46*, 53-60. <http://doi.org/10.1016/j.stueduc.2015.01.003>
- Nolen, S. B., Ward, C. J., & Horn, I. S. (2011). Motivation, engagement, and identity: Opening a conversation. In D.M. McInerney, R.A. Walker & G.A.D. Liem (Eds.), *Sociocultural theories of learning and motivation: Looking back, looking forward* (pp. 109-135). Information Age Publishing.
- 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. <https://doi.org/10.1007/s10734-013-9678-9>
- Ollerenshaw, J. A., & Creswell, J. W. (2002). Narrative research: A comparison of two restorying data analysis approaches. *Qualitative Inquiry, 8*(3), 329-347. <https://doi.org/10.1177/10778004008003008>
- O'Meara, K., Terosky, A. L., & Neumann, A. (2008). Faculty Careers and Work Lives: A Professional Growth Perspective. *ASHE Higher Education Report, 34*(3), 1-221.
- O'Sullivan, P. S., & Irby, D. M. (2014). Identity formation of occasional faculty developers in medical education: a qualitative study. *Academic Medicine, 89*(11), 1467-1473. doi: 10.1097/ACM.0000000000000374

- Miller, E. R., Fairweather, J. S., Slakey, L., Smith, T., & King, T. (2017). Catalyzing institutional transformation: Insights from the AAU STEM initiative. *Change: The Magazine of Higher Learning*, 49(5), 36-45. <https://doi.org/10.1177/10.1080/00091383.2017.1366810>
- National Science Board (2019). *The skilled technical workforce. Crafting America's Science & Engineering Enterprise* (Report #: NSB-2019-23). NSB.
- Nelson, N., & Brennan, R. (2021). Improving engineering education: two key areas to focus our attention. *Proceedings of the Canadian Engineering Education Association (CEEA)*.
- Pascarella, E. T., Seifert, T. A., & Whitt, E. J. (2008). Effective instruction and college student persistence: Some new evidence. *New Directions for Teaching and Learning*, 115, 55-70. <https://doi.org/10.1002/tl.325>
- Peach, H. G., & Bieber, J. P. (2015). Faculty and online education as a mechanism of power. *Distance Education*, 36(1), 26-40. <https://doi.org/10.1080/01587919.2015.1019971>
- Pearlston, D., DaMaren, E., & Mattucci, S. (2020). Reflections on Implementing a Students-as-Partners Approach to Curriculum Development in Engineering. *Proceedings of the Canadian Engineering Education Association (CEEA)*.
- Petersen, C. I., Baepler, P., Beitz, A., Ching, P., Gorman, K. S., Neudauer, C. L., & Wingert, D. (2020). The tyranny of content: "Content coverage" as a barrier to evidence-based teaching approaches and ways to overcome it. *CBE—Life Sciences Education*, 19(2), ar17. <https://doi.org/10.1187/cbe.19-04-0079>
- Pfund, C., Mathieu, R., Austin, A., Connolly, M., Manske, B., & Moore, K. (2012). Advancing STEM undergraduate learning: Preparing the nation's future faculty. *Change: The Magazine of Higher Learning*, 44(6), 64-72. <https://doi.org/10.1080/00091383.2012.728957>
- Pratt, D. D. (2002). Good teaching: One size fits all?. *New Directions for Adult and Continuing Education*, 93, 5-16.
- Prosser, M., Trigwell, K., & Taylor, P. (1994). A phenomenographic study of academics' conceptions of science learning and teaching. *Learning and Instruction*, 4(3), 217-231.
- Remmik, M., Karm, M., Haamer, A., & Lepp, L. (2011). Early-career academics' learning in academic communities. *International Journal for Academic Development*, 16(3), 187-199. doi: 10.1080/1360144X.2011.596702

- Remmik, M., Karm, M., & Lepp, L. (2013). Learning and developing as a university teacher: Narratives of early career academics in Estonia. *European Educational Research Journal, 12*(3), 330-341.
- Reybold, E. L., & Alamia, J. J. (2008). Academic transitions in education: A developmental perspective of women faculty experiences. *Journal of Career Development, 35*(2), 107-128. <https://doi.org/10.1177/0894845308325644>
- Robert, J., & Carlsen, W. S. (2017). Teaching and research at a large university: Case studies of science professors. *Journal of Research in Science Teaching, 54*(7), 937-960. <https://doi.org/10.1002/tea.21392>
- Roberts, J. (2006). Limits to communities of practice. *Journal of Management Studies, 43*(3), 623-639.
- Rogoff, B. (1995). Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In J.V. Wertsch, P. Del Rio & A. Alvarez (Eds.), *Sociocultural studies of mind* (pp. 139-164).
- Saldana, J. (2013). *The coding manual for qualitative researchers*. Sage.
- Samaras, A. P., Hjalmanson, M., Bland, L. C., Nelson, J. K., & Christopher, E. K. (2019). Self-Study as a Method for Engaging STEM Faculty in Transformative Change to Improve Teaching. *International Journal of Teaching and Learning in Higher Education, 31*(2), 195-213.
- Serow, R. C., Brawner, C. E., & Demery, J. (1999). Instructional reform at research universities: Studying faculty motivation. *The Review of Higher Education, 22*(4), 411-423. <https://doi.org/10.1353/rhe.1999.0018>
- Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Westview Press.
- Seymour, E., & Hunter, A. B. (2019). *Talking about leaving revisited: Persistence, relocation, and loss in undergraduate STEM education*. Springer.
- Shadle, S. E., Marker, A., & Earl, B. (2017). Faculty drivers and barriers: laying the groundwork for undergraduate STEM education reform in academic departments. *International Journal of STEM Education, 4*(1), 1-13. <https://doi.org/10.1186/s40594-017-0062-7>
- Shulman, L. S. (1993). Teaching as community property. *Change, 25*(6), 6-7.

- Sikes, P. (2006). Working in a 'new' university: In the shadow of the research assessment exercise? *Studies in Higher Education*, 31(5), 555-568.
<https://doi.org/10.1080/03075070600922758>
- Skelton, A. (2012a). Teacher identities in a research-led institution: In the ascendancy or on the retreat? *British Educational Research Journal*, 38(1), 23-39.
doi.org/10.1080/01411926.2010.523454
- Skelton, A. (2012b). Colonised by quality? Teacher identities in a research-led institution. *British Journal of Sociology of Education*, 33(6), 793-811.
<https://doi.org/10.1080/01425692.2012.692047>
- Skelton, A. (2013). Positively transformational or poisoned chalice? The impact of a course on higher education teaching at a research-intensive institution. *Teaching in Higher Education*, 18(8), 908-919. <https://doi.org/10.1080/13562517.2013.827640>
- Smith, C., & Boyd, P. (2012). Becoming an academic: The reconstruction of identity by recently appointed lecturers in nursing, midwifery and the allied health professions. *Innovations in Education and Teaching International*, 49(1), 63-72.
<https://doi.org/10.1080/14703297.2012.647784>
- Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., & Young, A. M. (2018). Anatomy of STEM teaching in North American universities. *Science*, 359(6383), 1468-1470. <https://doi.org/10.1126/science.aap8892>
- Steinert, Y., Nasmith, L., McLeod, P. J., & Conochie, L. (2003). A teaching scholars' program to develop leaders in medical education. *Academic Medicine*, 78(2), 142-149.
- Steinert, Y., O'Sullivan, P. S., & Irby, D. M. (2019). Strengthening teachers' professional identities through faculty development. *Academic Medicine*, 94(7), 963-968. doi: 10.1097/ACM.0000000000002695
- Stone, S., Ellers, B., Holmes, D., Orgren, R., Qualters, D., & Thompson, J. (2002). Identifying oneself as a teacher: the perceptions of preceptors. *Medical Education*, 36(2), 180-185.
- Sturtevant, H., & Wheeler, L. (2019). The STEM faculty instructional barriers and identity survey (FIBIS): Development and exploratory results. *International Journal of STEM Education*, 6(1), 1-22.
- Sunal, D. W., Hodges, J., Sunal, C. S., Whitaker, K. W., Freeman, L. M., Edwards, L., & Odell, M. (2001). Teaching science in higher education: Faculty professional development and barriers to change. *School Science and Mathematics*, 101(5), 246-257.

- Sunal, D. W., Wright, E.L. & Day, J.B. (Eds.).(2004). *Reform in undergraduate science teaching for the 21st century*. Information Age Publishing Inc.
- Terosky, A. L., O'Meara, K., & Campbell, C. M. (2014). Enabling possibility: Women associate professors' sense of agency in career advancement. *Journal of Diversity in Higher Education*, 7(1), 58. <https://doi.org/10.1037/a0035775>
- Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., Behling, S., & Freeman, S. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. *Proceedings of the National Academy of Sciences*, 117(12), 6476-6483.
- Thomas, N., Bystydzienski, J., & Desai, A. (2015). Changing institutional culture through peer mentoring of women STEM faculty. *Innovative Higher Education*, 40(2), 143-157. <https://doi.org/10.1007/s10755-014-9300-9>
- Tierney, W. G., & Bensimon, E. M. (1996). *Promotion and tenure: Community and socialization in academe*. SUNY Press.
- Tierney, W. G., & Rhoads, R. A. (1993). *Enhancing Promotion, Tenure and Beyond: Faculty Socialization as a Cultural Process*. ASHE-ERIC Higher Education Report No. 6. ASHE-ERIC Higher Education Reports, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183.
- Trede, F., Macklin, R., & Bridges, D. (2012). Professional identity development: A review of the higher education literature. *Studies in Higher Education*, 37(3), 365-384. <http://doi.org/10.1080/03075079.2010.521237>
- Trevitt, C., & Perera, C. (2009). Self and continuing professional learning (development): Issues of curriculum and identity in developing academic practice. *Teaching in Higher Education*, 14(4), 347-359. <https://doi.org/10.1080/13562510903050095>
- Triantafyllaki, A. (2010). Performance teachers' identity and professional knowledge in advanced music teaching. *Music Education Research*, 12(1), 71-87. <https://doi.org/10.1080/14613800903568254>
- Trowler, P., & Knight, P. T. (2000). Coming to know in higher education: Theorising faculty entry to new work contexts. *Higher Education Research & Development*, 19(1), 27-42. <https://doi.org/10.1080/07294360050020453>
- Umbach, P. D. (2006). The contribution of faculty of color to undergraduate education. *Research in Higher Education*, 47(3), 317-345. <https://doi.org/10.1007/s11162-005-9391-3>

- Viskovic, A. (2006). Becoming a tertiary teacher: Learning in communities of practice. *Higher Education Research & Development*, 25(4), 323-339.
<https://doi.org/10.1080/07294360600947285>
- Van Lankveld, T., Schoonenboom, J., Kusurkar, R. A., Volman, M., Beishuizen, J., & Croiset, G. (2017). Integrating the teaching role into one's identity: A qualitative study of beginning undergraduate medical teachers. *Advances in Health Sciences Education*, 22(3), 601-622. doi 10.1007/s10459-016-9694-5
- Walczyk, J. J., Ramsey, L. L., & Zha, P. (2007). Obstacles to instructional innovation according to college science and mathematics faculty. *Journal of Research in Science Teaching*, 44(1), 85-106. <https://doi.org/10.1002/tea.20119>
- Walker, J. D., Baepler, P., & Cohen, B. (2008). The scholarship of teaching and learning paradox: Results without rewards. *College Teaching*, 56(3), 183-190.
<https://doi.org/10.3200/CTCH.56.3.183-190>
- Warhurst, R. P. (2006). "We really felt part of something": Participatory learning among peers within a university teaching-development community of practice. *International Journal for Academic Development*, 11(2), 111-122. <https://doi.org/10.1080/13601440600924462>
- Warhurst, R. P. (2008). 'Cigars on the flight-deck': New lecturers' participatory learning within workplace communities of practice. *Studies in Higher Education*, 33(4), 453-467.
<https://doi.org/10.1080/03075070802211828>
- Wells, G. (2011). Motive and motivation in learning to teach. In D. M. McInerney, R.A. Walker & G.A.D. Liem (Eds.), *Sociocultural theories of learning and motivation: Looking back, looking forward*, (pp. 87-107). Information Age Publishing Inc.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.
- Wenger, E. (2010). Communities of practice and social learning systems: the career of a concept. In C. Blackmore (Ed.), *Social learning systems and communities of practice* (pp. 179-198). Springer.
- Wenger-Trayner, E., & Wenger-Trayner, B. (2015). "Learning in a landscape of practice: A framework." In E. Wenger-Trayner, M. Fenton-O'Creevy, S. Hutchinson, C. Kubiak & B. Wenger-Trayner (Eds.), *Learning in landscapes of practice* (pp. 13-29). Routledge.
- Wieman, C. (2017). *Improving how universities teach science*. Harvard University Press.

- 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.
<https://doi.org/10.1080/00221546.2005.11772285>
- Xu, Y. J. (2016). Attention to retention: Exploring and addressing the needs of college students in STEM majors. *Journal of Education and Training Studies*, 4(2), 67-76.
<https://doi.org/10.11114/jets.v4i2.1147>
- Ylijoki, O. H., & Ursin, J. (2013). The construction of academic identity in the changes of Finnish higher education. *Studies in Higher Education*, 38(8), 1135-1149.
<https://doi.org/10.1080/03075079.2013.833036>
- Zigler, E., & Seitz, V. (1978). Changing trends in socialization theory and research. *The American Behavioral Scientist (pre-1986)*, 21(5), 731.